Evaluation of Three RCRA Regulations Designed to Foster Increased Recycling

Prepared for:

EPA's Office of Planning Analysis and Accountability
EPA's Office of Policy Economics and Innovation
EPA's Office of Solid Waste

Prepared by:

Industrial Economics, Inc.
2067 Massachusetts Ave
Cambridge, MA 02140

November 30, 2004

TABLE OF CONTENTS

EXECUTIVE SUMMARY ES-1

ACRONYMS

1. INTRODUCTION 1

2. PROGRAM EVALUATION METHODOLOGY 5

3. ADOPTION AND AUTHORIZATION 11

4. THE UNIVERSAL WASTE RULE AND ITS APPLICABILITY IN RECYCLING NICKEL CADMIUM BATTERIES 23

5. EXCLUSION FOR OIL-BEARING SECONDARY MATERIALS FROM PETROLEUM REFINING 38

6. 180-DAY ACCUMULATION TIME FOR WASTEWATER TREATMENT SLUDGE FROM THE METAL FINISHING INDUSTRY 60

7. CONCLUSION 73

References

Appendix A: List of Interviewees and Interview Questionnaires 82

Appendix B: Methodology for Analysis of State Authorization Tracking System Data 98

Appendix C: Supplemental Information for 1998 Oil-Bearing Secondary Materials Exclusion 102

Appendix D: Methodology for 180-Day Rule for Wastewater Treatment Sludge 103

Appendix E: Quality Assurance Plan 118

EXECUTIVE SUMMARY

INTRODUCTION

As part of its ongoing efforts to facilitate additional recycling of hazardous waste, EPA's Office of Solid Waste (OSW) has promulgated rules designed to allow more flexibility in the management of certain hazardous wastes under the Resource Conservation and Recovery Act (RCRA). These changes range from providing conditional exclusions from the definition of solid waste to exemptions from specific RCRA requirements. By reducing the regulatory barriers, EPA intends to encourage producers of these wastes to recycle, thereby conserving natural resources and reducing the quantity of waste sent to landfill.

In order to evaluate the degree to which these regulatory changes have led to increased recycling, OSW conducted a review of three specific case studies. Industrial Economics, Inc. (IEc) assisted EPA with the evaluation. At one level, the evaluation examined the degree to which co-regulators (i.e., states) and regulated entities were aware of the three regulation exceptions and the extent to which these rules have been adopted by authorized states. The evaluation then examined the extent to which these three rules have led to changes in waste management practices including an increase in recycling rates, factors that may have contributed to any observed changes, and impacts on natural resource conservation. OSW assessed the following three rulemakings in this evaluation.

Nickel-Cadmium Sealed Cell Batteries Category of the Universal Waste Rule (60 FR 25492, 1995): The 1995 Universal Waste Rule (UWR) was intended to enable individuals, communities, and businesses to more easily collect and transport materials to ensure proper disposal, including recycling. EPA hoped this flexibility would increase recycling of Nickel-Cadmium (NiCd) batteries, thereby reducing the quantity of batteries entering the municipal solid waste stream.

Oil-Bearing Hazardous Secondary Materials (OBSM) and Recovered Oil rule (63 FR 42110, 1998): The 1998 OBSM exclusion was intended to encourage beneficial reuse and recovery of these residual materials, rather than the materials being disposed of in hazardous waste landfills or incinerators.

The 180-Day Accumulation Time rule for F006 Wastewater Treatment Sludges (65 FR 12378, 2000): The 180-Day rule extended from 90 to 180 days the length of time generators of F006 waste water treatment sludges could store the waste onsite if the waste are destined for recycling. The extension in accumulation time was intended to reduce transportation costs for generators recycling their F006 waste, thereby making recycling a more cost-effective management option.

METHODOLOGY

In evaluating these cases studies, we examined questions in four key categories: co-regulator and regulated entity awareness, state adoption and authorization of rules, changes in waste management practices, and changes in natural resource use and impact. We collected a wide range of information to address the evaluation questions for each of the three case studies (see Table ES-1). Information sources included interviews with EPA representatives, state co-regulators, and industry experts. IEc also used hazardous waste data from the annual Biennial Reports (BR) and information on state adoption and authorization from EPA's State Adoption and Authorization database (StATS).

Evaluation Question	**StATS**	**Biennial Reports**	**Industry-provided data**	**Industry Interviews**	**Co-regulator interviews**	**Literature Review**
EPA Co-Regulator and Regulated Entity Awareness				✓	✓	
Assessment of Extent of State Adoption and Authorization of the Three Rules	✓				✓	
Impact of Recycling Rules on Waste Management Practices and Factors Impacting Recycling		✓	✓	✓	✓	✓
Changes in Natural Resource Use and Impact			✓	✓	✓	✓

Table ES-1
Summary of Data Sources and Methodology for Addressing Evaluation Questions

KEY FINDINGS

Adoption and Authorization

RCRA is designed to allow states to assume primary responsibility for implementation. States can adopt rules by one of three methods: incorporating by reference, adopting verbatim, or by writing and implementing their own rules that are analogous to the federal regulations. Once a state adopts a rule, the appropriate EPA regional office reviews the rule and determines whether the state analogue is equivalent. If EPA believes the state rule is equivalent, EPA will authorize the state for that rule. Authorized states are responsible for implementing and enforcing state regulations, which act in lieu of the federal regulation. The three rules examined in this report are not enforceable by states until they are adopted and only federally enforceable following authorization.

The percentage of states and territories that have adopted and been authorized for these rules is basically a function of the age of the rule. The oldest rule, the 1995 UWR, has been adopted by 48 states, while the 2000 180-day rule has been adopted by 32 states. Co-regulator interviewees suggested several characteristics of rules to encourage recycling that might slow their adoption, though these factors were discussed abstractly, rather than from their experience with the case study rules specifically. They noted that states might take longer to adopt rules that would complicate enforcement, rules that conflicted with existing state law, and rules that were not mandatory. The cluster system of adopting and authorizing rules is also a factor in how readily a recycling rule is adopted and authorized. If the rule is part of an otherwise large or complex cluster, then adoption and authorization may be delayed. Co-regulator interviewees were not aware of any special processes on either the state or federal level for the adoption of and authorization for rules to encourage recycling. EPA Regional interviewees cited backlogs of state authorization packages and inadequate state authorization packages as the main causes of delay in authorizing states. These procedural causes worked along with substantive ones, such as concerns about the state's program or conflicts about the equivalence of a state's regulations. Again, the cluster system can delay authorization of rules to encourage recycling if another rule in the same cluster is problematic.

Delays in authorization apparently have little effect of the regulated community's behavior. Both industry and regulator interviewees said that the state's adoption of a rule was generally the "go-ahead" for changing waste management practices. Only one of the top five refining states, California, has not adopted the 1998 OBR exclusion; California has a state regulation very similar to the exclusion, but has not formally adopted nor sought authorization for this regulation. In contrast, three of the four states with the largest presence of F006-generating facilities have not yet adopted the 2000 180-day rule. It is unclear how the delay in adoption has affected facilities in these states. The 1995 UWR addresses the widespread generation of nickel-cadmium batteries, so it is not relevant to examine adoption by states with concentrations of the affected industry.

Case Studies

Below we summarize the key findings for each case study, organized in response to the key categories that constituted the main focus of the evaluation. We asked questions (detailed in Appendix A of the report) that addressed the following categories:

- how well the regulated community and other stakeholders understood and were made aware of the regulatory changes;
- the impact of the rule change on waste management practices;
- the factors, including the rule change, that have contributed to changes in recycling; and
- impacts of the rule change on areas other than recycling, when identified.

Summary of Findings for the UWR for NiCd Case Study

How aware is the regulated community of the exclusion?

- The industry trade association has effectively informed the commercial users about UWR.
- While consumers, businesses, and public agencies are likely not aware of the UWR, the industry trade association's outreach efforts are continuing to raise awareness of the importance and ease of NiCd battery recycling.

What is the impact on waste management practices?

- The UWR has allowed widespread NiCd battery collection and recycling.

What are the factors that influence decisions about recycling?

- Recycling has increased as a result of widespread rechargeable battery collection programs run by the battery industry.
- These collection programs have been implemented in response to state battery regulations and the 1996 Battery Management Act.

Summary of Findings for the Oil-Bearing Secondary Materials Case Study

How aware is the regulated community of the exclusion?

- Refineries are almost universally aware of the exclusion, though some interviewees suggested that some confusion remains about the scope and applicability of the exclusion

What is the impact of the exclusion on waste management practices?

- The exclusion has had little effect at refineries that were already recycling secondary materials in-process.
- It has fostered increased in-process recycling involving transfer of secondary materials between refineries.

What are the factors that influence decisions about recycling?

- Cost is the primary factor determining whether a refinery uses in-process recycling to manage secondary materials.
- Cost considerations range from the per unit and transportation costs for different options to concerns about damage to expensive capital equipment.
- Confidence and understanding of when and how the exclusion applies to in-process recycling was another important factor in refineries' decisions.
- Availability of management time to facilitate the use of in-process recycling was also cited as a barrier.

What are the other impacts of the exclusion?

- By making available a lower-cost management option for these secondary materials, the exclusion has driven down costs for all waste management options.
- However, the exclusion may be making compliance and enforcement more complicated.

Summary of Findings for the 180-Day Rule for F006 Wastes Case Study

How aware is the regulated community of the rule?

- Metal finishers are very aware of the 180-day rule as a result of the industry trade association's outreach.

What is the Impact of the rule on waste management practices?

- F006 generation and recycling levels have **declined** since the 180-day rule was promulgated.

- Interviewees note the decline in F006 sludge generation may be due to the economic downturn or efforts to conserve water.
- Recycling may have decreased due to a lack of viable recycling options.
- Respondents do not believe the 180-day rule has increased recycling rates.

What are the factors that influence decisions about recycling?

- F006 recycling is impacted by the cost of recycling.
- Costs, in turn, are impacted primarily by the type and concentration of metals in the wastewater treatment sludges.
- Metal type and concentration can be affected by pollution prevention efforts.
- The costs of recycling F006 waste may also be impacted by the hazardous waste listing.

What are the other impacts of the rule?

- Some respondents believe the 180-day rule improved communication between EPA and the metal finishing industry and can facilitate future regulations that more effectively encourage F006 recycling.

<u>Findings Across All Cases</u>

Co-regulator and Regulated Entity Awareness

According to our interviews with representatives from both trade associations and individual facilities, members of the regulated communities affected by these rules were for the most part, aware of them. In the case of the 1998 OBSM exclusion, however, interviews pointed to a lack of understanding of or confidence in the exclusion that may stem from the complicated legal and regulatory history of this exclusion. Co-regulator interviewees noted that their primary source of information about new rules was an EPA website that posted information about new clusters of amendments. Interviewees found this mode of communication to be sufficient in general, but noted that they were unaware of any special efforts by EPA to make co-regulators aware of rules to encourage recycling.

Impact of Recycling Rules on Waste Management Practices and Factors Impacting Recycling

Recycling has increased in two of three cases: the Universal Waste Rule and the exclusion for oil-bearing secondary materials. The Universal Waste Rule for NiCd batteries had the largest impact, contributing to a dramatic increase in the volume of these batteries recycled. The exclusion for oil-bearing secondary materials has also increased recycling by exempting transfers between refineries and providing a lower-cost recycling option for these materials. The 180-day rule did not have a significant impact on the extent of recycling of F006 sludges because any possible reduced transportation costs were not sufficient to encourage an otherwise uneconomical waste management practice.

The essential question associated with the evaluation is whether these rule changes were effective in encouraging recycling. We found that rule changes have the largest impact when the infrastructure and capacity to recycle are in place prior to the regulation, and when regulation or regulation-related costs represent the *primary* barrier to recycling. For example, with regard to the UWR, individual states and an industry group had established programs to collect, consolidate, and transport NiCd batteries to recyclers. The UWR simply eased this process by significantly reducing costs and enabling a much wider group of handlers to collect and consolidate batteries. On the other hand, while the F006 180-day rule may lead to reduced transportation costs, it has not impacted the overall costs, capacity and market for F006 wastes, and appears to have had little impact on recycling levels. The OBR exclusion did not lead to an increase in on-site recycling but did, by eliminating a regulatory restriction, result in an increase in the amount of material that was transferred from one facility to another. Overall, regulatory changes can enable or encourage an activity where the wheels are already in motion, but limited regulatory relief in itself does not seem to be sufficient to encourage recycling if economic factors are not already in place.

Changes in Natural Resource Use and Impact

Of the three case studies, the 1995 UWR has had the greatest effect on natural resource use and environmental impact. The UWR has facilitated the collection of thousands of tons of NiCd batteries which might have otherwise been disposed of in the municipal solid waste stream. In 2000 alone, as much as 555 tons of cadmium may have been diverted from the municipal solid waste stream, where the metal can leach into ground and surface waters and be released into the air during incineration. Given the public health risk posed by cadmium ingestion, this reduction of cadmium in the environment is an important benefit. In addition to avoiding environmental and health damages caused by cadmium in the waste stream, recovery of the two valuable metals contained in these batteries reduces the demand for virgin production and its associated environmental impacts. About half of this recovered cadmium is used to produce new batteries, the remainder is reused in surface plating and in fertilizers. Nickel is in high demand and can be used in stainless steel production.

The environmental impacts of the 1998 OBSM exclusion are unclear, in large part because of uncertainty about the amount of new recycling spurred by this exclusion. The purpose of in-process recycling of oil-bearing secondary materials is to recover the hydrocarbons, which would otherwise be disposed of. However, unlike the recovery of cadmium and nickel mentioned above, recovery of these hydrocarbons does not necessarily reduce the amount of virgin material extracted. The reinsertion process does reduce the volume of the secondary materials that are ultimately disposed, but no data were available to quantify this benefit. Some interviewees expressed concern about negative environmental impacts of the exclusion, including risks stemming from a lack of regulation of secondary material management and from the increased concentrations of hazardous content in petroleum coke which is released during combustion. However, no data were available to provide a more exact understanding of these risks.

The 180-day rule does not appear to have resulted in an increase in recycling of F006 waste, and consequently has had very little effect on natural resource use or environmental impact. Some small benefits may arise from the reduced number of trucks that are needed to transport the F006 wastes from the generator to the recycler, but these benefits could not be quantified.

Recommendations

Enhance Outreach and Communications

From our analysis of the authorization and adoption of the three rules evaluated to our individual assessment of each rule, we consistently heard the need for increased outreach and communication from EPA (and in some instances from the States). This communication is especially important when dealing with rules and regulations that are voluntary in nature. Interviewees noted that EPA could make more of an effort to inform States that rules have been promulgated and EPA Regions could work more proactively with states to help ensure that rules are adopted and sent to the Regions for authorization in a manner that will facilitate Regional reviews. In addition, interviewees noted that lack of common understanding about the rules sometimes lead to uneven enforcement in different states. Among the other key points we heard were the following:

- Despite the efforts of the PRBA and the Recycling Corporation, there is still limited awareness of the UWR exclusion for Nickel Cadmium batteries among consumers and many businesses are not aware of the rule. Consumers, especially, need to become more engaged if the rate of recycling is to increase and EPA needs to help in this communication effort.
- Increased communication efforts are needed to help clear up questions and uncertainties within the regulated communities about some of the rules. Some refinery representatives expressed the idea that uncertainty about the legality of some recycling practices limited the amount of recycling that they did. One IPR contractor noted that he distributed a letter he received from EPA clarifying many aspects of the exclusion and that this lead to a better understanding of the rule. Similarly, one industry representative noted that there was still uncertainty over the exclusion of oil bearing wastewater prior to primary treatment.

Consider Improving STATs database

EPA's database for tracking adoptions and authorizations (StATS) does not contain comprehensive information on state adoption dates. OSW staff noted that states are not required to report this information, but may do so voluntarily. The lack of complete data on state adoption dates makes it difficult to assess how quickly states are adopting rules and how much delay exists between adoption and authorization. Adoption dates are not a critical piece of data for understanding the implementation of regulations that are automatically implemented in the states. However rules designed to encourage recycling generally need to be adopted and authorized and are not available to the regulated community until adopted by the state. EPA should consider requiring states to report adoption dates, particularly for rules that encourage recycling, in order to increase understanding of the implementation of these rules.

Recognize that other EPA objectives such as waste reduction or pollution prevention measures, may interfere with efforts to encourage recycling of hazardous wastes.

When evaluating rules to encourage recycling, EPA should consider how industry initiatives to comply with other environmental statutes or to reduce waste generation will affect the apparent impact of the rule on recycling. For example, increased efficiency and pollution prevention activities may be depressing the value of F006 waste recycling by decreasing the metal content in the sludge. Sludges with low metal content are less likely to be recycled because the recoverable value is less. Similarly, interviewees in the refining sector noted that generation of some hazardous wastes have decreased as refineries have improved maintenance practices that prevent debris from entering wastewater treatment systems.

Consider imposing reporting requirements to effectively assess the impacts of rules intended to encourage recycling.

If wastes are excluded from the definition of solid waste, they will not be reported in annual Biennial Reports, thus eliminating the BR as a source of data to identify the impacts of the rules. For example, prior to the UWR, Treatment, Storage, and Disposal Facilities (TSDFs) were required to report the quantity of batteries managed annually in the BR. Similarly, refineries were required to report the quantity of secondary materials generated annually. Since the 1998 exclusion and the UWR were promulgated, this reporting was no longer required and thus these sources of data are no longer available. Fortunately, information on NiCd battery recycling is readily available because of the detailed records kept by an industry group and the recycler. In considering future rules to encourage recycling under RCRA, EPA could consider working with affected industries to establish reporting frameworks that allow the industry to publicize the environmental benefits of their efforts and allow regulators to understand the impact of the regulations.

ACRONYMS

ASTSWMO: Association of State and Territorial Solid Waste Management Officials
AESFS: American Electroplaters and Surface Finishers Society
API: American Petroleum Institute
BR: Biennial Report
CERCLA: Comprehensive Environmental Response, Compensation and Liability Act
CSI: Common Sense Initiative
EIA: Energy Information Administration
EMS: Environmental Management System
FR: Federal Register
GRG: Government Relations Group
HSWA: Hazardous and Solid Waste Amendments
HTMR: High Temperature Metals Recovery
INMETCO: International Metals Reclamation Company
IPR Contractor: In-process Recycling Contractor
LDR: Land Disposal Restrictions
LQHUW: Large Quantity Handlers of Universal Waste
MFSA: Metal Finishing Suppliers Association
NAMF: National Association of Metal Finishers
NiCd: Nickel-Cadmium
OBSM: Oil-Bearing Secondary Materials
OPAA: Office of Planning, Analysis, and Accountability
OPEI: Office of Policy, Economics, and Innovation
OSW: Office of Solid Waste
PRBA: Portable Rechargeable Battery Association
PSPD: Permits and State Programs Division
RBRC: Rechargeable Battery Recycling Corporation
RCRA: Resource Conservation and Recovery Act
SGP: Strategic Goals Program
SQG: Small Quantity Generators
SQHUW: Small Quantity Handlers of Universal Waste
StATS: State Authorization Tracking System
TRI: Toxic Release Inventory
TSDF: Treatment, Storage and Disposal Facility
UWR: Universal Waste Rule

1. INTRODUCTION

1.1 Purpose and Scope of the Evaluation

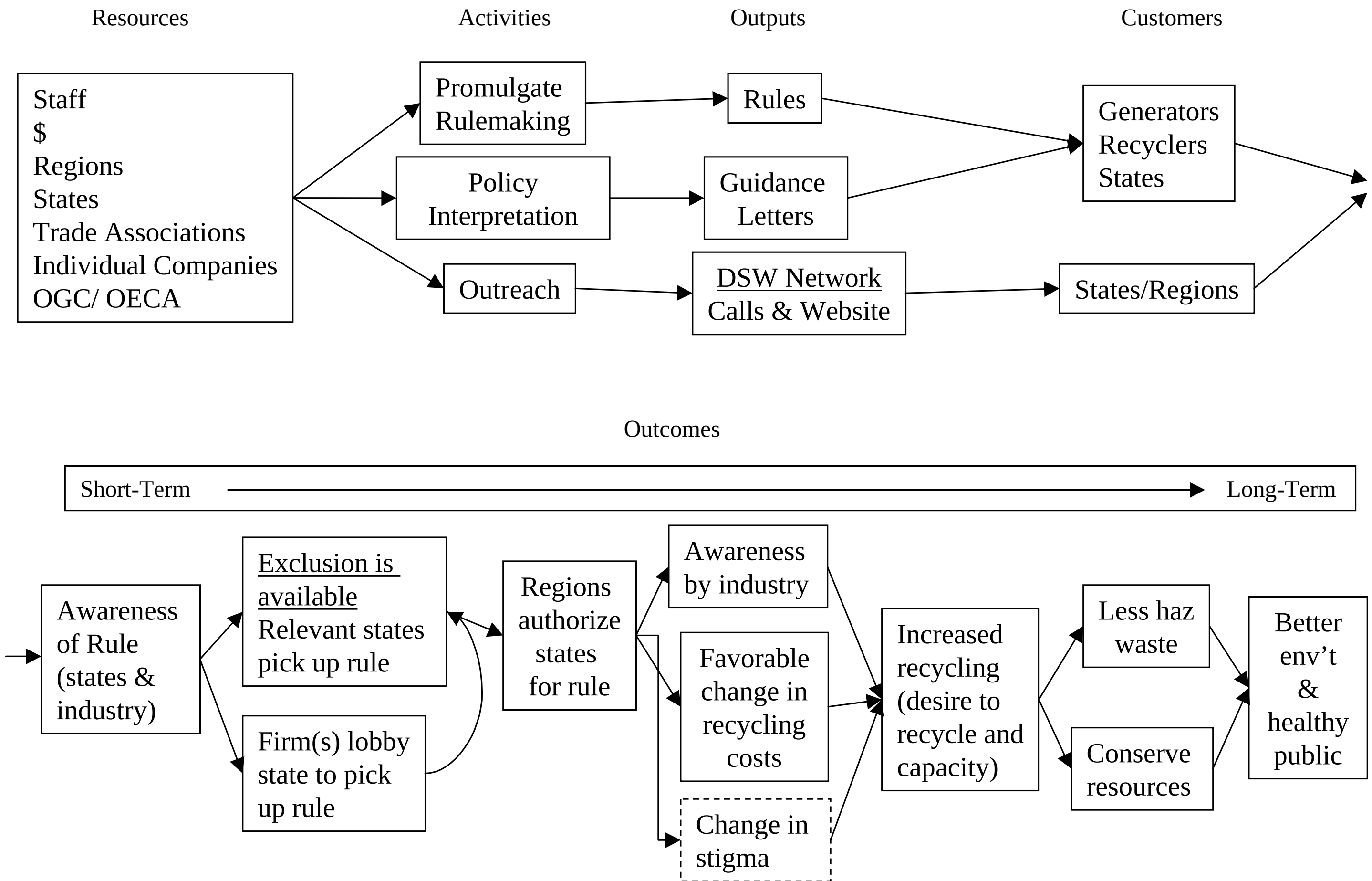
The Hazardous Waste Identification Division (HWID) within the Office of Solid Waste is responsible for defining those materials which are "solid waste" and those which are hazardous waste. The Resource Conservation and Recycling Branch of HWID is responsible for developing policy, regulations, and guidance in the areas of the definition of solid waste and hazardous waste recycling. The branch also works with States and other stakeholders to identify specific industries and waste streams that provide the greatest opportunity for reuse and recycling. Further, the branch is responsible for identifying innovative approaches to increasing reuse and recycling of hazardous waste while protecting human health and the environment. Finally, it is envisioned that the branch will develop national policies, regulations, and guidance in the area of materials management as OSW moves towards implementing the RCRA 2020 vision.

As part of its ongoing efforts to facilitate additional recycling of hazardous waste, EPA's Office of Solid Waste (OSW) has promulgated rules, under the Resource Conservation and Recovery Act (RCRA), designed to allow more flexibility in the management of certain hazardous wastes. These changes range from providing conditional exclusions from the definition of solid waste to exemptions from specific RCRA requirements. Through these changes, EPA intends to encourage producers of these wastes to recycle, thereby conserving natural resources and reducing the quantity of waste sent to landfill.

In order to evaluate the degree to which these regulatory changes have led to increased recycling, OSW is conducting a review of three specific case studies. Industrial Economics, Inc. (IEc and referred to as "we" in this report) assisted EPA with the evaluation, which received funding from EPA's Office of Planning, Analysis and Accountability (OPAA) and the Office of Policy, Economics, and Innovation (OPEI). At one level, the evaluation will examine the degree to which co-regulators (i.e., states) and regulated entities are aware of the three exceptions and the extent to which these rules have been adopted by authorized states. The evaluation then will examine the extent to which these three rules have led to an increase in recycling rates, factors that may have contributed to any observed changes, and any impacts on natural resource conservation. Based on the results of the analysis, OSW hopes to identify those elements that lead to success in encouraging recycling and to use this information to help target additional regulatory opportunities.

As a preliminary step in the analysis, IEc worked with OPEI and OSW staff to develop a generic "logic model' that illustrates how these regulatory relief programs are designed to work. The model provides a graphical representation of the relationships among goals, inputs, planned activities, outputs, and outcomes. The model, which was used to help draft the evaluation questions, is attached on the next page.

Logic Model for Regulatory Exceptions



External: market forces (T&D costs), number of recyclers, markets for recycled products, technology, bureaucratic process, politics, state budgets, PR, public goodwill

1.2 Overview of Case Studies

EPA chose to examine the following three rules designed to increase recycling of certain hazardous wastes.

Nickel-Cadmium Sealed Cell Batteries Category of the Universal Waste Rule (60 FR 25492, 1995: The Universal Waste Rule (1995 UWR) regulates hazardous substances that are present in consumer products, which may be found in significant volumes in nonhazardous management systems such as the municipal solid waste stream. Nickel-Cadmium (NiCd) batteries are one type of universal waste. The 1995 UWR enables handlers to accumulate and store universal wastes without RCRA storage permits or record-keeping requirements, and to transport these wastes via common carriers, such as the United Parcel Service. The 1995 UWR was intended to enable individuals, communities, and businesses to more easily collect and transport materials to ensure proper disposal, including recycling. EPA hoped this flexibility would increase recycling of NiCd batteries, thereby reducing the quantity of batteries entering the municipal solid waste stream.

Oil-Bearing Hazardous Secondary Materials and Recovered Oil Exclusion (63 FR 42110, 1998):The Oil-Bearing Hazardous Secondary Materials and Recovered Oil Exclusion (OBSM) excludes certain oil-bearing secondary materials generated by petroleum refineries from the definition of solid waste. These secondary materials are generated throughout the refining and wastewater treatment process, and are excluded when they are re-inserted into the refining process. The 1998 OBSM exclusion also enables refineries to transfer these secondary materials to another refinery for the purposes of recycling. The 1998 OBSM exclusion was intended to allow beneficial reuse and recovery of these residual materials, rather than dictating that the materials be disposed of in hazardous waste landfills or incinerators.

The 180-Day Accumulation Time Rule for F006 Wastewater Treatment Sludges (65 FR 12378, 2000): The 180-Day Accumulation Time Rule for F006 Wastewater Treatment Sludges (the 2000 180-day rule) extends the on-site storage period for generators who choose to recycle F006 wastewater treatment sludges using metals recovery technologies. These generators may store these wastes onsite for 180 days without a hazardous waste storage permit, doubling the standard accumulation time of 90 days. The 2000 180-day rule applies to large quantity generators of metal-bearing wastewater treatment sludges generated during certain metal surface finishing processes. These sludges are referred to as “F006 sludges” because they are the sixth listed “F-waste”, a category that EPA uses to designate wastes that are generated from general processes such as cleaning, degreasing, metal finishing and manufacturing. The extension in accumulation time is intended to reduce transportation costs for generators recycling their F006 waste, thereby making recycling a more cost-effective management option.

1.3 Program Evaluation Questions

In evaluating these case studies, the study team examined questions in four key categories: co-regulator and regulated entity awareness, state adoption and authorization of rules, changes in waste management practices, and changes in natural resource use and impact.

- **State adoption and authorization of rules:** To what extent have states adopted and been authorized for EPA recycling rules, and why have some states not pursued adoption? What factors influence the rate and extent of adoption and authorization, and what strategies could EPA employ to enhance co-regulator adoption and EPA authorization of recycling rules?

- **Co-regulator and regulated entity awareness:** To what extent are EPA co-regulators (i.e., states) and regulated entities aware of relevant EPA recycling rules? What factors influence the extent of awareness of EPA recycling rules among these groups? What EPA strategies are most and least effective at establishing this awareness, and what other strategies could EPA employ?

- **Impact of Recycling Rules on Waste Management Practices and Factors Impacting Recycling**: For specific waste streams to which EPA has granted recycling rules, have generator waste management practices changed? Most importantly, have recycling rates increased, remained the same, or decreased? IEc also examined why certain waste management practices changed, and identified other factors, such as waste disposal costs and generator capacity, that may have influenced these changes. We looked to identify the factors that influence waste management practices in order to identify potential regulatory rules most likely to enhance recycling rates. In conjunction with recycling rules, what other strategies or approaches could EPA employ to enhance generator recycling rates?

- **Changes in natural resource use and impact:** For the waste streams examined, to what extent have EPA recycling rules conserved natural resources and reduced waste disposal?

1.4 Organization of This Report

This remainder of the report is organized into six sections. Section 2 describes the methodology used in the evaluation. It also includes detailed information on the methodologies for evaluating the three case studies in appendices accompanying this report. Section 3 describes the rate of adoption and authorization of the three case study rules by states. This section presents information on the number of states that have adopted and been authorized for the rules, the rate of adoption and authorization, and findings regarding factors that impact the adoption and authorization process. The next three sections of the report focus specifically on each of the evaluation case studies, the UWR, OBSM, and F006 rule respectively. Each section contains an overview of the sector or material affected by the rule, information on the regulatory history and details of the rule intended to encourage recycling, and findings related to each of the four evaluation categories. Each case study section concludes with specific conclusions and lessons learned. Section 7 includes recommendations for possible actions by EPA in response to the findings.

2. PROGRAM EVALUATION METHODOLOGY

IEc collected a wide range of information to address the evaluation questions for each of the three case studies. Information sources included interviews with EPA representatives, state co-regulators, and industry experts. IEc also used hazardous waste data from the annual Biennial Reports (BR) and information on state adoption and authorization from EPA's State Adoption and Authorization database (StATS). The methodology and sources of data for each specific evaluation question are summarized in Table 1. More specific details on the methodology employed for each of the categories noted above.

Evaluation Question	StATs	Biennial Reports	Industry-provided data	Industry Interviews	Co-regulator interviews	Literature Review
EPA Co-Regulator and Regulated Entity Awareness				✓	✓	
Assessment of Extent of State Adoption and Authorization of the Three Rules	✓				✓	
Impact of Recycling Rules on Waste Management Practices and Factors Impacting Recycling		✓	✓	✓	✓	✓
Changes in Natural Resource Use and Impact			✓	✓	✓	✓

Table 1 Summary of Data Sources and Methodology for Addressing Evaluation Questions

2.1 EPA Co-Regulator and Regulated Entity Awareness

We interviewed EPA Regional contacts, State regulators and trade association and industry representatives to assess their awareness of the relevant rules. These interviews focused on how respondents learned about rules that affected their sectors and how this awareness affected their practices. We interviewed five EPA Regional contacts, six State regulators, and several members of the regulated communities affected by each rule. Findings related to general perspectives on regulator awareness are presented in the context of the adoption and authorization process. Information on the level of awareness of a specific rule is described in the results section for that case study.

2.2 Assessment of Extent of State Adoption and Authorization of the Three Rules

We first collected information on the extent of state adoption of and authorization for these three case studies using the StATS database[1], which provides adoption and authorization information for over 200 rules. This database, which is maintained by EPA's Permits and State Programs Division (PSPD) includes information current as of December 31, 2003. Where necessary, we made an effort to fill data gaps through interviews and direct information solicitations.

We queried both the *STATS* and *AUTHORIZATION* tables within the most recent version of the StATS database. We also collected information from adoption and authorization reports generated from the StATS database that are available on EPA's website.[2] While both the StATS database and the corresponding website contain many of the same fields, we identified some discrepancies between the tables. Based on the recommendations of PSPD staff, we relied upon the information published in the online report where information differed between the online report and the MS Access version of the database. Where we found data discrepancies and data were not included in the reports available online, we relied upon the value in the *AUTHORIZATION* table. State adoption dates are not included in the online reports and are not consistently included in the StATS database. Where necessary, we contacted state and regional contacts in order to collect information on missing adoption dates. Using these data, we analyzed several metrics:

- Number and percent of states that have adopted the rules;
- Number and percent of states that have been authorized for the rules;
- Rates at which states adopted and were authorized for the rules;

---

[1] After a rule is promulgated by EPA, states may adopt the rule, either by incorporating by reference, adopting verbatim, or writing their own rules analogous with the federal regulations. Once the state has adopted the rule, the appropriate EPA regional office reviews the rule and determines whether the state analogue is equivalent. If EPA believes the state rule is equivalent, EPA will authorize the state for that rule.

[2] EPA Office of Solid Waste and Emergency Response, *Authorization Status for All RCRA / HSWA Rules Listed by Checklist Number*, December 31, 2003, http://www.epa.gov/epaoswer/hazwaste/state/stats/stats_rulespecific.htm.

- Regional differences in adoption and authorization rates; and
- Rates of adoption in states with a significant presence of industry affected by the rules versus rates of adoption states without such an industry presence.

We sought to identify factors influencing adoption and authorization rates through interviews with EPA Regional contacts, State regulators, trade associations, and industry representatives. These interviews focused on the impediments to rule adoption and authorization and tried to determine the impact of the adoption and authorization process on generators' behavior.

2.3 Impact of Recycling Rules on Waste Management Practices and Factors Impacting Recycling

For this portion of the evaluation, we examined the 1995 UWR, 1998 OBSM exclusion and 2000 180-day rule in-depth, tailoring the methodological approach to reflect the availability of data and the complexity of the regulation. These methodologies are described below. Where noted, greater detail is provided in an Appendix.

2.3.1 The Universal Waste Rule and Its Applicability to Nickel-Cadmium Batteries

The 1995 Universal Waste Rule (UWR) and its impact on Nickel-Cadmium (NiCd) battery recycling have been studied extensively. We relied heavily upon these existing studies and reports to document NiCd battery generation, the presence of NiCd batteries in the waste stream, and current levels of NiCd collection and recycling. We learned of most of these sources from our contacts with the recycling industry and state officials. A complete bibliography of the sources for this case study is included in the references section.

We supplemented these studies with interviews with five NiCd battery experts, including:

- Two industry trade association representatives;
- One NiCd battery recycler; and
- Two rechargeable battery and product manufacturers.

We also collected information on state rechargeable battery take back programs from state websites and, to the extent possible, interviews with relevant state contacts. We asked interviewees about their awareness of the 1995 UWR, its impact on the recycling rates, and the primary factors impacting management of NiCd batteries. The complete list of interviews and the interview guides are included in Appendix A.

2.3.2 Exclusion for Oil-Bearing Secondary Materials Recycled in Petroleum Refining

We assessed the impact of the 1998 OBSM exclusion on recycling practices in the refining industry, relying primarily on interviews with key industry figures. Initially, we had planned to quantify the impact of the 1998 OBSM exclusion using hazardous waste data contained in the Biennial Reports. However, the exclusion changed reporting requirements for refineries, so they were no longer required to report to BRS the quantity of OBSMs generated, or how they were managed, *so long as* the refinery reinserted the OBSMs into the refining process. As a result, comparable data do not exist that would permit comparison of recycling rates before and after the exclusion.

We interviewed EPA staff, state enforcement staff, and industry representatives to learn about the impacts of the exclusion of these secondary materials. We interviewed nine individuals representing a variety of perspectives, including:

- Representatives from two major oil companies that represent 19 refineries (approximately 10 percent of all US refineries);
- Two individuals from the American Petroleum Institute, the primary trade association for the industry;
- One representative from the nation's largest treatment, storage, and disposal facility (TSDF) that processes refinery waste;.
- One representative from a contractor that provides materials processing services to refineries related to the exclusion;
- One refinery waste management consultant; and
- One representative from an environmental non-governmental advocacy group.

These interviews elicited information about awareness of the 1998 OBSM exclusion among the refining industry, the means through which industry representatives learn about new regulations, and suggestions for improving communication between the industry and EPA. The interviews also provided information about how and why waste management practices had changed following the promulgation of the exclusion, and identified other factors that influenced refineries' decisions about management of secondary materials. Interviewees were also asked about additional steps that EPA could take to remove barriers to recycling and reuse of secondary materials. Finally, the interviewees were asked about potential changes in natural resource impact as a result of any changes in management of refinery secondary materials. These interviews focused on identifying points of consensus about the impact of the exclusion and the prospects for additional recycling in the industry. The interviews also highlighted differences of opinion among stakeholders, and how these disagreements reflect the complexity of this exclusion. Appendix A provides the list of interviewees and the interview guides used.

2.3.3 180-Day Accumulation Time for F006 Wastewater Treatment Sludges

For this case study, we relied upon data reported in both the 1999 and 2001 Biennial Reports. Since F006 waste generators must report generation quantities in their biennial hazardous waste reports even when utilizing the flexibility of the 180-day rule, Iec was able to analyze waste generated both before and after the 180-day rule was promulgated. We also conducted interviews with recyclers and electroplating industry experts.

2.3.3.1 Biennial Report Analysis

Generators of wastewater treatment sludges report the quantity generated every other year in their hazardous waste Biennial Reports (BR). In the BR, each waste stream is identified by a series of codes, including: a source code indicating how the waste was generated; a waste code, such as F006, that identifies the type of waste generated; and a form code that indicates whether the waste is a solid, sludge, liquid, etc. Hazardous waste generators also identify how each waste stream is treated or managed using a set of codes identifying the location and type of treatment or disposal. EPA compiles the data reported on the BRs in a series of files that are available to the public on EPA's website. For the purposes of this analysis, the evaluation team relied upon MS Access conversions of the files.

IEc relied on BR data to identify all wastewater treatment sludges generated prior to the 180-day rule in 1999 and after the rule was promulgated in 2001. The evaluation team used treatment information presented in the BR to assess whether the F006 wastewater treatment sludges were recycled, landfilled, or otherwise disposed. EPA experts and staff from one of its consultants, DPRA, provided guidance on the source codes, waste codes, and form codes that identify F006 wastewater treatment sludges. These advisors also provided guidance on how the treatment information presented in the BR could be used to assess whether the waste streams were disposed or recycled. A full discussion of the BR analysis used to assess the impacts of the 180-day rule is included in Appendix C.

2.3.3.2 Stakeholder Interviews

We conducted six interviews with F006 recyclers, trade association representatives, and electroplaters who generate F006 waste, including.

- Representatives from two recyclers of F006 sludge;
- One representative from a hazardous waste blender, an organization that collects and consolidates hazardous waste prior to disposal;
- Representatives from two metal finishing trade associations: the National Metal Finishing Resource Center and the National Association of Metal Finishers; and
- One representative of an electroplating shop.

Each discussion focused on the individual's awareness of the 180-day rule, current trends in the generation and management of F006 wastes, factors that impact the disposal and recycling of

F006 waste, and benefits of the 180-day rule and F006 recycling. The complete list of interviewees and the interview guides are included in Appendix A.

2.4 Changes in Natural Resource Use and Impact

We sought to identify the extent to which the three case study rules have conserved natural resources, reduced waste disposal, or resulted in other positive environmental impacts. We used a different approach for each case study, based on the available data.

A number of earlier studies had examined the environmental benefits of the 1995 UWR in great detail, typically focusing on measuring reductions in cadmium in the municipal solid waste stream. NiCd batteries leach cadmium metal, which can have negative human health effects, such as kidney and liver damage, after long-term exposure. We combined data on the number of NiCd batteries recycled, and thereby absent from the waste stream, with estimates of the leaching rate of cadmium, to estimate the overall amount of cadmium prevented from entering the waste stream.

Due to a lack of quantitative information about waste management changes resulting from the 1998 OBSM exclusion, we relied primarily on qualitative data from stakeholder interviews. We asked interviewees to discuss potential or realized environmental impacts resulting from an increase in recycling of residual materials at refineries. Specifically, we asked about reduced waste disposal and reduced consumption of crude oil by refineries.

For the 2000 180-day rule, we relied on studies conducted in conjunction with the proposed or final rules that assessed environmental benefits associated with recycling metal finishing wastewater sludges, including estimating volumes of metal recovered. We combined these estimates with waste management data from the 1999 and 2001 Biennial Reports to determine total volumes of metal recovered.

3. FINDINGS ON THE ADOPTION AND AUTHORIZATION OF RULES DESIGNED TO ENCOURAGE RECYCLING UNDER RCRA

States generally assume primary responsibility for implementing RCRA regulations.[3] States can adopt rules by one of three methods: incorporating by reference, adopting them exactly as written (verbatim), or by writing and implementing their own rules that are analogous to the federal regulations. Once the state adopts the rule, the appropriate EPA regional office reviews the state analogue and determines whether it should be authorized. Authorized states are responsible for implementing and enforcing state regulations, which act in lieu of the federal regulation.

Hazardous waste regulations can be implemented under RCRA (the "core program") or its amending statute, the Hazardous and Solid Waste Amendments of 1984 (HSWA). These rules are often referred to as non-HSWA and HSWA rules, respectively. EPA implements HSWA rules immediately after they are promulgated, before the state adopts and authorizes the regulation. Thus, HSWA rules are federally enforceable as soon as they are promulgated, whereas non-HSWA rules become effective in authorized states only after the state adopts the rule. At that point, the rule is enforceable by state and federal authorities.

The three case study rules that the evaluation team examined are all non-HSWA rules. As a result, these rules are not enforceable by states until they are adopted and only federally enforceable following authorization. Furthermore, states are not required to adopt revisions that are less stringent than existing rules, which applies to most rules designed to encourage recycling, including the three case studies for this evaluation.

IEc sought to assess the impact possible lags in adoption and authorization might have upon industry's ability to take advantage of the case study rules. The assessment of the impact of the adoption and authorization process consisted of two parts: a quantitative analysis of adoption and authorization rates and insights on adoption and authorization gathered through interviews with state and EPA regional staff. We first present the data on state adoption and authorization rates, followed by discussion of factors that may affect how readily states adopt rules designed to encourage recycling, and how quickly these states maybe authorized by the Regional office.

3.1 State Adoption Rates

Information on state adoption rates comes from data available in the State Authorization Tracking System (StATS) and reflects adoptions and authorizations finalized as of May 2004. We also contacted state and EPA Regional staff to fill in gaps when data on adoption or authorization dates were missing from the database. However, we were unable to determine the adoption dates for seven states that had adopted the OBSM exclusion, three states for the 180-day rule, and 12

[3] In addition to the 50 states, two territories (Guam and the U.S. Virgin Islands) are authorized to administer certain aspects of the RCRA program. As a result, the overall number of jurisdictions we considered as a baseline for understanding the adoption and authorization process was 52. In the interest of readability we use the single term "states" in place of "states and territories".

states for the 1995 UWR.[4] Consequently, some of the findings of this analysis regarding the rate of adoption could change if additional information becomes available.

3.1.1 Findings on State Adoption Rates

States adopt rules gradually, thus more states have adopted the UWR than the oil-bearing secondary materials rule and the 2000 180-day rule, which were promulgated more recently.

As of May 2004, 48 states had adopted the UWR, whereas only 32 had adopted the OBSM exclusion, and 30 had adopted the 180-day rule (see Figure 1).

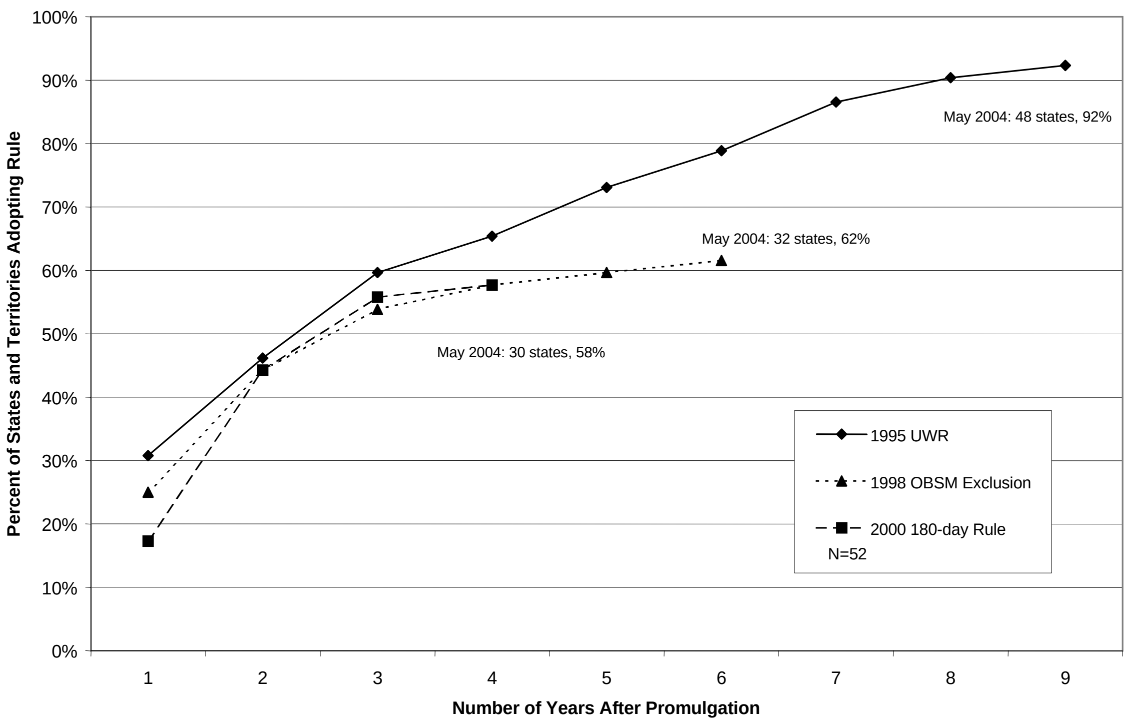


Figure 1. Rates of State Adoption of Three RCRA Regulations to Encourage Recycling, 1995-2004. Results based on IEc analysis of data in State Authorization Tracking System (StATS) and from personal communication with state regulatory staff.

Most states adopt a rule within the first two years following promulgation.

By the end of the second year following promulgation, each rule had been adopted by approximately 23 states. However, this pattern is not the result of a group of states that consistently

[4]See Appendix B for a listing of the states for which adoption dates are unavailable.

adopts rules quickly; since only nine states adopted all three rules within the first two years following their promulgation.

States have continued to adopt the UWR more readily than either the 1998 OBSM exclusion or the` 2000 180-day rule.

Beginning in the third year, the rate of adoption slows from approximately 12 states per year to 5 or fewer (see Table 2). At this point the rates of subsequent adoption for the three rules begin to diverge and the more recently promulgated 180-day rule has a higher adoption rate, at this time.

	Average Rate of Adoption[1] (States/year)	Average Rate of Adoption During First and Second Years Following Promulgation (States/year)	Average Rate of Adoption After First Two Years Following Promulgation[2] (States/year)
1995 UWR	5.3	12	5.7
1998 OBSM Exclusion	5.3	11.5	3.0
2000 180-day Rule	7.5	11.5	2.3

Table 2: Rates of State Adoption of Three RCRA Rules to Encourage Recycling, 1995-2004. Rates shown in states/year. Results based on IEc analysis of information contained in the StATS database supplemented with data provided by state and regional contacts.

[1] Average rate of adoption shown in states/year. Calculated by dividing the number of adopting states by the number of years since promulgation of the rule, not including the remainder of the year in which the rule was promulgated. This applies to the metrics shown in the second and third data columns of the table as well. For example, the first two years following promulgation of the 1995 UWR are 1996 and 1997.

[2] Note that this average is based on a different number of years for each rule, which may distort the averages somewhat. For the 1995 UWR, n=7; 1998 OBSM exclusion, n=4; 2000 180-day rule, n=2.

Presence of the affected industry in a state does not necessarily result in faster adoption of rules to encourage recycling by that state.

Among four states with a significant presence of affected facilities for the 2000 180-day rule, only Illinois has adopted (2001). Interestingly, the other three states (California, Ohio, and Michigan), have not yet adopted this rule. In contrast, four of the five major refining states have adopted the OBSM exclusion. Louisiana and Michigan adopted in 1999, while Texas adopted in 2001. An adoption date was not available for Illinois, and California is the only major refining state that has not yet adopted the rule. However, our interviews revealed that California has existing regulations that are very similar to the exclusion. The 1995 UWR targets consumer-generated NiCd batteries which are generated across the country. As a result, the question of industry influence in certain states is less relevant. The sole domestic NiCd battery recycling facility, however, is in Pennsylvania, which did not adopt the UWR until 1997 following the 1996 Battery Management Act (which mandated it in all states).

Rates of adoption vary across EPA Regions.

EPA Regions are not responsible for states' decisions regarding adoption of certain RCRA regulations. However, the rate of progress may serve as an indicator of how effectively the Region is in raising awareness about these rules among states. Table 3 shows the adoption progress for each Region and average adoption delay among the states in each Region

Region	Percentage of Rules Adopted [1]	Average Time to Adopt Rules (years)[2]
1	56 (10/12)	3.7
2	67 (6/9)	2.5
3	78 (14/18)	2.4
4	71 (17/24)	0.9
5	61 (11/18)	1.9
6	100 (15/15)	2.1
7	75 (9/12)	3.4
8	78 (14/18)	1.2
9	42 (5/9)	2.2
10	60 (9/15)	1.8

Table 3: Regional Comparison of States' Adoption of RCRA Rules to Encourage Recycling. Results based on IEc analysis of information contained in the StATS database supplemented with data provided by state and regional contacts.

[1] Percentage is based on the number of state adoptions within that Region divided by the total number of possible adoptions; the number of states in the region multiplied by three (the number of case studies). For instance, Region 7 contains four states, and therefore has a baseline of 12 possible adoptions across the three rules.

[2] Delay is calculated as the difference between the year in which a state adopted the rule and the year in which the rule was promulgated. Thus, if a state adopted the 1998 OBR exclusion in 2000, the delay would be two years. States that did not adopt the rules are not included.

3.1.2 Influences on Adoption Rates

Several factors affect the rate of adoption, including the process employed by individual state, the complexity of the rule, and the level of staffing dedicated to the adoption process.

States processes for adopting rules can affect the rate of adoption.

States can adopt rules by incorporating the rule by reference into its regulatory structure, adopting the federal language verbatim, or by writing and implementing their own rules that are analogous to the federal regulations. Each state generally adheres to one process for most adoptions. Regional and state representatives report that adoption by reference is generally the fastest process for both adoption and authorization. In contrast, interviewees note that states that write their own equivalent rules or adopt rules verbatim tend to take more time to both adopt and be authorized for a rule. One regional representative noted that state procedures also influence the adoption process. For example, some states have councils that review all regulations, while others must promulgate their rules through their state legislature, which can be a complicated and lengthy process.

Complicated rules or rules in the same "cluster" as a contentious rule generally take longer to adopt.

EPA experts noted that, in general, the more complicated or contentious a rule is, the more likely conflicts with existing state statutes are to occur, which will lengthen the amount of time the state needs to adopt the rule. In addition, one EPA regional representative noted that EPA's cluster system for authorization may delay adoption of certain rules, especially if the cluster is large. These clusters group all federal rules promulgated within a certain period in order to limit the number of times states need to submit revision applications. However, if a certain regulation in a cluster requires involvement of the legislature or is delayed for another reason, this representative noted that the state can "bust the cluster" in order to expedite adoption and authorization for the other rules in the cluster.

Staff availability is another extremely important factor in determining how quickly a state adopts a rule.

Interviewees noted that several states had only one employee assigned to manage the adoption process, which can create a bottleneck effect, slowing down all adoptions.

Most interviewees said that the rates of adoption and authorization for rules intended to encourage recycling do not differ from rates for other rules.

Nearly all regional and state interviewees noted that regulations intended to encourage recycling were considered and adopted in the same way as all other regulations. However, one Regional representative suggested that adoption of recycling regulations might be lower priority for states than regulatory actions that increase stringency. According to this Region, states might be reluctant to adopt delistings or recycling rules if they increased the enforcement burden or if they conflicted with other state rules.

Affected industries may encourage EPA to promulgate certain regulations and states to adopt them.

Industry representatives affected by the exemptions reported that they had encouraged EPA to promulgate the rules and the states to adopt them. Key producers of rechargeable batteries formed a trade association, the Portable Rechargeable Battery Association (PRBA) in 1992, in part to encourage EPA to adopt regulations to encourage recycling, such as the UWR. EPA and the metal finishing industry worked together through the Agency's Common Sense Initiative (CSI); a key outcome of this initiative was the 180-day rule. One state contact noted that while the metal finishing industry did lobby the state to adopt the F006 180-day rule, the industry "didn't have to lobby very hard" as the state adopts federal rules in a timely manner as a matter of procedure. Petroleum refining representatives whom we interviewed about the oil-bearing secondary materials exclusion reported playing an active role in trying to get states to adopt the exclusion as soon as possible, by providing information to the state about any technical obstacles that might arise.

Interviewees agreed that EPA encourages timely adoption of all rules, but noted that, in general, the Agency does not give any special emphasis to recycling rules.

Several representatives from EPA Regions said that they generally encourage states to stay as up-to-date as possible with changing federal regulations overall, but that no special emphasis is given to recycling regulations. One state interviewee concurred, noting that, in general, EPA "strongly encourages" adoption in the Federal Register notice for the final rule. EPA does not, however, more actively advocate adoption. One regional representative reported that he would be more likely to encourage states to adopt optional rules or rule revisions that are less stringent than the existing ones, in hopes of streamlining a program.

EPA Headquarters representatives noted that there was very little they could do to encourage timely adoption of recycling rules. One regional contact noted states may delay adoption of recycling regulations if other, more controversial rules are part of the same cluster. This interviewee said that EPA could promote timely state adoption of rules intended to increase recycling by promulgating a "stand alone" rule.

While EPA does not reach out proactively, most state staff indicated that they had almost no problems learning about new EPA regulations. Several mentioned that they regularly checked EPA's state authorizations website for information about newly promulgated rules.

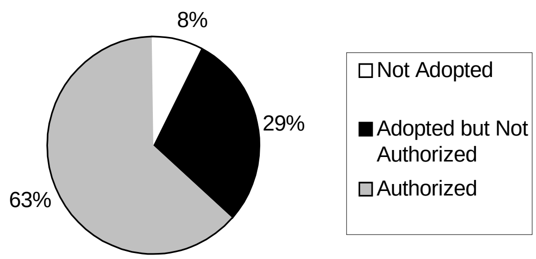
3.2 State Authorization Rates

3.2.1 Findings on State Authorization Rates

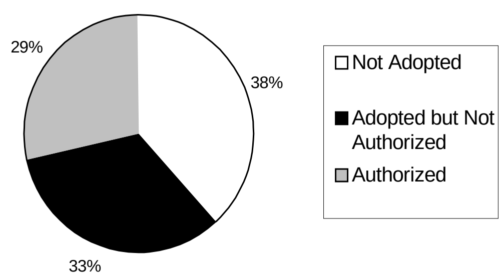
EPA regions have approved approximately half of state authorization packages.

Across the three rules considered in this analysis, states have adopted 110 rules and been authorized to administer 58 of these. Nearly 65 percent of all states are authorized for the 1995 UWR, while only 29 percent of states are authorized for the 1998 OBSM exclusion, which was promulgated three years after the UWR. The most recently promulgated 2000 180-day rule is only authorized in 19 percent of states (see Figure 2). Nationwide, 52 state adoptions have yet to be approved by a regional office (See Table 3).

Adoption and Authorization Status for 1995 UWR



Adoption and Authorization Status for 1998 OBSM Exclusion



Adoption and Authorization Status for 2000 180-day Rule

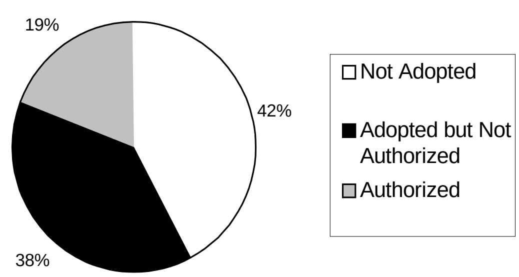


Figure 2 Adoption and authorization status of three case studies

Source: Results based on IEc analysis data in State Authorization Tracking System (StATS)

On average, states are authorized slightly more than two years after they adopt the rule.

This length of time varies considerably among the Regions, as shown in Table 4. Region 9 has the fastest average authorization time of 1.3 years, while Region 2 is typically the slowest with an average time of four years. The delay between adoption and authorization is caused by a number of factors which are discussed in greater detail below.

Region	Percentage of Authorization Packages Approved[1]	Average Length of Time Between State Adoption and Authorization (years)[2]	Number of Authorization Packages Awaiting Approval
1	40 (4/10)	1.7	6/10
2	17 (1/6)	4	5/6
3	86 (12/14)	1.6	2/14
4	59 (10/17)	2.4	7/17
5	45 (5/11)	3	6/11
6	67 (10/15)	2.1	5/15
7	11 (1/9)	2	8/9
8	36 (5/14)	3.5	9/14
9	60 (3/5)	1.3	2/5
10	78 (7/9)	2.7	2/9

Table 4 Regional Comparison of Progress Authorizing States to Implement RCRA Rules to Encourage Recycling. Results based on IEc analysis of information contained in the StATS database supplemented with data provided by state and regional contacts.

[1] Number of authorizations divided by the number of state adoptions across the three rules.
[2] Length of time is calculated as the difference between the year in which a state was authorized for a rule and the year in which the state adopted that rule.

The rates of authorization are consistent across all three rules within the first three years after promulgation (see Figure 3).

In the first three years after adoption, there is a consistent trend among the rates of adoption for the three case studies. The rate of authorization for the 1998 OBSM exclusion began to slow four years after promulgation, slightly after the rate of adoption began to decline. Because the 180-day rule was only promulgated in 2000, it is not yet clear how the rate of authorization will change at the four-year point.

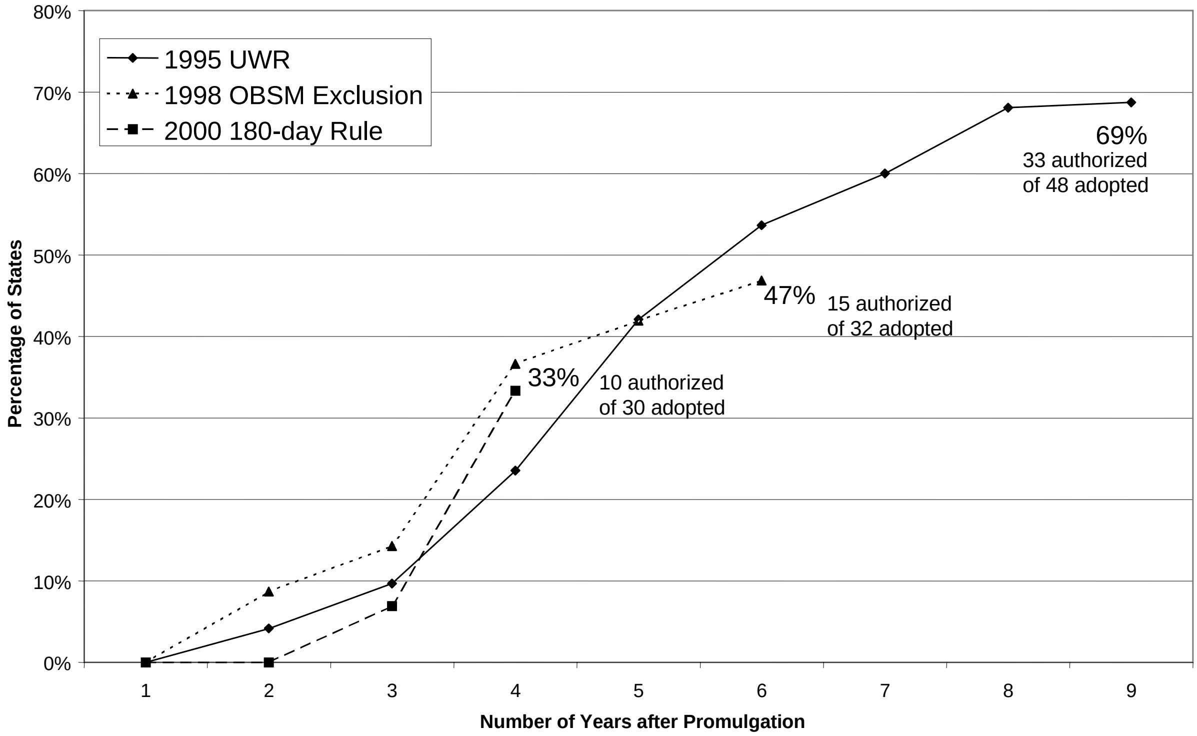


Figure 3. Progress of State Authorization Among States that have Adopted, 1995-2004. Results based on IEc analysis of data in State Authorization Tracking System (StATS) and from personal communication with state regulatory staff.

3.2.2. Influences on Authorization Rates

Delays in the authorization process may result from backlogs of previously adopted rules, concerns with state adoption packages, or regional concerns for existing state regulations.

Interviewees noted that the large number of people and offices in the Region that have input into an authorization may create opportunities for delay. An authorization can also be delayed if a state program is otherwise under investigation by EPA, or if any lawsuits pertaining to the regulations or the state's programs are pending. One state contact said that EPA withheld authorization of any further regulations because of its concerns with several existing state regulations that might impact implementation of the RCRA program.

To try to facilitate the authorization process, interviewees noted some Regions had begun reviewing state rules before they were even adopted (especially in states that choose to write their own rules), and made suggestions to state rule writers along the way. This also helped speed the authorization process as Regions were more aware of potential differences between state regulations and federal rules. In cases where Regions have concerns regarding state RCRA programs, one state contact suggested that EPA authorize the rule with conditions. For example, a rule could be authorized with the condition that if EPA had concerns regarding its implementation, state authorization could be recalled.

Interview respondents said that EPA and state regulators publish information about new regulations, but do not generally conduct additional outreach to the regulated community regarding rules that encourage recycling.

Regional and State interviewees reported that EPA made limited efforts to encourage the regulated community to utilize the flexibility created by recycling regulations. One state interviewee did point out that the public notice requirements for all rulemakings required a minimum standard of outreach. One state contact noted that states may develop fact sheets and information statements and make these materials available on their websites. States may also inform the regulated community of these rules intended to encourage recycling during the inspection and permitting process.

One regional interviewee told IEc that EPA sometimes puts considerable effort into getting the word out about a new regulation, including presentations to trade associations, or mailings targeted at affected facilities. The interviewee noted that EPA usually undertakes these activities only for non-controversial regulations.

Interviewees did not agree as to how adoption and authorization lags impact the behavior of the regulated community.

Most interviewees stated that members of the regulated community would expect to change their recycling practices when their state adopts the rule, not waiting for the authorization. Other respondents reported that they expected the regulated community to change its practices immediately following federal promulgation. One regional respondent suggested that facilities may change their behavior before adoption because they do not expect the state or region to bring enforcement action against the facility during the lag period before the rule is adopted or authorized. Alternatively, one regional contact noted that some larger companies with sophisticated legal counsels are hesitant to take advantage of these rules until after they are authorized, because of concerns that they are not federally enforceable.

Interviewees commenting on the 1995 UWR noted that lags in adoption did impact the progress in recycling NiCd batteries. As will be discussed in greater length in the section devoted to this case study, the sole North American facility for recycling of NiCd batteries is located in Pennsylvania. Pennsylvania did not adopt the UWR until June of 1997. As a result, until that point, NiCd batteries had to be manifested and treated as hazardous waste within Pennsylvania state lines. One respondent commented that this created a “bottleneck;” NiCd batteries were collected as allowed under the 1995 UWR, but were not sent to the recycler.

Interviewees for the 1998 OBSM exclusion revealed that many refineries believed that federal court rulings affirmed that these wastes were already excluded, even before EPA changed its regulations.[5] Industry interviewees did note that California's decision not to adopt the rule, and to regulate instead based on existing state rules, may limit the amount of material transferred there. In other jurisdictions, secondary materials can be transferred between any two refineries but not in California. Also, one interviewee reported that Delaware state regulators are not overly supportive of the objectives of the exclusion. However, this position is rare among states, particularly those that have successful reuse programs already in place. In addition, there is no evidence that this perceived opposition to the exclusion is in any way hampering recycling by refineries.

3.3 Conclusion

3.3.1 Summary of Key Findings

It takes several years for states to adopt and be authorized for these rules. Of those states that have adopted the three case study rules, most states adopted the rules in the first two years after their promulgation. Accordingly, the highest rates of authorization occurred three to five years after their promulgation. Yet, even five years after promulgation, only approximately 30 percent of states were authorized for the 1998 OBSM exclusion and the 1995 UWR.[6]

Adoption is impacted by a number of factors, many of which are beyond EPA's control. Respondents cited a wide range of factors that might impact a state's adoption process. Many of these factors, including the staff time devoted to adoption and the legislative process the state follows, vary from state to state and rule to rule. One respondent also noted that rules that complicate a state's enforcement functions might be adopted more slowly, which may affect recycling rules that require additional time from enforcement staff. These factors, and thus the adoption rate, would also seem to be unaffected by encouragement or assistance from EPA. Respondents remarked that the number of rules included in a cluster and the complexity of rules could impact adoption time.

EPA is not perceived as actively promoting state awareness and adoption of rules to encourage recycling. State interviewees reported that EPA is not proactive in notifying them of recently promulgated rules to encourage recycling. They also said that EPA does not generally make any effort to facilitate adoption of such rules beyond those normally used to assist the states to remain current with the federal program.

Lags in adoption inhibit industry's ability to recycle in some cases. Most interview respondents said that a lag in adoption would delay changes in waste management practices, but delays in authorization would not have an impact. Respondents stated that the experiences of the 1995 UWR support this response. A key state's lag in adoption impacted the industry's ability to recycle NiCd batteries. Experiences with the 1998 OBSM exclusion do not however support these

---

[5]See the Oil-Bearing Secondary Materials case study (Section 4) for more detail on the case history relating to this exclusion.

[6]The 180-day rule was promulgated only four years ago, so a similar metric is not available.

same conclusions. Industry's response to the OBSM exclusion, however, may be out of the ordinary due to its views about the legality of recycling these secondary materials, even before promulgation of the exclusion.

3.3.2 Points for Further Research and Recommendations for EPA

3.3.2.1 Encourage State Adoption Rates

EPA's database for tracking adoptions and authorizations (StATS) does not contain comprehensive information on state adoption dates. PSPD staff noted that states are not required to report this information, but may do so voluntarily. The lack of complete data on state adoption dates makes it difficult to assess how quickly states are adopting rules and how much delay exists between adoption and authorization. Adoption dates are not a critical piece of data for understanding the implementation of HSWA regulations, because these regulations are automatically implemented in the states regardless of their adoption status. However, non-HSWA regulations, and other regulations that decrease the stringency of a state's RCRA program, are not implemented until the rule is adopted by the state. Therefore, rules to encourage recycling are generally not available to the regulated community until adopted by the state, increasing the significance of adoption. EPA should consider requiring states to report adoption dates, particularly for rules that encourage recycling, in order to increase understanding of the implementation of these rules. In addition EPA could work to encourage state to adopt there rules. EPA should investigate why three states with a significant amount of facilities that qualify for the F006 exemption, have not adopted the rule.

3.3.2.2 Work to Increase Lags in State Adoption and Authorization

To facilitate the adoption and authorization process, EPA could encourage Regional authorization staff to increase communication with state regulatory staff as they adopt new rules. This communication will allow the Region to anticipate potential differences between state and federal regulations and to provide suggestions to state rule-writers, while encouraging prompt adoption.

The cluster system of adopting and authorizing changes to the state's RCRA program generally facilitates the adoption process, but in certain situations may delay the adoption of certain rules. As one regional respondent noted, EPA could consider issuing recycling rules independently to prevent delays in adoption of these rules that are caused by the presence of complicated or controversial rules in the same cluster. EPA could also encourage states to "bust clusters" in cases where implementation of a recycling rule is being delayed.

To prevent delays in authorization, as recommended by one state contact, in cases where Regions have concerns regarding state RCRA programs, EPA could consider authorizing the rule conditionally. For example, a rule could be authorized with the condition that if EPA had concerns regarding its implementation, state authorization could be recalled.

4. THE UNIVERSAL WASTE RULE AND ITS APPLICABILITY IN RECYCLING NICKEL CADMIUM BATTERIES

4.1 Introduction

The Universal Waste Rule (UWR) regulates a number of hazardous materials generated by a large number of both industrial and non-industrial sources, including Nickel Cadmium (NiCd) batteries. NiCds are rechargeable batteries used in both the industrial and consumer sectors. NiCd batteries can be discharged and recharged many times and function particularly well in high-drain applications requiring large power bursts. Industrial NiCds are large vented batteries and are used in aircraft, railroad cars, and subway trains as a source of emergency and starting power, switching, and signaling. In the consumer market, NiCds are often relied upon in power tools, dustbusters, portable phones, and video cameras.

Battery manufacturers continue to make progress in removing and replacing the toxic components of batteries. In the case of NiCd batteries, however, cadmium serves as the battery's power source. The level of cadmium can not thus be reduced without a proportionate reduction in power. In order to protect against the threats of cadmium, NiCd batteries must be properly managed and disposed.

4.1.1 State Regulations

Prior to the UWR, NiCd batteries were considered a hazardous waste. Residential wastes, however, are exempt from RCRA. Thus, while a business using and generating a NiCd battery would have to manage that battery as a hazardous waste, a consumer generating that same battery could legally dispose of it in his or her household trash. In 1989, Connecticut passed the first law regarding consumer NiCd batteries. As of 2004, a total of 21 states have passed state laws regarding these batteries.[7] State regulations cover NiCd battery labeling requirements and requirements on the removability of batteries from the products in which they are stored. Some states have also required that manufacturers of Ni-Cd batteries implement take-back programs to collect and properly dispose NiCd batteries generated by consumers.

4.1.2 The Portable Rechargeable Battery Association

To address the variety of state regulations being promulgated in the late 1980's, the five largest manufacturers of rechargeable batteries formed the Portable Rechargeable Battery Association (PRBA or Battery Association) in 1991. The PRBA was formed to organize the battery industry to develop consensus regarding regulatory issues including rechargeable battery labeling

[7]Bette Fishbein, INFORM, Inc., *Industry Program to Collect Nickel-Cadmium (Ni-Cd) Batteries*, http://www.informinc.org/recyclenicd.php, viewed March 31, 2004.

standards, to advocate and lobby for adoption of regulations consistent with these consensus views, and to provide legislative and regulatory support to help members comply with regulations.[8]

4.1.3 The Universal Waste Rule

In May 1995, EPA promulgated the Universal Waste Rule (UWR) to govern certain hazardous wastes frequently generated by the consumer sector. Specifically, the UWR defined universal wastes as those:

- generated in a wide variety of settings, not solely industrial;
- generated by a vast community; and
- present in significant volumes in nonhazardous management systems.

The May 1995 UWR identified three universal wastes: hazardous waste batteries, hazardous waste pesticides, and mercury-containing thermostats. The regulations also included a provision whereby individuals and states could petition EPA to define additional universal wastes.

EPA promulgated the UWR to encourage proper disposal and recycling of universal wastes. The UWR was designed to enable collection programs, such as that set up by the Rechargeable Battery Recycling Corporation (the Recycling Corporation), to collect and properly manage unregulated portions of the universal waste streams (i.e., the wastes generated by the consumer sector) and to remove these wastes from municipal solid waste. EPA also hoped the rule would improve implementation for the existing Subtitle C hazardous waste regulatory program (i.e., increase proper management from businesses or public agencies currently not complying with RCRA regulations regarding universal wastes, including NiCd batteries). The UWR is designed to allow longer storage time of designated universal wastes, reduce the record keeping burden, and reduce the total annual cost of waste transportation.

The Universal Waste Rule dictates requirements for handlers, transporters, and destination facilities. Universal waste handlers are those who generate or who receive and consolidate universal waste. Handlers who accumulate less than 5,000 kg of universal waste on-site at any one time are considered Small Quantity Handlers of Universal Waste (SQHUW); those who accumulate 5,000 kg or more on-site at any one time are Large Quantity Handlers of Universal Waste (LQHUW). Once the LQHUW designation is made, the handler remains a LQHUW for the remainder of the year. Handlers are not limited in the amount of universal waste they can accumulate on-site (although those accumulating 5,000 kg or more are defined as LQHUW). Universal waste can be stored on-site for up to a year. Once shipped, handlers are not required to keep records of the wastes for the purposes of hazardous waste biennial reports. LQHUW are required to keep basic shipping records. Handlers must also undergo some basic training regarding the proper handling and

[8]Portable Rechargeable Battery Association, *PRBA Goals*, http://www.prba.org/, viewed May 19, 2004.

management of universal waste. Similarly, universal waste transporters are not required to manifest waste, but must manage the waste according to Department of Transportation hazardous material shipping requirements, if they apply. Transporters that store universal waste for more than 10 days must comply with the requirements outline for universal waste handlers. Destination facilities are subject to regulation as hazardous waste treatment, storage, and disposal facilities (TSDFs) and must keep records of all universal waste shipments received and sent.

4.1.4 The Rechargeable Battery Recycling Corporation

In response to the UWR, in 1995 the PRBA formed the non-profit Recycling Corporation to administer the recycling and collection of NiCd and other rechargeable batteries. The Recycling Corporation offers free recycling to consumers, retailers, communities, and public agencies. The Recycling Corporation program is funded by battery and product manufacturers that pay to licence the Recycling Corporation seal. By becoming a licensee, manufacturers can imprint the Recycling Corporation seal on their battery packs. The seal enables end-users to identify the batteries as recyclable and includes a phone number users can call to learn how to recycle their rechargeable battery. Consumers who call the toll-free number imprinted on the battery are referred to the closest retail collection site.

The Recycling Corporation collects batteries through retailers, communities, business and public agencies, and licensees. The Recycling Corporation sends retailers that choose to participate in the program a Battery Recycling Kit, which includes bags to contain the batteries, instructions on handling and collecting batteries, and signs to advertise the program within the store. The Recycling Corporation provides retailers containers that can be sent safely via UPS to a number of consolidation points across the country. Batteries are then shipped to a recycling facility, the International Metals reclamation Company (INMETCO), for recovery. Retailers bear none of the costs of shipping or disposing of the collected batteries. Retailers participate in the program for the "green image" and the additional business they may receive from the Recycling Corporation referrals. Communities that collect batteries must transport them to a central county collection point, but the Recycling Corporation pays for subsequent shipping and disposal costs. Business who are required under RCRA to properly dispose of the batteries are required to pay to transport the batteries to one of three consolidation points, but the Recycling Corporation then ships the batteries to INMETCO and covers recycling costs.

The Recycling Corporation has also set up a program to encourage licensees to take-back and recycle batteries they manufacture. Licensees may be uniquely able to collect used batteries as consumers exchange them for new ones. If licensees choose to collect their own batteries and ship them to the recycler, they receive a rebate for 75 percent of the Recycling Corporation cost of the seal. Because the licence fees paid for the seal are intended to cover the cost of battery collection and transportation, the rebate ensures that licensees do not pay these costs twice.[9]

[9] More information on the Recycling Corporation is available on its website, http://www.rbrc.com.

4.1.5 The 1996 Battery Management Act

State rechargeable battery regulations and uneven state adoption of the UWR created a patchwork of battery regulations across the U.S. In some states, manufacturers were required to label batteries appropriately and implement take back programs. NiCd batteries were treated as universal waste in some states, but had to be managed and transported as hazardous waste in others. To nationalize the UWR and regulations governing NiCd batteries, the U.S. Congress passed the Mercury-Containing Rechargeable Battery Management Act on May 13, 1996. The Battery Act established uniform NiCd battery labeling requirements and dictated that NiCd batteries be easily removed from the products they powered wherever it was safe to do so. The Battery Act also implemented the UWR in all states that had not yet adopted the rule.

4.2 Findings

Evaluation Category	Finding
Regulated community awareness of the exclusion	• The industry trade association has effectively informed the industrial users about UWR. • While consumers, businesses, and public agencies are likely not aware of the UWR, the industry trade association's outreach efforts are continuing to raise awareness of the importance and ease of NiCd battery recycling.
Impact of the exclusion of waste management practices	• The UWR has allowed widespread NiCd battery collection and recycling.
Factors that influence decisions about recycling	• Recycling has increased as a result of widespread rechargeable battery collection programs run by the battery industry. These collection programs have been implemented in response to state battery regulations and the 1996 Battery Management Act.

Table 5 Summary of Findings for the UWR for NiCd Case Study

Source: The findings for the UWR for NiCd batteries case study are based on a review of previous analyses, recycling data provided by a major trade association, and five interviewees with a range of industry stakeholders and recycling experts.

4.2.1 Awareness of the UWR

The PRBA plays an important role in informing the industry of application regulations, including the UWR.

The Battery Association examines regulatory changes that can affect manufacturers and industries that use rechargeable batteries in their products. In addition, the Association works to educate the battery industry about important regulations and lobby governments. In this role, the association lobbied EPA to promulgate the UWR. One industry representative noted that the PRBA circulates a monthly *Legislative Update*. PRBA informs members of the industry of the requirements of the UWR by providing information on its website and responds to inquires from manufacturers. A trade association representative noted that he believes that over 95 percent of battery producers and manufacturers of products that use batteries are aware of the UWR. One industry respondent noted that because of the PRBA and Recycling Corporation, the company has "been aware of the UWR since day one."

Consumers or businesses using products that contain NiCds are not likely aware of the UWR. Through the Recycling Corporation's efforts, consumers are becoming more aware of the ease of recycling NiCd batteries.

A trade association representative noted that awareness of and compliance with the UWR among businesses using NiCd batteries is really dependent upon the company's desire to be environmentally responsible. While some companies realize they are in violation, many small businesses using NiCds are unaware that these materials are regulated. One industry representative noted that even if businesses are aware of the Recycling Corporation and its program, they may not be aware of the regulations that make the collection program possible. Another interviewee noted that consumers are frequently unaware that these batteries should be recycled.

The Recycling Corporation plays an important role in educating consumers about the proper management of NiCd batteries. To promote the collection program and encourage battery recycling, the Recycling Corporation reports spending over three million dollars per year on consumer surveys and marketing to the consumer sector. The Recycling Corporation funds print ads in trade and consumer magazines, including *Better Homes and Garden* and *Time*, and has developed television and radio Public Service Announcements (PSAs). Richard Karn, *Home Improvement*'s "Al," serves as the Recycling Corporation spokesperson and promotes the program in print media and on television guest appearances. Despite these efforts, a trade association representative notes that he "wishes awareness [of Recycling Corporation] was higher" among consumers and municipalities.

EPA does not play a significant role in raising awareness of the UWR. Some state agencies do try to inform consumers about proper disposal of NiCd batteries.

One industry representative noted that EPA and the state agency did not inform them of the UWR, likely because they lacked the resources to do so. This respondent noted that because manufacturers of battery packs and products that contain rechargeable batteries are not in one distinct SIC/NAICS code sector, informing the appropriate businesses of the rule would have been difficult. A trade association representative noted that EPA posts information about the rule on their website and "is doing everything they can possibly do."

One interviewee noted that state environmental departments frequently direct consumers to the Battery Association to encourage proper disposal of NiCd batteries. One state contact noted that the state has a website dedicated to educating consumers about NiCd battery disposal.

4.2.2 Changes in Waste Management and Recycling Practices

The exact quantity of used NiCd batteries that is generated in the U.S. each year is not known.

The battery production chain is complex; there are many steps between the initial producer of a battery cell and the business or consumer that uses and discards that battery. Approximately 350 million consumer NiCd batteries were sold in the U.S. in 2000.[10] The exact number of batteries discarded, however, is unknown.

Battery cells are produced by a manufacturer and the individual cells are then made into battery packs. Packs can be made by the original manufacturer or a third party. Approximately 80 percent of NiCd batteries are not sold separately, but are rather incorporated into products that businesses and consumers purchase.[11] Used battery generation rates are also dependent upon the life of the battery and how the battery is disposed. Depending on the application and the level of use, NiCd batteries can last from one to ten years. Batteries may be discarded immediately or may be stored for some period of time before disposal. Since a large percentage of NiCd batteries are used in the consumer sector, there are no records related to disposal quantities.

Two accepted methodologies can be used to assess the quantity of used NiCd batteries generated in a given year.

Battery generation rates can be estimated using a market sales based methodology or a municipal solid waste based methodology. The market sales based methodology assumes an average life for both a consumer and an industrial NiCd battery. According to this methodology, in any given year, the number of used batteries generated is equal to the quantity of batteries sold in the

---

[10] Bette Fishbein, INFORM, Inc., *Industry Program to Collect Nickel-Cadmium (Ni-Cd) Batteries*, http://www.informinc.org/recyclenicd.php, viewed March 31, 2004.

[11] Jozef Plachy, U.S. Geological Survey, *Cadmium Recycling in the United States in 2000: U.S. Geological Survey Circular 1196-0*, http://pubs.usgs.gov/circ/c1196o/ viewed March 3, 2004.

current year minus the battery's average life. Thus, if five years is assumed as the average life of a consumer battery, the number of consumer batteries disposed in 2004 is equal to the number sold in 1999. More extensive models break NiCd batteries down into individual segments and applications, assigning an average life. Market sales based methodologies must also determine battery distribution into the market place. Factors that are considered include the number of cells sold by battery application, the average number of cells in an application, and the length of time between when the battery is manufactured and when it is actually sold in a product. Finally, the market sales based approach is complicated by delays in disposal of NiCd batteries after their useful life has expired. Studies indicate that many consumers store spent batteries for a considerable period of time before they are ultimately disposed.[12] A trade association representative illustrated this practice, frequently referred to as "hoarding," by noting how long consumers might keep an old dustbuster in the garage.

NiCd disposal can also be measured using a municipal solid waste methodology. This methodology relies upon samples of municipal solid waste. Combined with information on NiCd recycling, the municipal solid waste stream data can provide information on the total amount of used NiCd batteries generated in a given year. This methodology is based upon the assumption that batteries are not being composted or released into the environment. While the municipal solid waste stream methodology eliminates complexities such as battery life and hoarding, waste stream sampling must be extensive and careful to measure only NiCd batteries in the waste stream, not cadmium as a whole. Cadmium can also be released from other sources including other batteries, fertilizers, and construction materials.[13]

Estimates of Cadmium Discarded

Several studies have attempted to calculate the amount of cadmium discarded in NiCd batteries. In 1989, EPA sponsored a study by Franklin Associates to assess the amount of cadmium in the municipal solid waste stream from consumer products. IEc updated and revised this study in 1995 for the International Cadmium Association, and in that analysis included estimates made by the PRBA (see Table 6). Results indicate that cadmium typically accounts for 11 - 15 percent of the weight of a NiCd battery.[14] Using a value of 11 percent and IEc estimates for tons discarded as shown in Table , we estimate that as much as 19,736 tons of NiCd batteries were disposed in the municipal solid waste stream in 1995 and 32,418 in 2000. Two collection programs in Europe,

---

[12]Organization for Economic Cooperation and Development, *Recycling Rate Calculation Methodologies: A Review of Techniques for the OECD Expert Group on Recycling Rate Calculation Methodology*, undated.

[13]Organization for Economic Cooperation and Development, *Recycling Rate Calculation Methodologies: A Review of Techniques for the OECD Expert Group on Recycling Rate Calculation Methodology*, undated.

[14]Bette Fishbein, INFORM, Inc., *Industry Program to Collect Nickel-Cadmium (Ni-Cd) Batteries*, http://www.informinc.org/recyclenicd.php, viewed March 31, 2004.

CollectNiCad and STIBAT, are relying upon municipal solid waste based methodologies to assess NiCd discards.[15]

Year	Tons Discarded Franklin Estimate	Tons Discarded IEc Estimate	Tons Discarded PRBA Estimate
1995	1,709	2,171	1,345
2000[1]	2,032	3,566	2,590

Table 6 Estimates of Cadmium Discarded in NiCd Batteries (tons)
Results shown as presented in Industrial Economics, Inc., *Estimation of Cadmium Discards in Municipal Solid Waste*, September 1995.[1] Year 2000 values are projected.

NiCd batteries are recycled by a small number of Treatment, Storage and Disposal Facilities.

The INMETCO facility in Ellwood City, Pennsylvania is the only facility with the high temperature metals recovery (HTMR) process needed to recycle batteries and is the only recycler of NiCd batteries in North America. INMETCO recycles batteries by draining them, shredding them, and feeding the materials into the furnace. Nickel and iron are recovered from this process and are used in the manufacture of stainless steel. In 1995, INMETCO installed a cadmium recycling plant to recover cadmium from NiCd batteries. This cadmium is then fed back into the production of new NiCd batteries. NiCd batteries are also recycled by SNAM in France, SAFT in Sweden, Accurec in Germany, and several facilities in Japan.

The quantity of NiCd batteries recycled in the U.S. increased dramatically from 1996 - 2000 years.

The quantity of NiCd batteries INMETCO has collected for recycling has increased dramatically since the early 1990s, increasing every year (see Figure 4). In 2000, INMETCO reported receiving 3,699 tons of NiCd batteries, up from only 418 tons in 1990.[16] Interview respondents note that this trend has continued beyond 2000. Figure 4 illustrates the growth in NiCd battery recycling by INMETCO.

[15]Organization for Economic Cooperation and Development, *Recycling Rate Calculation Methodologies: A Review of Techniques for the OECD Expert Group on Recycling Rate Calculation Methodology*, undated.

[16]Hugh Morrow, International Cadmium Association, *Recycling Cadmium Products*. Prepared for *Recycling Metals from Industrial Waste, Colorado School of Mines, Golden Colorado, June 23, 2004.*

Some batteries collected by handlers in the U.S. are not recycled by INMETCO and are shipped overseas for recycling. In 1993, the U.S. sent 40 tons of NiCd batteries to SNAM and 175 tons to SAFT for recycling.[17] In 2002, Kinsbursky Brothers, a battery handler based in California,

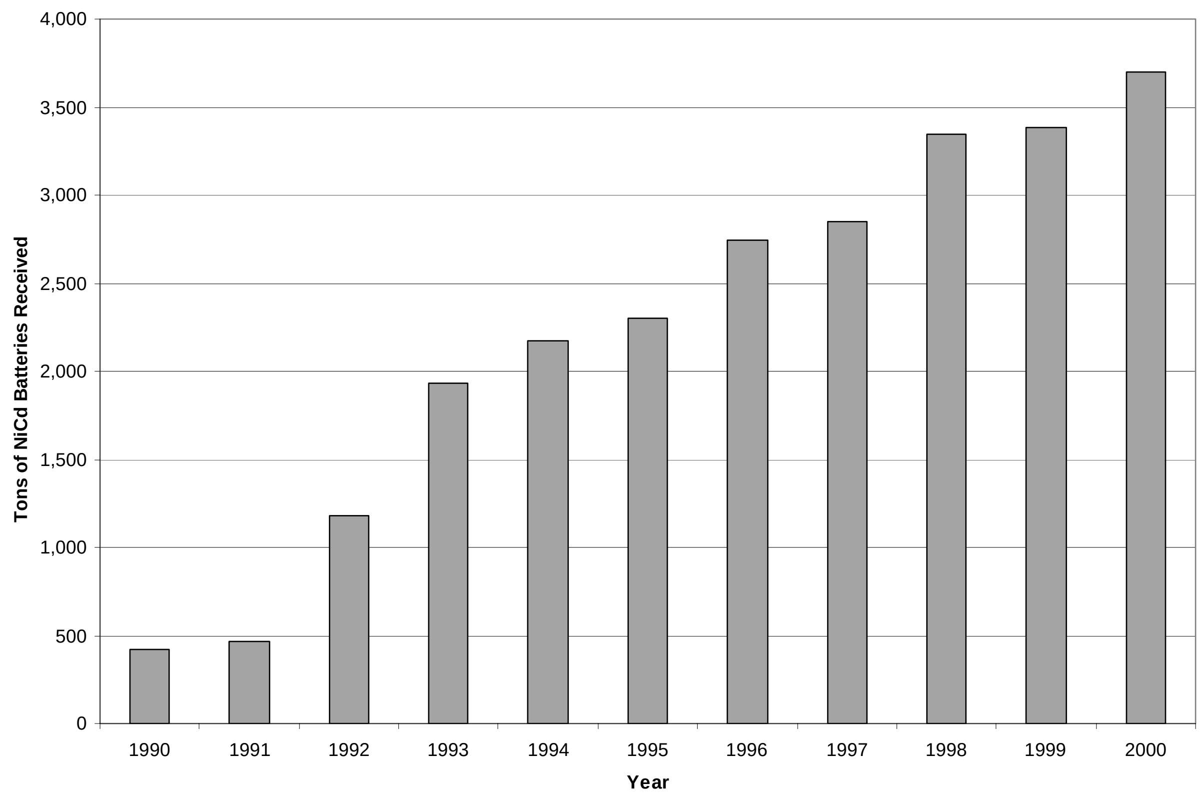


Figure 4 Volume of NiCd Batteries Recycled at INMETCO 1990-2000.
Source: *Recycling Cadmium Products*, Hugh Morrow, International Cadmium Association.

exported 159 tons of hazardous waste to France; this was likely a shipment of NiCd batteries to the SNAM facility in France.[18,19]

---

[17] *Summary of 1993 Hazardous Waste Exports Arranged by Country, Treatment/Disposal Method, Waste Type*, provided by Paul Borst, EPA.

[18] Maribelle Rodríguez, Hannah Arnold, Syd Gernstein, Katherine Craig, and Jenny Peters, ICF Consulting, *Memorandum to James Kent: 2002 Annual Export Report Data*, December 5, 2003.

[19] Personal communication with Paul Borst, EPA.

The quantities of batteries the Recycling Corporation has collected has also continued to increase (see Figure 5). The Recycling Corporation reports that there are currently over 350 licensees in their program who carry the Recycling Corporation logo on their batteries. These licensees constitute 95 percent of the portable rechargeable power industry.[20] Since the Recycling Corporation began the collection program in 1994, they have collected, transported, and recycled nearly 35 million batteries.[21] The Recycling Corporation recycled nearly 74 percent more batteries in 2003 (970 tons) than in 1997 (1,685 tons). The Recycling Corporation measures their success in

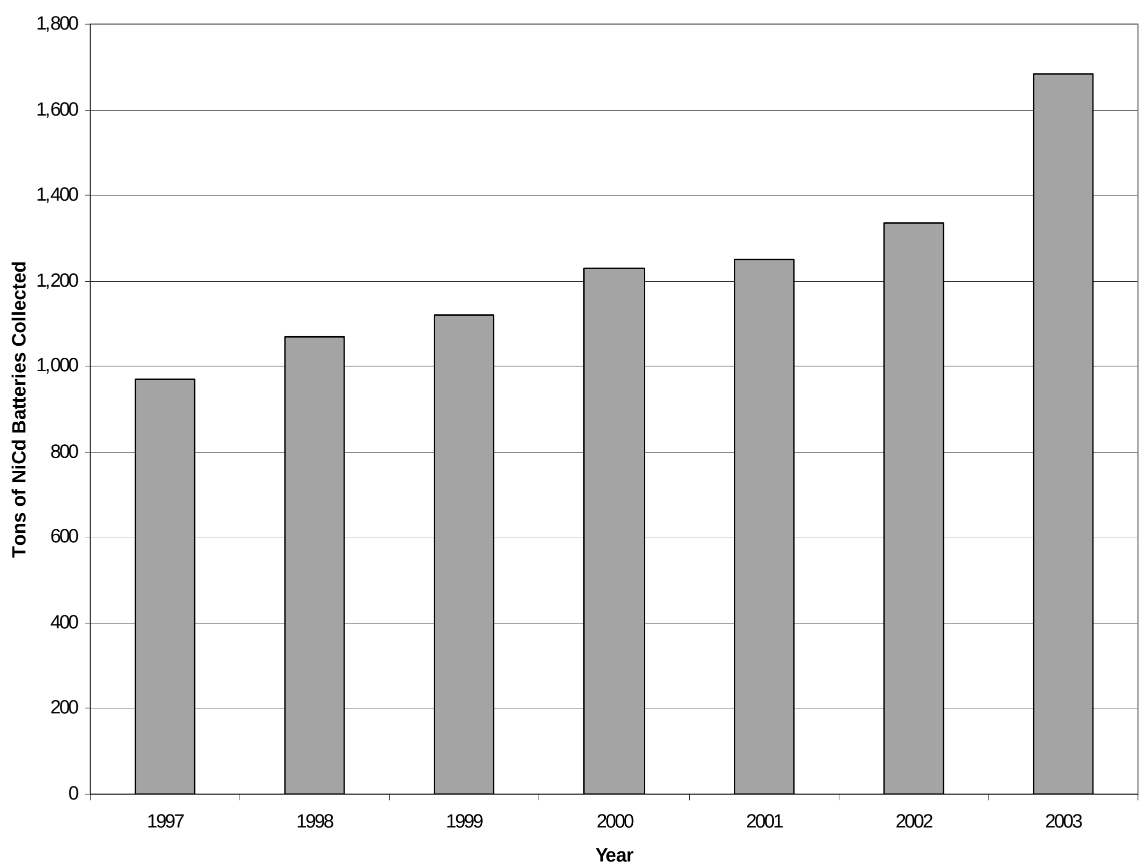


Figure 5 Volume of NiCd Batteries Collected by Recycling Corporation 1997-2003. Source: *Cell Phone Collection Recycling Program* presented, Rechargeable Battery Recycling Corporation

[20]Recycling Corporation website, *OEM/Licensee*, http://www.rbrc.com/licensee/index.html, viewed May 19, 2004.

[21]Recycling Corporation, *Year in Review*, http://www.Recycling Corporation.com/newsroom.html, viewed May 19, 2004.

the annual increase in batteries collected; each year the company aims for 15 percent growth in collection volumes. In 2003 alone, Recycling Corporation saw a 26 percent jump in the collection of NiCd batteries.[22]

4.2.2.1 Factors Impacting Waste Management

Industrial NiCds were being recycled prior to the UWR. New recycling opportunities lie predominantly within the consumer, public agency, and small business sector.

Interviewees noted that users of large vented, industrial NiCd batteries (e.g., railroads, airlines) were complying with RCRA regulations and properly managing spent batteries prior to the UWR. There are a relatively small number of these large industrial users, most of whom stay in close contact with their supplier. Suppliers frequently collect used batteries from users when they purchase a new one. One interviewee noted that the value of the nickel that could be recovered from these large industrial batteries offset the cost of managing and recycling the batteries as hazardous waste. The size of these industrial batteries also ensures that they are less easily overlooked and improperly discarded.

It is important to note that while approximately 80 percent of large industrial batteries are recycled, only approximately 20 percent of small consumer NiCd batteries are recycled.[23] These batteries are used both in factory applications (e.g., batteries used for cordless drills) and, more significantly, in the consumer sector. A 2002 Recycling Corporation survey indicated that 54 percent of consumers use four or more products powered by rechargeable batteries every day.[24] INMETCO reported recycling 1,483 tons of batteries from the *consumer sector* alone in 1997. In 1999 INMETCO recycled 32 percent more consumer batteries, a total of 1,956 tons.[25,26]

The Recycling Corporation noted that the number of community, retailer, and public agency participants continues to grow. Recent reports show that participation by businesses has increased by 11 percent and community recycling has increased 41 percent. [27] The Recycling Corporation currently has 30,000 retail partners that recycle consumer batteries. In addition, 1,500 communities

---

[22]Rechargeable Battery Recycling Corporation (Recycling Corporation), cell phone collection and recycling program presentation, undated.

[23]Jozef Plachy, U.S. Geological Survey, *Cadmium Recycling in the United States in 2000: U.S. Geological Survey Circular 1196-0,* http://pubs.usgs.gov/circ/c1196o/ viewed March 3, 2004.

[24]Recycling Corporation, *Year in Review*, 5.

[25]Morrow, *Recycling Cadmium Products*

[26]The evaluation team had access to information on consumer battery recycling for only 1997 - 1999.

[27]Recycling Corporation, *Year in Review*, 1.

have signed on to Recycling Corporation's program.[28] One industry interviewee estimated that 90 percent of consumer batteries are collected when consumers return them to a retailer for a replacement. This respondent noted that recycling rates can be increased only through improved market awareness.

State rechargeable battery regulations may have increased recycling within the state. The most significant impact of these programs, however, was the impetus for subsequent federal battery regulation and the formation of the Recycling Corporation.

A number of states adopted regulations to remove batteries from the municipal solid waste stream in advance of the UWR. One interviewee noted that the state "couldn't wait on the Feds" and passed its own legislation in 1993. Regulations differed from state to state, but a number of states, including Minnesota, New Jersey, and Florida passed regulations that restricted the disposal of NiCd batteries, even by consumers, and required manufacturers to implement unit collection systems to "take back" NiCd and other rechargeable batteries.

One industry interviewee noted that the threat of being fined for non-compliance with a state regulation had a significant impact on manufacturer behavior. With state take back regulations in place, manufacturers could not sell batteries within the state unless systems were in place to collect spent batteries. Another interviewee noted that manufacturers also had concerns about liability should NiCd batteries in the municipal solid waste stream result in damage to the environment or public health and safety. These concerns pushed manufacturers to form the PRBA and Recycling Corporation. An industry representative noted that if a state regulator found one of the manufacturer's batteries in a landfill, they would "want it to have the Recycling Corporation seal on it." This seal would demonstrate that the manufacturer had joined the national collection program and fulfilled the requirement to implement a take back program. Ultimately, these varied state programs paved the way for the 1996 Battery Act.

The UWR and the Battery Act have allowed collection programs, like the one run by the Recycling Corporation, to flourish.

A trade association representative noted that the UWR has made "all the difference in the world." Prior to the universal waste rule, NiCd batteries could not be accumulated in significant quantities and had to be disposed of quickly after they were collected. NiCd batteries had to be shipped via a hazardous waste transporter. The UWR has enabled generators and handlers to ship NiCd batteries via common carriers, such as UPS. When still defined as a hazardous waste, transportation costs were significantly higher than their current level. One source noted that prior to the UWR, the cost of shipping batteries was one dollar per pound; following the UWR, the cost has dropped to 17 cents per pound.

The UWR made the entire Recycling Corporation collection and transportation program feasible and economical. Retailers and businesses can collect batteries from consumers without

---

[28]Recycling Corporation, *Year in Review*, 1.

being permitted under RCRA, batteries can be amassed and stored for a significant length of time, and batteries can be transported easily and economically. The UWR has also enabled state programs to function. Before the UWR, manufacturers had difficulty complying with state take back laws because batteries were difficult to collect and costly to manage, transport, and recycle.

Since the Battery Act implemented the UWR nationwide, batteries could also be transported unobstructed across the nation without requiring that the materials be manifested and managed as hazardous waste. One state contact noted that before the Battery Act implemented the UWR in Pennsylvania, the home of INMETCO, there was a substantial bottleneck of collected batteries.

4.2.3 Benefits of the Universal Waste Rule

Increased recycling of NiCd batteries reduces the quantity of these materials in the municipal solid waste stream.

The UWR has facilitated the collection of thousands of tons of NiCd batteries which might have otherwise been disposed of in the municipal solid waste stream. If not properly disposed, cadmium from NiCd batteries can leach into ground and surface waters. Cadmium can also be released through air emissions from incineration. The U.S. EPA classifies cadmium as a persistent and bioaccumulative toxic pollutant and it can cause lung and kidney damage. Humans can absorb cadmium from inhalation or by ingesting animal products that contain cadmium. Expensive pollution control devices are required to prevent these releases of cadmium from the municipal solid waste stream.

From 1990 - 2000, INMETCO recycled nearly 25,500 tons of NiCd batteries. Given that Cadmium is generally 11 to 15 percent of the weight of a NiCd battery,[29] as much as 2,805 tons of cadmium may have been diverted from the municipal solid waste stream as a result of NiCd battery recycling over the ten year period.[30] Even small levels of cadmium can be harmful to human health. EPA defines "safe" long-term exposure to cadmium in drinking water for a 10 kg child consuming one liter of water per day as only 0.005 mg/L.[31]

---

[29]Fishbein.

[30]Calculated by multiplying the reported quantity of batteries recycled by INMETCO in 2000, 3,699 tons, by the high end estimate of the cadmium contained in NiCd batteries, 11 percent.

[31]U.S. EPA Office of Ground Water and Drinking Water, *Technical Factsheet on: Cadmium*, http://www.epa.gov/OGWDW/dwh/t-ioc/cadmium.html. Viewed August 22, 2004.

Recycling NiCd batteries recovers materials that can be reinserted into the production process.

Both nickel and cadmium are recovered from the recycling of NiCd batteries. Nickel is in high demand and can be used in stainless steel production. Cadmium is also recovered and can be reused in surface plating, battery production, and in fertilizers. Approximately 50 percent of the recovered cadmium is used to produce new batteries.

4.3 Conclusion

4.3.1 Summary of Key Findings

NiCd battery recycling has increased significantly since the early 1990s, particularly in the consumer sector. This increase is the result of a series of events and initiatives. The UWR and the Battery Act eased the collection, transportation, and disposal of NiCd batteries. With these regulations in place, the battery industry was able to develop successful programs to foster recycling of NiCd batteries. However, the initial drivers for the federal NiCd battery regulations and the industry actions were state-specific regulations requiring battery manufacturers and consumers to properly dispose NiCd batteries.

The industry-based PRBA and the Recycling Corporation have played crucial roles in the collection and recycling of batteries. One recycler noted that the Recycling Corporation "has had a drastic impact" on the ability to recycle. This participant noted that the Recycling Corporation has launched a national marketing campaign that government agencies or recyclers could not afford. Recycling Corporation's licensee system has also enabled the group to finance much more wide-spread collection than would have occurred through communities and state agencies alone. Still, the need exists to increase consumer awareness and EPA can play a role in that.

4.3.2 Points for Further Research and Recommendations for EPA

4.3.2.1 Increase Outreach

EPA should take a more active role in increasing awareness of the rule and its benefits among consumers and other stakeholders. Interviewees noted that enhancing consumer understanding of the program is instrumental to increasing recycling rates.

4.3.2.2 Ensure Availability of Quantitative Data to Assess Recycling Rates

For the purposes of this analysis, the evaluation team relied heavily upon the NiCd battery collection and recycling statistics voluntarily collected by the industry trade association, the Recycling Corporation. This data is essential in understanding changes in NiCd battery recycling and the impact of federal regulations intended to encourage recycling. The data also allows the Recycling Corporation to demonstrate the industry and the Recycling Corporation licensees' efforts.

Similar detailed information on recycling levels for other universal or hazardous wastes would assist EPA in understanding the impact of existing regulations or in identifying opportunities for future efforts. When developing future regulations intended to encourage recycling under

RCRA, EPA could consider encouraging or requiring industry groups to track information on recycling levels. While these requirements would create an additional administrative burden, the experience of the Recycling Corporation has shown that detailed information on recycling levels can be valuable to industry groups in demonstrating the success of the industry's voluntary initiatives.

4.3.2.2 Gather Data on NiCd Battery Disposal

Despite the detailed information on NiCd battery recycling levels, IEc was not able to definitively determine the percentage of NiCd batteries being recycled or disposed. While recycling is closely tracked, disposal levels are not known. This information is necessary to assess true recycling rates and identify the level of NiCd batteries entering the nation's solid waste stream. As well as providing a fuller understanding of the impacts of the UWR, disposal quantities have important implications in assessing the potential impact on human health.

As was discussed earlier in the report, one method that can be used to assess disposal quantities and the level of cadmium in the waste stream is to sample municipal solid waste. EPA could consider whether this type of sampling would be worthwhile in understanding the full impacts of the UWR and the Battery Management Act.

5. EXCLUSION FOR OIL-BEARING SECONDARY MATERIALS FROM PETROLEUM REFINING

5.1 Background and Introduction

The petroleum industry poses unique issues for resource conservation and recycling. The industry converts crude oil into a range of fuel products, in addition to lubricants and other feedstocks for petrochemical production. The refining process is highly diverse because crude oil from different origins requires highly customized treatments and because of the need to produce specially formulated fuels for different markets. EPA's definition of solid waste (40 CFR 261.2) excludes secondary materials which are recycled as part of an ongoing manufacturing process, unless they are used to produce fuels. Consequently, EPA has found it necessary to develop a separate set of exemptions and exclusions for the refining industry, culminating in the 1998 exclusion for hazardous secondary materials. The 1998 exclusion is intended to facilitate in-process recycling of hazardous secondary materials from petroleum refining, also known as "oil-bearing secondary materials."[32]

Rule 40 CFR 261.4(a)(12), promulgated on August 6, 1998, excludes from the definition of solid waste all oil-bearing secondary materials generated in petroleum refining when inserted in a normal refinery process as feedstock, so long as these materials are not placed on the land or speculatively accumulated. When these materials are excluded from the definition of solid waste they are not subject to regulation under RCRA, including hazardous waste management requirements under subtitle C of that statute. In contrast, EPA retains RCRA jurisdiction over materials that are "exempt", and may still impose certain requirements on their management. Throughout this report, "excluded" is used as short-hand for the phrase "excluded from the definition of solid waste."

As a result of this exclusion, refineries with suitable process units, including petroleum cokers or thermal desorbers, can recycle oil-bearing secondary materials into these units ("in-process recycling") without managing the materials as hazardous wastes in the interim. The 1998 OBSM exclusion also applies to oil-bearing secondary materials that are shipped between refineries for in-process recycling. With the regulatory barrier to off-site refineries removed, facilities without cokers, thermal desorbers, or other suitable process units can send their secondary materials to another refinery instead of sending them off-site for treatment, disposal, or out-of-process recycling.[33]

---

[32] The industry refers to these materials as in-process materials, while EPA refers to them as oil-bearing residuals or oil-bearing secondary hazardous materials.

[33] The final rule also contained two other minor provisions to increase recycling. First, it extended the recovered oil exclusion to petrochemical facilities co-located with a petroleum refinery and excluded spent caustic solutions from petroleum refining when used as feedstock to produce certain petrochemical products. This evaluation does not assess the impact of these two minor exclusions.

In finalizing the 1998 exclusion, EPA had several goals. First, the rulemaking was an effort to increase beneficial reuse and recovery of oil-bearing materials in petroleum refineries by reducing the regulatory burden associated with reinsertion of these materials into the refining process.[34] EPA also aimed to facilitate refinery-to-refinery transfer of oil-bearing secondary materials in order to provide more opportunities for beneficial reuse and recovery, and to reduce the volumes of waste incinerated or sent to landfill. This evaluation seeks to determine whether the 1998 exclusion has advanced EPA's objectives towards resource conservation and recycling goals, and to identify those factors that have been important in changing the refining industry's practices.

This chapter of the report has five parts:

- Discussion of case history and rulemaking background leading up to the 1998 exclusion;
- Overview of the petroleum refining industry, including waste generation and management practices;
- Presentation of findings:
  - Industry-wide awareness and understanding of the 1998 exclusion
  - Impact of the exclusion on waste management practices
  - Factors that are important in refineries' decisions about waste management
  - Other impacts of the exclusion
  - Opportunities to increase recycling in this sector
- Conclusion and Recommendations for EPA

5.2 Case History and Rulemaking Background

The 1998 final rule followed a series of regulatory actions that were, in part, prompted by several District of Columbia Circuit Court decisions (see Table 6). EPA first proposed the exclusion for oil-bearing secondary materials in 1988 and finalized it in 1994. That final exclusion allowed recovered oil from any process in the petroleum industry (including exploration and production) to be inserted into the earliest stages of the refining process. Oil-bearing secondary materials were not included in this exclusion. In the 1994 recovered oil rule, EPA did not exclude recovered oil inserted into the coker because of concerns about hazardous constituents that might accumulate in the coke product, creating additional risks during later combustion.

In 1995, EPA proposed a broader exclusion for the petroleum industry. The 1995 proposal would have excluded oil-bearing secondary materials generated during any phase of petroleum production when inserted into any stage of the refining process. EPA's rationale for this broader exclusion was in part to avoid "unproductive disputes" about what materials qualified as recovered oil and to allow refineries greater flexibility in where to insert oil-bearing materials. EPA expected that materials that could not clearly be classified as recovered oil would most likely be recycled into

[34] In the final rule, EPA acknowledges that OBSMs were already being recycled back into refinery units, albeit as exempt (rather than excluded) wastes, noting that it expects this exclusion to have "*little net effect on the materials or units involved*."(see *63 FR 42118*).

the coker. EPA's earlier concerns regarding insertion into the coker were addressed after a careful evaluation of the process and a review of public comments.

5.2.1 Waste Generation and Management in the Petroleum Refining Industry

During the oil refining, more oil is separated into a series of desired products. First, the oil is desalted and distilled into its components, or fractions. The subsequent "downstream" processes further convert the crude components using cracking, reforming, alkylation and coking. Coking is a thermal cracking process used to convert low-value residual fuel oils into lighter-end feedstock for other refinery processes that make transportation fuels. Petroleum coke is a byproduct of this process and is basically solid carbon with varying amounts of impurities, including sulfur solids and metals. In general, the lightest fractions of crude are most valuable, and most downstream processes at a refinery are designed to convert the heavy, bottom fractions into lighter fuels.

Throughout the refining process, tanks are used to store crude oil and intermediate process feeds for cooling and further processing. These tanks, as well as those that store finished petroleum products, must be cleaned intermittently to remove the sludges and liquid tank bottom wastes that have accumulated.[35] Wastes are also generated during maintenance of process units and the network of pipes connecting these units. Many refining processes make use of catalysts that contain hazardous metals– these spent process catalysts must be replaced at regular intervals. EPA has listed eleven hazardous wastes from petroleum refining: K048- K052, K169-K172, and F037-F038. Petroleum refinery wastes might also be regulated as hazardous based on their characteristics. Ignitability (D001) and benzene toxicity (D018) are the most common hazardous characteristics among wastes from petroleum refineries.

Non-hazardous wastes, which may constitute 90 percent of the total waste generated at refineries, are generally disposed of in off-site or on-site landfills. Hazardous wastes are managed in a number of ways: incineration, recycling, treatment (e.g., chemical fixation, neutralization), land treatment or disposal in a Subtitle C onsite or offsite landfill. Waste can also be sent off-site for recycling or can be recycled on-site. On-site recycling may be either "in-process", meaning that it occurs within the refining process, or "non-process" if it utilizes alternative reclamation and recovery methods that do not fall within the scope of normal refinery operations (e.g., fuel blending.)

In-process recycling aims to recover any hydrocarbon value remaining in residual materials that would otherwise be disposed of. As noted in the final rule, the hydrocarbon content of these materials is typically around ten percent.[36] By reducing the regulatory requirements accompanying

[35]Refineries tend to operate at full capacity almost continuously, making any shutdown very expensive. As a result, any tank cleaning, sludge removal or other maintenance-related waste generation is likely to occur in bursts. Because refineries generate these wastes sporadically, careful planning is necessary if the materials are to be stored to provide feedstock for other production processes that operate regularly without exceeding the 90-day storage threshold that would trigger RCRA permitting.

[36]See 63 FR 42123.

in-process recycling, EPA hoped to increase the recovery of this hydrocarbon and to reduce volumes of hazardous waste produced by refineries.

<u>5.2.2 Description of In-Process Recycling</u>

The most common process unit to receive oil-bearing secondary materials is the petroleum coker. While OBSMs can sometimes be inserted with the coking feedstock, they are most commonly inserted in the quench cycle of the coker because of their low oil content.[37] After the coker feedstock has been converted into light ends and coke, quench water is required to cool the coker to allow for safe handling. In a process developed by Mobil Oil Company known as MOSC (Mobil Oil Sludge Coking), reprocessed oil-bearing sludges are inserted with the quench water. Because the coke drum is still extremely hot when the quench is injected, any light-end hydrocarbons in the sludge will be volatilized and recaptured, while the solids are deposited in the coke product. Before insertion with the quench water, these sludges are processed to remove as much of the oil as possible. This recovered oil is then inserted into the crude distillation unit or the catalytic cracker, while the remaining sludge, which contains mostly water, solids, and some amount of hydrocarbon, is inserted with the quench.

The units and processes that receive secondary materials vary depending on the characteristics of the material. Recovered oil is usually returned to the crude distillation unit or catalytic cracker. Secondary materials with less oil may be inserted with the coker feedstock or into a thermal desorber. The particle size of solids in the secondary materials also constrains which materials are appropriate coker feedstock. Very-low oil content materials can be inserted into the quench cycle of the coker. In fact, inserting high-oil content materials with the quench can cause malfunction of the coking unit.[38]

Some refineries hire contractors to oversee the storage and processing of sludges prior to insertion into the coker, thermal desorber or other process units. Such secondary materials must be carefully processed before insertion into units to prevent settling, solidifying and formation of large solid particles. One contractor estimated that around half of refineries with cokers hire contractors to assist with managing feedstock. These contractors are referred to as in-process recycling contractors ("IPR Contractors") throughout this report.

5.2.3 Recovered Oil from Co-located Petrochemical Facilities

[37] According to industry information provided to EPA prior to the final rule in August 1998. See 63 FR 42114.

[38] Additional discussion of the coking and quenching processes can be found in Attachments B and C of comments submitted by the American Petroleum Institute in a letter to William F. Brandes, September 3, 1997.

In the 1995 proposed rule, EPA also proposed to add an exclusion for recovered oil generated by petrochemical facilities that is inserted into the refining process at a refinery that is co-located or commonly-owned. In a clarification to the 1994 recovered oil rule, EPA stated that oil from petrochemical facilities was also excluded when reinserted into a petroleum refinery, but only in situations where the oil was recovered from wastewater treatment systems shared by a refinery and petrochemical facility, which applied to only a small fraction of facilities. In the 1998 final rule, EPA did promulgate a "petrochemical recovered oil" exclusion, which while narrower than what had been proposed, did allow for petrochemical oil from systems other than wastewater treatment to be excluded when returned to a refinery.

Rulemaking	**Recovered Oil from Petrochemical Industry**	**Recovered Oil**	**Oil-Bearing Secondary Materials**
1988 proposed[1]		Excluded when generated and recycled within the refining process	
1994 final[2]	Excluded when generated from a wastewater treatment system shared with a refinery and recycled into any refining process prior to distillation and catalytic cracking	Excluded when generated anywhere in the petroleum industry, and when recycled into any refining process prior to distillation and catalytic cracking (recovered oil inserted into the coker is not excluded)	Not excluded
1995 proposed[3]	Excluded when inserted into the process at a refinery that is co-located or co-owned.	Excluded when inserted into any part of the refining process (including the coker)	
1998 final[4]	Excluded from the definition of hazardous waste when inserted into the process at a refinery that is co-located, so long as the recovered oils are hazardous only because they exhibit the characteristics of ignitability or benzene toxicity.	Excluded when generated anywhere in the petroleum industry, and when recycled into any refining process.	Excluded when generated and recycled within the refining process

Table 7 Main Elements of Proposed and Final Exclusions for Recovered Oil and Oil-Bearing Secondary Materials in the Petroleum Industry from 1988 through 1998

Sources:

[1] 53 FR 519, January 8, 1988

[2] 59 FR 38542, July 28, 1994

[3] 60 FR 57747, November 20, 1995

[4] 63 FR 42110, August 6, 1998

5.3 Overview of the Refining Industry

EPA's Biennial Report for 2001 contains generator records for approximately 180 refineries that are concentrated on the Gulf Coast, in California and in the Midwest (see Tables 8 and 9).

EPA Region	Number of Facilities
6	58
5	28
9	26
8	17
3	13
4	12
2	10
10	8
7	6
1	1

Table 8 Distribution of OSBM - affected facilities among EPA Regions.
Source: Facilities reporting under NAICS 32411 to the 2001 Biennial Report. Site ID Form, Item 6.

State	Number of Facilities
Texas	30
California	24
Louisiana	18
Pennsylvania	10
Illinois,	10
New Jersey	7
Ohio	7
Indiana	6
Kansas	6

Table 9 Distribution of OSBM-affected facilities among states (only list of top 7 states) For a complete listing of all 50 states, see Appendix C.
Source: Facilities reporting under NAICS 32411 to the 2001 Biennial Report. Site ID Form, Item 6.

Refinery capacity in the United States increased throughout the 1990s, mostly through investments that increased throughput and created additional refining capacity at existing facilities. A recent study conducted by the RAND Institute reports that average refinery utilization increased from 78 percent in 1985 to over 92 percent in 2000.[39] Simultaneously, the industry has also undergone considerable consolidation, including notable mergers (e.g., Exxon and Mobil, Conoco and Phillips Petroleum). In addition to acquisitions of individual refineries by both major and independent oil companies the number of firms in the United States engaged in refining decreased from 189 in 1981 to 58 in 2002.

5.4 Findings

The findings are presented in four categories: regulated community awareness of the exclusion, impact of the exclusion on recycling practices, factors that influence decisions about recycling, other impacts of the exclusion, and opportunities for increased recycling. Table 10 summarizes these findings.

Evaluation Category	**Finding**
Regulated community awareness of the exclusion	• Refineries are almost universally aware of the exclusion, though some interviewees suggested that some confusion remains about the scope and applicability of the exclusion
Impact of the exclusion on waste management practices	• The exclusion has had little effect at refineries that were already recycling secondary materials in-process, but has fostered increased in-process recycling involving transfer of secondary materials between refineries
Factors that influence decisions about recycling	• Cost is the primary factor determining whether a refinery uses in-process recycling to manage secondary materials. • Cost considerations range from the per unit and transportation costs for different options to concerns about damage to expensive capital equipment. • Confidence and understanding of when and how the exclusion applies to in-process recycling was another important factor in refineries' decisions. • Availability of management time to facilitate the use of in-process recycling was also cited as a barrier.
Other impacts of the exclusion	• By making available a lower-cost management option for these secondary materials, the exclusion has driven down costs for all waste management options. • The exclusion may be making compliance and enforcement more complicated.

Table 10 Summary of Findings for the Oil-Bearing Secondary Materials Case Study

[39] Peterson, D.J. and Sergej Mahnovski. *New Forces at Work in Refining: Industry Views of Critical Business and Operations Trends.* RAND Institute, MR-1707-NETL. 2003. http://www.rand.org/publications/MR/MR1707/index.html.

5.4.1 Regulated community awareness of the exclusion

Refineries are almost universally aware of the exclusion.

After ten years of preliminary rulemakings and court battles, the refining industry was well prepared for the 1998 exclusion. The American Petroleum Institute (API), the industry's primary trade association, had made a concerted effort to obtain this exclusion, and many API member companies were actively involved in providing process information to support the rulemaking. Several interviewees reported that they would be shocked if any refinery did not know about this exclusion, and noted that most API members knew about the exclusion well before it was finalized in 1998. Another refinery representative noted that all refinery managers were aware of the exclusion, but that some were just too busy to take advantage of it.

Refineries learn about hazardous waste regulations affecting their operations through a variety of sources, including trade associations and waste management service providers, and to a lesser extent, EPA.

Most refineries reported a proactive approach to learning about hazardous waste regulations relevant to their facilities. API also plays a critical role in informing members about proposed and final rulemakings relating to hazardous waste management. Representatives from almost a dozen API member companies sit on a Waste and Remediation Task Force that leads API's efforts to review and submit comments on rulemakings.

Some IPR contractors have played an important role in informing refineries about the exclusion and explaining its application. In order to persuade refineries to purchase their services, IPR Contractors often find themselves reassuring refinery operators that their secondary materials can fall under the exclusion. One major IPR contractor, Tetra, reports that up until the middle of 2003, calls placed to refineries to discuss its services would often be met with questions about the legality of transferring materials between refineries for in-process recycling. These refineries were aware of the exclusion, but were hesitant to take advantage of it, citing ambiguity in the regulation. The Tetra representative wrote a letter to EPA seeking clarification on the exclusion, and then sent copies of EPA's reply to every refinery in the country. According to the Tetra representative, EPA's response to this letter has been instrumental in clarifying the scope of the exclusion, and its distribution has increased the overall level of understanding of the regulations.[40]

Refineries reported that EPA consulted them during the regulatory development process about waste management and the nature of waste streams. This consultation obviously facilitated refineries' awareness of the exclusion. However, the industry representatives did not indicate that EPA or the states played an active role in informing them about the exclusion after it was

[40]Letter from Robert Springer, Regulatory Status of Oil-Bearing Secondary Materials Under RCRA. August 19, 2003. Available through RCRA Online at: http://yosemite.epa.gov/osw%5Crcra.nsf/Documents/599BB6014270A56F85256DB00071837F.

promulgated, or encouraged them to change their waste management practices to take advantage of the exclusion's flexibility.

5.4.2 Impact of Exclusion on Recycling Practices

Prior to the exclusion, many refineries were already inserting OBSMs into the coker and other process units. However, there remained a good deal of uncertainty about how these materials ought to be managed under RCRA.

All of the interviewees reported that recycling secondary materials to the coker and other process units was a common practice prior to the 1998 exclusion. Cokers were already viewed as manufacturing process units, so refineries could recycle materials to the coker in either the feedstock or the quench cycle without obtaining a RCRA permit for the coker. However, any treatment, storage or transport of these secondary materials prior to reinsertion had to be compliant with subtitle C requirements. In one case, a refinery was even accepting these materials from other refineries for insertion in a thermal desorber under a special permit issued by the Louisiana Department of Environmental Quality. EPA's intention with the 1998 exclusion was to clarify the Agency's jurisdiction regarding these materials, consistent with the relevant legal decisions at the time, and to encourage further recycling.

According to our interviewees however, a number of refineries were treating OBSMs as if they were excluded prior to the adoption of the exclusion in their respective states. Our interviews revealed that some refineries had not been handling these secondary materials as hazardous waste (e.g., they had not been obtaining RCRA permits for storage tanks and/or they had not been testing and reporting the materials to BRS.) It has long been the industry's contention that these materials are in-process and therefore not subject to RCRA jurisdiction.

Some refineries may be reluctant to recycle wastes to the coker or other process units because of uncertainty about the regulatory status of this practice.

One interviewee stated that prior to the rule, some refineries were hesitant about recycling to the coker or other points in the refining process because of concerns about the legality of recycling within the refining process. According to the interviewee, two states had initiated enforcement actions against companies regarding storage violations of materials which the refineries asserted were in-process, but which the state asserted were hazardous wastes. These sorts of conflicts about the jurisdictional status of oil-bearing secondary materials prior to the 1998 rule increased refineries' perceptions of legal uncertainty surrounding management of these materials that may have made refineries reluctant to recycle within the refining process.

The Tetra representative noted that some refineries are still wary about compliance under the exclusion, and that his company has a standard practice of contacting state and EPA Regional regulators to notify them when a refinery will be changing its waste management practices in response to the exclusion. One refinery representative confirmed that even after the exclusion, he continues to get mixed messages about the exclusion from enforcement and policy branches of state regulatory agencies, and across state agencies.

While there is some disagreement among our interviewees, it appears the exclusion has not increased in-process recycling within a given refinery. While it has reduced regulatory compliance costs associated with this practice, the cost implications of the affected regulations are only a small portion of refinery costs and may not motivate a change in a refinery's practices.

One refinery representative reported that the exclusion resulted in important cost savings, but that it did not change recycling practices within their refineries. This interviewee reported that his company had a long-held policy of recovering the maximum hydrocarbon value from feedstock and they were already re-using material to the extent practical. One interviewee from the waste treatment industry also noted that most refineries recycled the same amount of secondary materials after the exclusion took effect, as before it. However, this interviewee suggested that some materials that had previously been recycled at RCRA-permitted facilities were now being recycled in process under the 1998 OBSM exclusion.

The Tetra representative disagreed. His experience suggested that some refineries that may have been hesitant about recycling before the exclusion were now more likely to recycle. In a 2003 survey of refineries, Tetra found that at least 60 percent of refineries with cokers were inserting OBSMs. The interviewee reported that five years ago only 30 percent were doing so, but this percentage was anecdotal and not based on a parallel survey of refineries. Representatives from one oil company noted that more of their refineries are inserting OBSMs into the quench cycle of the coker since 2000. However, this increase is not a result of the exclusion, but rather of the transfer and diffusion of technical expertise about the quench cycle recycling process following a merger of two oil companies.

The 1998 exclusion has encouraged some refinery-to-refinery transfers of these secondary materials.

Only about a third of the refineries in the country have cokers, depending on the kind of crude oil they process.[41] As a result of the 1998 exclusion, refineries without cokers or other suitable downstream processing units (e.g., a thermal desorber) now have the option of paying another refinery to recycle their OBSMs in addition to conventional management options. Some of these refinery-to-refinery transfers are mediated by contractors (IPR contractors) who operate on-site at a host refinery and charge fees to refineries sending OBSMs for processing.

[41] 54 out of 157 refineries had coking units in 1996. Energy Information Administration. Petroleum Supply Annual– 1996. Volume 1, June 1997

Secondary materials are being transferred to at least two refineries in the Gulf Coast region for recycling under the exclusion.

One Texas refinery recycles both materials generated at its own refinery and materials shipped from other refineries, into its coker. Tetra, an IPR contractor, has been assisting the Texas refinery with managing and processing the materials for insertion into the coker. Another IPR Contractor, Phillips Services Corporation (PSC), assists with the processing of secondary materials using the thermal desorber at a refinery in Louisiana.[42] One interviewee with extensive experience in the Gulf Coast Region reports that the majority of the OBSMs being transferred as a result of the exclusion is going to Tetra. This interviewee also suggested that small volumes of OBSMs were also being transferred within other regional markets, though his knowledge of these regions was less direct.

The representative from Tetra described how Tetra's partnership with a Texas refinery makes use of extra capacity in the coking system. The amount of transferred material that is accepted depends on the coker capacity; in the words of the Tetra representative, "the host refinery comes first." For example, if the host refinery is cleaning out its own tanks one month, then no excess capacity may exist. Tetra's cooperative partners, who are mostly in the Gulf Coast area and Oklahoma, are sensitive to this fluctuating capacity. Tetra began operations at the Texas refinery in 2000, but did not begin accepting trucks until two years later. Nine other refineries transfer feedstock material (secondary materials) to the Texas refinery, and Tetra is currently in negotiations with several additional refineries.

We cannot describe a specific volume of oil re-used due to the exclusion.

The Tetra representative reported that the company profiles materials before they leave the sending refineries– conducting an analysis comparable to what a transfer, storage and disposal facility (TSDF) might use to characterize incoming materials.[43] When Tetra receives these secondary materials, the recovered oil is inserted into the catalytic cracker or crude unit, and solids are inserted into the quench cycle of the coker. According to data presented at a petroleum industry workshop in 2002, Tetra has processed 230,000 barrels of secondary materials from both the host refinery and cooperative partners (Phelan, 2002). From this feedstock, 90,000 barrels of oil were recovered, and another 60,000 barrels of oil-bearing slurry was inserted into the coker. Due to the lack of data on the quantity of these secondary materials that were transferred from other refineries, it is not possible to ascribe a specific volume of oil recovered or waste avoided to the exclusion.

PSC receives and processes material from other refineries for insertion into the refinery's thermal desorber. According to information presented at the petroleum refining workshop

[42]We were unable to speak with a representative from PSC, but several other interviews provided a general description of PSC's operations.

[43]Another representative of the waste treatment industry pointed out that service providers like Tetra are not required to analyze incoming materials. Because of this, these providers can often offer lower prices per unit of secondary materials than can a RCRA-permitted treatment and disposal facility.

mentioned above, approximately one-third of the capacity of the thermal desorber is used to receive OBSMs from other petroleum refineries (Phelan, 2002). Using the thermal desorber, sludge is separated into recoverable oil, water and residual solids that meet LDR treatment standards. This waste minimization effort recovers 1000 tons of oil from 3800 tons of sludge each year. Interestingly, this exchange was occurring prior to the exclusion because the operation was effectively granted a jurisdictional exclusion by the Louisiana Department of Environmental Quality (Louisiana DEQ). One interviewee suggested that the federal exclusion increased the perceived legitimacy of this recycling, and that may have encouraged a few additional refineries to send their secondary materials to the Louisiana refinery for recycling.

Refinery-to-refinery transfers are expected to increase as more refinery managers become more confident in the exclusion.

All of the industry interviewees predicted that refinery-to-refinery transfers would increase in the future. Tetra is currently negotiating arrangements with other facilities, mostly in the Gulf Region, to accept secondary materials from other refineries.[44] In general, refineries' increasing confidence in the exclusion's applicability to refinery-to-refinery transfers may lead to additional transfers in the future.

Some state regulations limit refinery-to-refinery transfers, which may be restricting refineries' utilization of the exclusion.

California's regulations only allow transfers of OBSMs among refineries with common ownership, an important distinction from the federal rule that allows transfers among any refineries.[45] Prior to the 1998 exclusion, California had a statute that allowed transfers between co-owned refineries and has chosen to not expand the state regulations to make them equivalent to the federal rule. Accordingly, California refineries can only transfer secondary materials to be recycled in-state at a refinery owned by the same company, but can transfer these materials to any refinery out-of-state.

5.4.3 Factors That Influence Decisions about Recycling

Industry representatives discussed several factors that influence their decisions about whether to recycle in-process, either in an on-site or off-site coker. The main determinant is the cost of various waste management options available to refineries. For refineries with cokers on-site, the amount of recycling is also partly determined by the capacity and sensitivity of the coker, and concerns about maintaining compliance with other regulations, especially those related to air quality. For refineries without suitable recycling units on-site, the most important factors when considering whether to send secondary materials off-site to be recycled in-process are: a lack of management

[44] However, some of these other refineries may not have sufficient excess capacity to accept a profitable volume of OBSMs from other refineries.

[45] California Health and Safety Code, Section 25143.2(c)(2)(d)(2)(c)(ii).

attention or confidence in the exclusion, the desire to maintain operating costs as confidential, and differences in transportation costs.

According to a survey by one IPR contractor, 60 percent of refineries with cokers on-site use these cokers to recycle OBSMs, either in the feedstock or quench cycle. The key factors driving this decision are discussed below.

5.4.3.1 Factors determining on-site recycling at refineries with cokers

Capacity of the coker: The volume of OBSMs that a facility recycled to the coker depends on the availability of other coker feedstock and the overall capacity of the coker. Many of the secondary materials that might be suitable for insertion into the coker are generated sporadically in large quantities when tanks are cleaned out. For example, refineries clean out sludge from crude oil storage tanks (K169) on average every 10.5 years.[46] This might create a volume of secondary materials that exceeds the coker's capacity at that time. These excess secondary materials would then have to be transferred to another refinery or disposed.

Depending on the coker's operation and specifications, certain OBSMs may not be suitable for insertion. OBSMs might have too much or too little oil, or concentrations of metals that would result in off-specification coke. However, the interviewees could not provide specific information about what might disqualify a residual for recycling to the coker. These specific answers vary across refinery and across coking batches. For example, if the input coker feedstock was low in metals, then the secondary materials inserted with the quench could have higher concentrations of metals than might normally be acceptable.

Management attitudes: Several industry interviewees noted that a refinery's management might be resistant to the idea of inserting secondary materials into the coker or other process units. Resistance may stem from the additional complications associated with preparing materials for insertion into the coker or the extra monitoring and oversight necessary to ensure that the residuals do not cause malfunction of the coker or an off-specification coke product. Even if a refinery has excess capacity in its coker and could recycle secondary materials from other refineries, the management may decide that the small amount of money to be made from such a transaction is not worth the hassle and risks of damaging expensive processing equipment. In the words of one refinery operator, "it's just not their business" to accept secondary materials from other refineries, and that "they haven't even figured out the benefits of recycling their own secondary materials, much less those of other refineries." Another interviewee suggested that the refining industry is particularly slow to change waste management practices.

Potential for creating more hazardous waste: Companies with thermal desorbers are not as likely to want to receive feedstock from other refineries because the thermal desorber creates more inert

[46] 1992 RCRA 3007 Survey, as cited in DPRA. 1998. *Cost Impact Analysis of the Coking Exemption on Crude Oil Tank Sludge and Clarified Slurry Oil Sludge Compliance Costs from Listing as a RCRA Hazardous Waste.*

solid hazardous wastes that they must handle afterwards. Cokers, in contrast, produce no such residual because these solids are incorporated into the coke product with no discernable impact on coke quality.

Compliance with air permits: Air quality regulations are by far the most costly areas of environmental compliance for refineries. In a 2003 RAND Institute study of the market and regulatory outlooks of refinery operators, representatives repeatedly voiced concern about upcoming air and water regulations. While RCRA issues may have been important to some operators, they were evidently not among the most pressing regulatory issues.[47] According to one interviewee, a refinery may therefore choose to not undertake new waste management practices if these efforts would complicate the facility's air permits. In addition, changing regulations and standards for fuel characteristics already require frequent process adjustments that may take precedence over developing or implementing new waste management strategies. On the other hand, one interviewee noted that refineries may be willing to devote management time to coordinating beyond-compliance waste management practices if it would improve their relationships with EPA and permitting staff

Availability of other low-cost waste management options: Refineries have a number of other economical waste management options available in addition to in-process recycling. Interviewees could not provide specific cost information, in part because these costs fluctuate depending on the exact contract signed between a refinery and waste management company. However, disposal fees at hazardous waste landfills have declined considerably over the past ten years. One interviewee reported that these fees are now as low as they have ever been. This interviewee reported that space in hazardous waste landfills has become so inexpensive that it costs little more to use than non-hazardous waste landfills. Besides landfills, a refinery may also find non-process recycling options, such as transfer to cement kiln, to be less expensive.[48] A refinery is less likely to assume the administrative and logistical hassles of managing materials for insertion into the coker as costs for off-site management decrease.

Toxic Release Inventory and BRS Reporting Benefits: Materials that are recycled under the exclusion are considered in-process materials and not hazardous wastes, and therefore do not have to be reported to BRS or the Toxic Release Inventory (TRI). This applies to both refineries that recycle on-site and those that are transferring OBSMs to another refinery for excluded recycling. The refinery representatives cited the ability to reduce volumes reported to TRI and BRS as a small incentive to recycle. The benefits of reducing these volumes and improving their public reputation were said to be generally insignificant next to the economic considerations.

---

[47] Peterson, D.J. and Sergej Mahnovski. *New Forces at Work in Refining: Industry Views of Critical Business and Operations Trends.* RAND Institute, MR-1707-NETL. 2003. http://www.rand.org/publications/MR/MR1707/index.html.

[48] While in-process recycling has become one of the least expensive waste management options for refineries, a facility that has its own coker or other suitable process unit is not likely to send materials to another refinery for in-process recycling after their own coker is at capacity, or if they have elected to not recycle to the coker.

5.4.3.2 Factors determining whether a refinery without a coker will send secondary materials to another refinery or continue using conventional waste management methods

Cost of various waste management options: Cost is by far the most important factor in a refinery's decision about how to manage hazardous wastes. The costs of managing waste under the exclusion compare favorably to conventional waste management options. Refineries inserting secondary materials into their processes are not required to test materials, keep manifests, or adhere to RCRA subtitle C storage requirements. In addition, capital costs are covered by the host refinery. As a result, this service can be provided at a lower cost than non-process recycling such as RCRA cement kiln or thermal desorption. Even landfills, which have become very inexpensive, have additional RCRA requirements that may drive up their costs. Refinery representatives reported they might change their treatment method or service provider several times a year as they shop around for the best price. One refinery representative noted that they would always try to manage secondary materials as excluded first, before opting for out-of-process recycling, treatment or disposal, because of the cost savings.

> *Transportation costs:* Transportation costs associated with different waste management options influence recycling behavior. These costs are determined by the proximity of the destination and by the mode of transportation required by regulation. Since secondary materials transferred to another refinery for recycling are not hazardous wastes, these materials do not have to be transported using RCRA-permitted vehicles, and do not have to be manifested, which lowers the costs.[49] A representative from Tetra Process Services reported that they have received inquiries from a refinery in Hawaii about their in-process recycling operation in Port Arthur, Texas. Despite the extra distance that this refinery would have to ship the wastes to reach Port Arthur instead of its usual landfill in Utah, the lower shipping and receiving fees made the transfer worthwhile.

Certainty of capacity of accepting facility or unit: Due to the regulatory penalties associated with storing wastes onsite for more than 90 days, refineries must be cautious about relying on a waste management option that may suddenly become unavailable. Storing secondary materials on-site before shipping to another refinery can also be expensive because the "roll-off boxes" used for this purpose are rented. One refinery representative reported that one of its facilities previously sent material to Shell Norco, but ceased doing so because of capacity issues with Shell's thermal desorber.

Confidentiality of operating costs: Sending wastes to another refinery requires divulging hazardous waste disposal costs to a competitor. As a result, refineries will only ship wastes to another refinery for recycling when the cost is significantly lower than alternative waste management practices. According to one IPR Contractor, refineries that are on the tightest budgets

[49] The representative from Tetra reports that they generally do use RCRA-permitted transport vehicles even though they are not required to by law.

are those most likely to opt to ship to another refinery because they are more likely to value the immediate payoff of inexpensive waste management instead of the strategic interest of keeping operating costs confidential.

Liability and enforcement considerations: Most industry representatives did not cite CERCLA or RCRA corrective action liability as a major factor in how a refinery opts to manage its waste. However, uncertainty about when and how the exclusion applies to refinery-to-refinery transfers was mentioned by interviewees as an impediment. Despite outreach efforts by API and IPR contractors, some refineries may be hesitant to send secondary materials to another refinery outside of the RCRA manifest system.

5.4.4 Other Impacts of the Exclusion

Many of the interviewees had suggestions about other ways that the refining sector and waste management had changed as a result of the exclusion – beyond the basic question of whether recycling practices had been affected.

5.4.4.1 Environmental Impacts of the Exclusion

When EPA promulgated the final rule for this exclusion in 1998, it cited the goal of encouraging environmentally-sound recycling. The Agency did not mention any specific environmental benefit endpoints that might be anticipated, such as reduced crude oil consumption or decreased risk of accidental release. In interviews on the benefits of the exclusion, few of the interviewees provided information on environmental benefits. One industry interviewee declined to provide information about the environmental benefits of the exclusion as a matter of principle. According to this interviewee, the petroleum industry's position is that because RCRA does not have jurisdiction over secondary materials that are recycled in-process, there is no need to "justify" the exclusion in terms of environmental benefits or even information about changes in recycling.

The IPR contractor interviewee noted that reducing the distances that secondary materials are transported (e.g., to a closer coker rather than a more distant landfill) lessened the risk of accidents and also reduced fuel consumption for heavy-duty transport vehicles. However, it is not clear that secondary materials transported to another refinery are always moving over less distance than those going to landfill or another RCRA treatment facility. As discussed above in the factors in recycling section, secondary materials might go to a more distant waste management option if the per-unit cost of managing the materials is sufficiently lower than that of the nearby option.

Possible Negative Impacts

The exclusion creates the possibility for negative environmental impacts, both by increasing the concentrations of toxic materials in petroleum coke and by creating the potential for RCRA corrective action or CERCLA sites. One waste treatment provider and a representative from an environmental group (ENGO) interviewed by IEc spoke at length about the environmental risks created by the exclusion. Similar statements were presented to EPA during the public comment period for the 1998 final rule. The first concern is that the exclusion expands the use of quench cycle coking, which deposits additional toxic metals and sulfur solids into the coke product. The concentrations of these impurities are limited by product specifications, and the 1998 exclusion defers to these specifications in not establishing a limitation on the concentrations of these constituents in the secondary materials inserted in the quench cycle. Several interviewees noted that while the practice of inserting oil-bearing secondary materials in the quench may not cause the coke product to become off-specification, it likely does result in a more highly-contaminated product that requires additional pollution control devices to control emissions of sulfur dioxide. In addition, dust from petroleum coke can be dispersed during transport, and subsequently inhaled or deposited on the land or in water. At the Port of Long Beach, where petroleum coke is exported, a five-year study is underway to monitor the effectiveness of existing coke dust control measures and determine whether additional measures are needed. While risks from increased concentrations of solids in coke during combustion may be mitigated by pollution control devices, public health risks from inhalation of coke dust may be exacerbated by higher sulfur and heavy metal concentrations.

Exclusion may lead to improper management practices

Several non-refinery interviewees expressed concern that the exclusion may increase the likelihood of improper management of secondary materials. One petroleum waste management representative noted that while RCRA's many requirements for labeling, monitoring and maintaining tanks, analyzing wastes, and carefully tracking hazardous wastes can be onerous, they do decrease the likelihood that these wastes will be released into the environment. The interviewee questioned whether oil refineries would manage them the OBSMs in a manner that would create equivalent safeguards to those established by RCRA. It is important to note that the IPR contractor interviewed by IEc noted that he did use RCRA-permitted transport companies to move secondary materials between refineries, in part because of the risks associated with a release. IEc was not able to gather sufficient information to judge how safely secondary materials bound for recycling were being managed safely by all IPR contractors or by refineries recycling in their own process units.

5.4.4.2 Economic Impacts on the RCRA waste management industry

According to one waste management industry interviewee, the availability of a low-cost in-process recycling option for waste treatment has created substantial downward pressure on the pricing of all alternatives. This has benefitted all refiners, even those who are not utilizing the exclusion. This downward pressure on prices, in conjunction with a decline in overall waste volumes as a result of recycling and waste reduction and minimization efforts, has had a negative financial impact on the RCRA waste management community at large. In addition, the competition from in-process recycling is reducing demand for RCRA-permitted recycling alternatives, such as cement kilns and off-site thermal desorption. The interviewee expressed the belief that recycling alternatives like cement kilns and gasification were superior to in-process recycling since they recovered a greater amount of energy from the secondary materials and created less pollution in doing so.

5.4.4.3 Regulatory Impacts

The exclusion may have changed the nature of applications for regulatory exemptions or variances. IEc spoke with one EPA Regional employee who reviews applications for regulatory variances submitted by refineries. This employee noted that most incoming requests for recycling variances or exemptions now follow the framework established by the exclusion; the facility generally tries to demonstrate that the material being recycled is similar to a feedstock and that the recycling procedure is part of the normal refinery process. In a sense, the exclusion has provided a framework for refineries seeking to justify use of a process for recycling. The EPA employee noted that adherence to this framework had greatly increased the quality and validity of these applications, making them quicker to review and corroborate. By facilitating this regulatory process, the exclusion may be increasing recycling indirectly.

The exclusion may create inspection and enforcement difficulties for states.

Several interviewees noted that the exclusion creates a two-tier system, as secondary materials bound for in-process recycling can be stored in non-permitted tanks, but secondary materials that will be disposed of or treated must be handled, tested, and labeled in accordance with RCRA subtitle C. Since inspectors cannot ascertain whether a residual stored in a non-permitted tank will in fact be recycled in-process, it is possible that some RCRA violations at the facility may go undetected. Even under the exclusion, secondary materials cannot be excluded from storage regulations if they are speculatively accumulated.[50] For instance, 75 percent of a certain volume of materials stored prior to recycling must be recycled within the calendar year. However, without requirements to record the dates that certain secondary materials are generated, storage regulations become nearly impossible to enforce. Furthermore, secondary materials that a refinery plans to recycle in-process might still end up in a RCRA facility due to capacity constraints, process operations problems, or other unexpected incidents. One interviewee felt that the exclusion added an element of uncertainty in these situations. In particular, the interviewee questioned what the "point of generation" would be for these secondary materials, which are now wastes.

5.4.5 Opportunities for increased recycling in the petroleum refining sector

In addition to describing economic and organizational barriers to in-process recycling, many interviewees had suggestions for steps that EPA could take to increase in-process recycling in the refinery sector.

One waste management industry interviewee suggested that EPA encourage refineries to develop Environmental Management Systems (EMS).

---

[50] A material is "accumulated speculatively'" if it is accumulated before being recycled. A material is not accumulated speculatively, however, if the person accumulating it can show that the material is potentially recyclable and has a feasible means of being recycled; and that--during the calendar year (commencing on January 1)--the amount of material that is recycled, or transferred to a different site for recycling, equals at least 75 percent by weight or volume of the amount of that material accumulated at the beginning of the period. (40 CFR 261.1(c)(8))

He noted that the Marathon Ashland refinery in Garyville, Louisiana was currently the only facility with an EMS in place.[51] It is unclear that the implementation of EMSs across the industry would lead to increased utilization of the 1998 exclusion, but the additional reporting and record-keeping that accompanies an EMS could potentially provide EPA with additional sources of information to assess the impact of the exclusion on recycling rates.

Several interviewees suggested that EPA exclude the catalysts K171 and K172 when recycled and regenerated at a metal recovery facility.

They noted that many refineries sent catalysts off-site for metal recovery prior to their listing in 1999, and that this practice had dropped off almost completely. Many industry suggestions for how to increase recycling in the refining sector involve broadening the exclusion. Some industry interviewees suggested that EPA modify the proposed revisions to the definition of solid waste ("ABR rule" 68 FR 61558) to apply to refinery operations. Several other suggestions corresponded to earlier proposed exclusions, including:

- Exclusion of recovered oil and oil-bearing secondary materials from co-located or commonly owned petrochemical facilities when recycled in the refinery process.
- Exclusion of oil-bearing secondary materials from exploration, transport and other pre-refining stages of petroleum fuel production when recycled in the refinery process.

While most of the refinery representatives favored these additional broad exclusions, one Regional interviewee suggested that additional work to encourage recycling in this sector should focus on individual waste streams rather than provide umbrella-like exclusions or exemptions.

Another common suggestion for how to increase recycling was to clarify the application of the exclusion to certain specific cases.

One of these specific cases involves the question as to whether gasification is considered part of the refining process, and therefore, whether materials recycled through gasification are excluded. Similarly, one industry interviewee noted that there was some dispute over the exclusion of oil-bearing wastewater prior to a primary treatment (where oil is recovered). In particular, this interview noted that the D.C. Circuit Court of Appeals had ruled that EPA needed to revisit its decision to not exclude oil-bearing wastewater in 2000, but that EPA had not yet issued a rule in response (*API vs. EPA, 216 F.3d 50 (D.C. Cir. 2000)*. The need for EPA clarification on the application of the exclusion was also raised during a 2002 meeting of refinery representatives, waste management industry specialists, EPA representatives and co-regulators. In that meeting, refinery representatives said that they were sometimes shuttled between state, Regional, and Headquarters staff in attempts to obtain clarification.

[51] The facility has been a member of EPA's Performance Track program since January 2002.

Several waste management industry interviewees suggested establishing land disposal requirements (LDRs) for more wastes would lead to an increase in recycling in the refinery sector.

LDRs constitute the largest real driver toward recycling, according to one waste management industry interviewee. One interviewee noted that the petroleum refinery land disposal restrictions that began in 1990 have substantially reduced the volume of refinery waste by encouraging waste minimization initiatives relative to the refiners' processes and procedures. The remaining hazardous sludges and emulsions are generally centrifuged onsite to reduce waste volumes and recover oil, a process that generates net financial benefits for the generator. The result of refinery waste minimization and recycling technologies is that very little *hazardous* waste leaves the refineries. On the other hand, large volumes of *non-hazardous* waste with notable hydrocarbon content routinely leave refineries for landfills. A representative from an IPR Contractor also noted that many valuable non-hazardous wastes are sent to landfills instead of being recycled because landfills are so much cheaper.

One waste management industry interviewee believed that EPA should reevaluate whether it was in fact beneficial to increase in-process recycling. This interviewee cited the potential environmental harms associated with jurisdictionally-excluded (in-process) recycling and suggested that the resource recovery was less effective than in non-process recycling processes such as cement kilns.

5.5 Conclusion

5.5.1 Summary of Key Findings

Excluding oil-bearing secondary materials did not greatly increase the use of in-process recycling at refineries that were already recycling these materials prior to the exclusion. The experience of our interviewees was that any refinery with a coker on-site was already recycling the amount of material that was optimal for that facility based on a variety of economic and engineering factors. However, the quantity of materials recycled on-site might increase if EPA were to broaden the exclusion to apply to secondary materials generated in other petroleum and petrochemical sectors.

By allowing OBSMs transferred between refineries for in-process recycling to be excluded from the definition of solid waste, the 1998 rule did foster some increase in recycling of OBSMs, and clarified the regulatory situation. Some refineries are choosing to send secondary materials to other refineries for in-process recycling because excluded recycling is usually less expensive than other management options for these secondary materials. By excluding secondary materials recycled in-process, and therefore lowering the costs associated with regulation for this service, a greater volume of secondary materials are being recycled and more resources are being recovered instead of being sent to landfill. Refinery-to-refinery transfers of OBSMs are increasing and are likely to become more common as refineries become more confident in the exclusion. Awareness of the OBSM exclusion is widespread, but confusion about some nuances of the exclusion may be limiting its utilization.

5.6.2 Points for Further Research and Recommendations for EPA

5.6.2.1 Obtaining Quantitative Data for Increased Recycling

A lack of quantitative data prevented a full assessment of the industry's utilization of the OBSM exclusion for this evaluation. One refinery representative suggested that refineries would be willing to work with EPA to gather the data necessary for such an assessment. Such data would enable EPA to measure the effectiveness of the exclusion and use this information to both communicate the results to stakeholders and to predict the impact of future efforts to increase recycling in the petroleum refining sector.

EPA could also use the existing biennial reporting system to estimate the amount of recycling by designating a special waste code for wastes generated when processing secondary materials for recycling. Currently, these wastes are referred to as F037 wastes, making them indistinguishable from other wastewater treatment wastes generated at the refinery.

5.6.2.2 Better Understanding of Environmental Impacts of Exclusion

The environmental impacts of the OBSM exclusion remain uncertain, in part because of the lack of information about how secondary material management practices have changed. However, because secondary materials that are recycled are not regulated under RCRA, it is unclear how these secondary materials are stored, transported and processed prior to recycling. Some specific data points that would help EPA gain a better understanding of the environmental impact are:

- Difference in transport distances for recycled and disposed materials.
- Volume of waste produced from processing secondary materials prior to recycling compared to the original volume of secondary materials

5.6.2.3 Additional Outreach to Refineries

Confidence in the applicability of the OBSM exclusion seems to be an important factor in whether a refinery chooses to recycle in-process. EPA should consider additional outreach measures to refineries to address remaining concerns about how the exclusion applies in specific situations.

Simply being available to answer a refinery's questions may not be adequate to encourage additional recycling under this exclusion. First, industry interviewees reported being frustrated when attempting to get clarification of regulations because state and regional staff deferred to each other. EPA should consider ways to reduce the confusion caused when refinery representatives seeking interpretations of the regulations, perhaps by clarifying EPA and state roles in interpretation.

The second reason that a passive approach may be inadequate to increase refineries' confidence in the exclusion is that busy refinery representatives may not initiate contact with EPA. A refinery may be considering recycling and have questions about the exclusion, but may delay contacting EPA due to other issues of more immediate concern. In these cases, EPA-initiated contact may spur the refinery into initiating recycling programs that had been neglected. EPA might consider combining outreach with efforts to gather information about existing recycling practices.

5.6.2.4 Examine the Effect of Regulatory Exclusions on Enforcement Practices

The use of exclusions from the definition of solid waste as a tool to encourage recycling raises several issues that are not present with other tools, such as exemptions. For instance, it may be more difficult for state enforcement staff to inspect facilities where similar streams of secondary materials are being handled differently– some compliant with RCRA, and some excluded from RCRA. As EPA considers excluding more refinery secondary materials, as well as secondary materials in other sectors, it may be prudent to discuss any inspection complications with state enforcement staff. Such discussions may produce ideas to mitigate these complications with future exclusions.

6. 180-DAY ACCUMULATION TIME FOR WASTEWATER TREATMENT SLUDGE FROM THE METAL FINISHING INDUSTRY

6.1 Introduction

F006 wastes are wastewater treatment sludges generated from electroplating, a type of metal surface finishing. Metals are finished "to improve appearance, to slow or prevent corrosion (rust), and to increase strength and resistance to wear (in the case of "engineering" finishes)" (American Electroplaters and Surface Finishers Society, Inc. , 2004). Electroplating relies upon electricity to coat the metal. Objects can be finished using a variety of metals including gold, silver, chromium, copper, nickel, tin and zinc. In the electroplating process, the metal that will be used to coat an object is dissolved in an electrolytic plating bath in the form of positive charged ions. The object to be plated is placed in the bath and given a negative charge, causing the positively charged metal ions to adhere to the surface of the object. In a typical plating line, an object is plated with a number of coatings in a series of different plating baths.

F006 sludges are produced from the treatment of electroplating rinse waters. Thus, the composition of the sludge is dependent upon the plating treatment used, the configuration and number of treatment and rinse tanks, and the substances in the plating bath (acid/alkaline and cyanide/noncyanide). The composition of the sludge is also dependent upon the material used to precipitate the metal ions. Hydroxide, or lime, and sulfide reagents are generally used. Generators frequently co-mingle rinse waters from different plating lines, so sludges may contain a mix of metals. Electroplating wastewater treatment sludges were listed as hazardous waste in 1980 because they contain cadmium, chromium, nickel, and complex cyanides.

In 1994, EPA established the Common Sense Initiative (CSI) to promote environmental protection and pollution prevention through the use of pilot programs and multi-stakeholder decision making. The metal finishing industry was one of six industries chosen to participate in the CSI. The 180-Day Accumulation Time Under RCRA for Waste Water Treatment Sludges from the Metal Finishing Industry rule (the 180-day rule) stems from the metal finishing CSI's efforts.

The 180-day rule, promulgated on March 8, 2000, enables large quantity generators of F006 sludges up to 180 days (and up to 270 days in some cases) to accumulate these wastes on-site without a hazardous waste storage permit or interim status, provided that the generators recycle the F006 sludges through metals recovery. The 180-day rule flexibility is conditional upon generators implementing pollution prevention practices and complying with applicable management standards. The 180-day rule is designed to encourage recycling of hazardous waste, reduce the volume of waste that is land disposed, and encourage pollution prevention practices.

EPA implemented the 180-day rule in response to suggestions from generators of F006 wastewater treatment sludges. It was anticipated that allowing generators to send waste half as often (i.e., every 180-days vs. every 90-days), would result in lowered transportation costs. Those supporting the rule argued that they needed the 180-day accumulation time rule to accumulate economically viable amounts of waste volumes.

IEc sought to understand the current trends in the generation and management of F006 wastes and factors impacting those trends. As part of this effort, we also examined electroplating industry awareness and use of the 180-day rule. Where possible, IEc also tried to collect information on the benefits of F006 recycling, and specifically the 180-day rule. The following section summarizes information gleaned from interviews with industry stakeholders, literature reviews, and analyses of 1999 and 2001 hazardous waste data as reported on 1999 and 2001 National Biennial RCRA Hazardous Waste Reports.

6.2 FINDINGS

Evaluation Category	Finding
Regulated community awareness of the rule	• Metal finishers are very aware of the 180-day rule as a result of the industry trade association's outreach. Some state representatives, however, may not be aware of the rule.
Impact of the rule on waste management practices	• Amounts F006 generated and recycled have declined since the 180-day rule was promulgated. • Interviewers note the decline in F006 sludge generation may be due to the economic downturn or efforts to conserve water. • Recycling may have declined due to a lack of viable recycling options. • Respondents do not believe the 180-day rule has increased recycling rates.
Factors that influence decisions about recycling	• F006 recycling is impacted by the cost of recycling. Costs, in turn, are impacted primarily by the type and concentration of metals in the wastewater treatment sludges. • Metal type and concentration can be affected by pollution prevention efforts. • The costs of recycling F006 waste may also be impacted by the hazardous waste listing.
Other impacts of the rule	• Some respondents believe the 180-day rule has improved communication between EPA and the metal finishing industry and has served as a stepping stone to future regulations that may more effectively encourage F006 recycling.

Table 11 Summary of Findings for the 180-Day Rule for F006 Wastes Case Study

Source: IEc analysis of hazardous waste data in the 1999 and 2001 Biennial reports, as well as six interviews with diverse industry representatives.

6.2.1 Awareness of the 180-day Rule

Industry representatives must be proactive in order to learn of new regulations that might affect them. Trade associations play a key role in informing industry of the new potentially applicable regulations.

One trade association representative noted that being aware of regulations is "part of their job." Trade association representatives actively seek information on regulatory changes. One representative noted that the association representatives learn of regulations by searching for press releases and looking for announcements on EPA's website. Trade associations also frequently work closely with the EPA. The Government Relations Group, the government advocacy group of three major industry trade associations (the National Association of Metal Finishers, the Metal Finishing Suppliers Association, and the American Electroplaters and Surface Finishers Society), closely follows regulations and is in close contact with the regulatory agencies. Because the F006 180-day rule grew out of the Common Sense Initiative and Strategic Goals Program, industry trade groups were particularly informed about the rule; the industry trade groups helped EPA to develop the 180-day rule.

The Government Relations Group works to inform industry stakeholders and find ways to comply with new rules. This Group communicates through state affiliate offices and branches. Offices and branches publish newsletters that include information about new rulemakings affecting the industry. Other trade associations post news articles regarding regulatory developments on their websites and send email broadcasts to their members. Two business respondents also noted that they have staff who closely follow rulemakings that could affect them. One recycler noted that they have a "selfish interest" in staying on top of regulatory changes.

Metal finishers are very aware of the 180-day rule.

A trade association representative noted that the metal finishing industry as a whole is "very aware" of the 180-day rule, estimating that 75 percent of the industry is aware of the rule. This respondent noted that businesses that could benefit from the 180-day rule may have higher awareness. For example, job shops that produce smaller volumes of waste, and thus may benefit from the opportunity to consolidate waste shipments may have higher awareness than a captive shop producing significant quantities of sludges. A metal finisher noted that the industry is so heavily regulated that most managers must be very aware of environmental regulations.

Another finisher noted that awareness is closely tied to involvement in a trade association. According to one trade association representative, trade associations represent roughly half of all metal finishers. Small businesses or captive platers within a large organization may have lower levels of awareness than mid-size job shops because they are less likely to be trade association members. Captive shops are less likely to be involved in trade association because they are "stuck behind the walls of a large company." The one major industry trade association, the Surface Finishing Industry Council, publishes a regulatory newsletter, *Washington Report*. This newsletter informs platers of new regulations, proposed regulations, and legislative issues.

EPA and state agencies do not play a significant role in informing industry of the 180-day rule, but could play a more active role. One trade association representative noted that state representatives themselves may not be aware of the 180-day rule.

Two industry representatives noted that EPA's efforts to inform regulated industries is limited, but sufficient. As noted, trade associations play an important rule in informing the industry about regulatory changes. To raise awareness, this respondent suggested that EPA devote funding to developing common sense versions of regulations and publish this information in industry trade journals. A trade association representative noted that state agencies could conduct more outreach to affected industries in their state. For example, states could write press releases about new key rulemakings. In order to learn about rule changes on the state level, he must call state contacts directly.

Another trade association representative noted that some state regulators, particularly within states that have not yet adopted the rule, are not aware of the 180-day rule themselves. This representative suggested that EPA continue to inform states through ECOS and other organizations of state regulators. One state contact agreed that state participation in the Association of State and Territorial Solid Waste Management Officials (ASTSWMO) is crucial to keeping abreast of new rulemakings. This state regulator also relies upon the federal register and newsletters like the Hazardous Waste News and Inside EPA to learn of new rulemakings that could affect businesses in their state. To ensure all states have readily accessible information on new rulemakings, this state contact recommended that EPA also develop a continuously updated website to report on the Agency's rulemaking efforts.

6.2.2 Changes in Waste Management and Recycling Practices

Hazardous waste generation quantities declined between 1999 and 2001.

Biennial Report data suggests that F006 wastewater treatment sludge generation decreased by 46 percent, from 220,964 to 118,478 tons, between 1999 and 2001 (see Table 12). The size of an individual waste stream can vary considerably. It is interesting to note, however, that while the actual number of waste streams being reported declined by only 100, the mean quantity of waste generated decreased dramatically from 1999 to 2001, suggesting a decline in very large quantity waste streams.

Reporting Year	Number of Generators	Number of Waste Streams	Tons of Waste	Mean Waste Stream (tons)	Median Waste Stream (tons)
1999	1,244	1,413	220,964	156.38	21.00
2001	1,183	1,313	118,478	90.23	20.76

Table 12. Solid and Sludge F006 Wastes Generated in 1999 and 2001
Results based on analysis of 1999 and 2001 Biennial Report data

IEc's Sludge generation data are also collected as part of the National Metal Finishing Strategic Goals Program (SGP). The SGP is a voluntary program launched in 1998 that came out of the CSI, as a cooperative effort between EPA and several metal finishing industry trade associations. SGP companies within the metal finishing industry can voluntarily work towards a defined set of environmental goals, reporting annually on their progress. As they work towards these objectives, SGP companies have access to a range of incentives, including on-site technical assistance, non-regulatory environmental audits, and EMS training.[52] The SGP program aggregated the 1999 - 2001 sludge generation data presented on 193 SGP company annual worksheets. Like the BR data, SGP data suggests a decrease in sludge generation. The decrease is, however, much smaller; sludge generation decreased by only five percent, from 5,213 tons to 4,963 tons (Strategic Goals Program, 2004).[53]

Hazardous waste data from the Strategic Goals Program and Biennial reports indicate that F006 recycling has also declined between 1999 and 2001.

While SGP members continue to recycle a significant portion of their waste, the percentage of waste recycled declined from 1999 to 2001 from 59 percent in 1999 to 47 percent of waste generated (in 2001) (see Table 13). BR data show similar downward trends (see Table 12). Waste managed by metals recovery is being recycled, the metals recovered as a commodity. Other waste streams are being land disposed or stabilized.[54] Thus, the volumes in both the stabilization and land disposal rows of Table 14 represent wastes that are not recycled.

Year	Waste Generated (Tons)	Waste Landfilled (Tons)	Tons and Percentage Waste Recycled[1] (Tons)
1999	5,123	2,117 (41%)	3,006 (59%)
2001	4,963	2,650 (53%)	2,313 (47%)

Table 13 F006 Sludge Generated, Landfilled, and Recycled in 1999 and 2001 by SGP Companies
Quantities presented in tons. Results based on evaluation team's analysis of information presented on the National Metal Finishing Strategic Goals Program website at http://www.strategicgoals.org/reports2/ and personal communication of Program staff.[1] Calculated based on generation and landfill quantities. George Cushnie of CIA resources noted that recycling volumes could be inferred to be the difference between the quantity of waste generated and landfilled.

[52]For more information on the National Strategic Goals Program, see www.strategicgoals.org.

[53]Companies completing SGP worksheets should also be submitting Biennial Reports. Thus, SGP data reported here should be reflected in the 1999 and 2001 BR data.

[54] Personal communication with Paul Borst, EPA, May 18, 2004.

Waste Management Method	1999		2001	
	Waste Streams Count	Waste Volume Count	Waste Streams Count	Waste Volume Count
Metals Recovery	523 (49%)	36,861 (37%)	437 (44%)	23,104 (35%)
Stabilization	413 (38%)	34,698 (35%)	330 (33%)	23,591 (36%)
Land Disposal	139 (13%)	27,180 (28%)	223 (23%)	19,475 (29%)
Total	**1,075**	**98,739**	**990**	**66,171**

Table 14 Management Summary of F006 Wastewater Treatment Sludges in 1999 and 2001
Results based on IEc's analysis of 1999 and 2001 Biennial Reports. Volumes in Stabilization and Land Disposal rows are not recycled.

Interview respondents posited different reasons for observed trends in F006 sludge generation and recycling.

One industry representative noted that the amount of F006 wastes generated is driven by the state of the economy. When companies are busy and plating activities increase, the level of F006 sludge generation will also increase; an economic downturn such as the recent U.S. slowdown would thus decrease sludge generation. In addition, one contact noted that economic conditions and environmental regulations have forced many electroplaters overseas, further reducing the sludge generated in the United States. One industry representative noted that reductions in sludge generation may be due to pollution prevention efforts, as platers reduced water use. The lower volume of water in the resulting wastes enables platers to use smaller amounts of material to precipitate the metal, thus reducing the overall quantity of sludge produced. Despite overall trends indicating a reduction in total sludge generation, one industry contact noted that the quantity of sludge generated per unit of metal plated may in fact be increasing over time. Because of strictly enforced local wastewater discharge standards, metal finishers are working to make their wastewater cleaner. To do so, companies have added coagulants to the process to increase precipitation of metals. These activities increase the quantity and density of the resulting sludge.

One industry interviewee noted that a heightened concern for liability associated with improper land disposal makes recycling an attractive option. However, two industry representatives noted that recent declines in F006 sludge recycling were resulted from recycling markets for F006 having "dried up." In recent years, these industry representatives report that some recyclers have stopped accepting F006 wastes.

6.2.3 Factors Impacting Waste Management

Recyclers do not generally find F006 wastes to be a profitable source of commodity metals.

Respondents generally contended that F006 recycling capacity has declined because recyclers do not find F006 recycling to be sufficiently lucrative. Respondents cite a number of factors impacting the economic feasability of F006 recycling, for which pricing is based on the types and concentration of metals in the F006 sludge. A higher metal content will result in more commodity product for the recycler; as the cost of recycling is offset by this benefit, generators will be charged less to recycle their waste. To extract value from the sludge, recyclers must separate out each component of the sludge. One recycler noted that if platers would separate their waste streams, the sludges would be more marketable.

One recycler noted that the metal finishing process does not result in sludges with metal content in sufficiently high values to encourage recycling. In general, the company rarely accepts materials with less than 10 percent zinc content and is only "enthusiastic" about waste streams containing over 20 percent zinc. One trade association representative noted that F006 sludges generally contain 10 percent metal by weight; although recent studies suggest metal content may be higher.[55] Other wastes, such as K061 waste generated through steel production, contain higher concentrations of metals and are thus more attractive to recyclers.

Increased efficiency and pollution prevention activities may be depressing the value of F006 waste recycling by decreasing the metal content in the sludge. One industry representative notes that "platers have gotten better at their process" and as a result now generate less metal waste. For example, metal finishers have implemented pollution prevention technologies and refined processes to use rinse tanks more efficiently. As a result, less metal is present in wastewaters and ultimately in the F006 sludges. One recycler noted that generators are using metals more sparingly, thus reducing the metal content in the generated sludge.

One recycler also noted that platers are increasingly using "electroless nickel," which contains phosphorous as a plating material because environmental regulations favor the material and it is cheaper and easier to use. The phosphorous, however, is difficult to separate from the sludge during the recycling process. A trade association representative pointed out that by increasing total volume, coagulants used to precipitate metals from the waste will ultimately decrease metal concentrations. The most widely used coagulants are iron-based; in many cases, recyclers would have to remove this iron from the sludge, creating an additional level of complexity.

In addition to the impacts of metal content and concentration, several respondents noted that smelters may be reluctant to accept F006 sludges because they are generated in such small quantities. One recycler noted that it is more economical to recycle a single 10,000 ton waste stream from a steel producer than a large number of 200 ton streams generated by electroplaters. Another recycler noted that simply from a practical standpoint, it is difficult for a smelter to accept a large number of "minuscule" waste streams.

---

[55]See Table 10. F006 sludge metal content is discussed in greater detail in the *Benefits of the 180-day rule* section.

The characterization of metal finishing wastewater treatment sludges as a listed hazardous waste may make recycling less economically feasible.

One trade association representative noted recyclers are uninterested in recycling F006 because of the cost associated with disposing secondary materials from the recycling process. Because F006 is a listed waste, recycling residual must be treated as a hazardous waste. These disposal requirements represent an added cost for recyclers. Another industry representative noted that because F006 waste is a listed hazardous waste, the few recyclers who have the permits necessary to recycle hazardous waste can charge a premium for recycling. This contact notes that permitted recyclers are fighting the delisting of F006 because of the premiums they can currently charge to recycle the waste.

Two recyclers, however, contended that F006's status as a listed waste does not affect a recycler’s decision. One recycler noted that the decision to recycle F006 waste is based solely on the price of the recovered metal and the tipping fee, (i.e., cost charged to the waste generator). This interviewee notes that the cost of managing the waste and its residuals is not a factor in the recycler’s decision. Another recycler noted that even if F006 were not listed and the residual were not considered hazardous waste, the materials would still be handled as hazardous material. This is due to the belief that the F006 “should be treated lightly” and can be dangerous if mismanaged or released into the environment. A metal finishing representative disagreed, noting that as much as 55 percent of all F006 waste generated in the U.S. is considered chemically not hazardous.

One metal finisher noted that the characterization as a listed waste has an impact on F006 recycling, because of its limits on brokers, not recyclers. As discussed above, smelters are often unable to accept small quantity waste streams from a large number of small metal finishers, or find it cost prohibitive to do so. One recycler suggested that he would be more amenable to accepting F006 waste if received in bulk from a broker who collected and consolidated F006 wastes from small generators. F006's hazardous waste listing, however, reduces the number of brokers willing to handle the waste because in order to handle F006 sludges, brokers must obtain hazardous waste permits.

The 180-day rule provides cost savings for only a portion of F006 generators.

The 180-day rule was designed to decrease transportation costs for generators recycling their waste, thereby making recycling a more financially viable management option. Platers must send the F006 waste for disposal after 180-days or when they have accumulated sufficient waste to fill a truckload of waste, whichever comes first. Cost savings occur when the number of trucks required for the 180-day accumulation scenario is less than the number of trucks required for the 90-day accumulation scenario. Platers who generate only partial truckloads of waste in 90 days, but could accumulate a full truck load in 180 days can realize cost savings as a result of the 180-day rule. As a result, platers producing large quantities of waste that generate a quantity sufficient to fill a truck in 90 days do not experience cost savings form the 180-day rule. RCRA Small Quantity Generators (SQG) do not experience a benefit from the 180-day rule specifically, because SQGs were already permitted to store waste on-site for 180 days.

One industry representative described the 180-day rule as providing benefit for "a fairly narrow band of the universe" of metal finishers. For a truck capacity of 18 tons, facilities can experience costs savings when annual waste volumes ranging from 12.9 tons/year (or 1,000 kg/month which makes this facility a large quantity generator) and 72 tons/year. Platers generating seventy-two tons or more each year are assumed to generate 18 tons or more (i.e., a full truck-load) every 90 days. For a truck capacity of 30 tons, the break-even point increases to 120 tons/year (i.e., a 30 ton truckload every 90 days).

One recycler noted that recyclers had already devised a more efficient means of transporting F006 waste; thus the 180-day rule has not had an impact on transportation costs. For example, recyclers have already established efficient "milk runs" to collect and transport small volumes of waste from a number of generators. The additional storage time does not decrease the costs of these transportation routes.

Interview respondents agree that the 180-day rule has had little to no impact on recycling levels.

Two respondents noted that while some companies mandate recycling for environmental reasons, these companies are in the minority. In general, generators make decisions about whether to recycle their waste or dispose of it in a hazardous waste landfill based upon the costs of each option. One trade association representative noted that "if it is cheaper to send waste to a landfill, the plater will do so." Even if the generator can take advantage of lower transportation costs, another trade association representative points out that sending waste to a landfill may still be a less expensive option. Because several large recyclers no longer accept F006 wastes, it is now even more likely that generators will have better access to landfills than to a recycler. The generator must incur costs of both transportation and disposal. As discussed above, recycling costs are dependent upon the content of the F006 sludge. One trade association representative noted that recyclers and landfillers compete for business; if recycling prices decline, landfill prices will likely also drop.

Respondents disagree over the best approach to increase F006 recycling.

One metal finisher and one trade association representative believe that excluding F006 wastes bound for recycling from the definition of solid waste would remove key barriers to recycling, such as recyclers' concerns about handling recycling residues. Two recyclers note that recycling is not occurring simply because of a lack of profitable source sludges. One recycler noted that the F006 wastes that "can be recycled, are being recycled." These latter respondents do not believe the exclusion will have an impact on recycling levels and that recycling will only increase if recyclers find it more profitable (e.g., through lower costs or increased payments from generators).

One trade association representative suggested that F006 recycling could increase if platers were more aware of the recycling options available. To explore recycling options, platers generally send a sludge sample to a recycler to assess the sludge quality and determine the management price. The representative noted that this research can be prohibitively expensive for some platers and may prevent them from exploring recycling as a valid disposal option. This respondent suggested EPA survey recyclers to compile information on what recycling options are available, how much recycling costs, what metal concentrations recyclers require, and which metals can interfere with metals recovery efforts. With this information in hand, the respondent believes that platers could make more informed decisions about F006 management. Feedback from a recycler raised concerns about whether such a study would be useful. The respondent noted that determining if an F006 sludge is "recycleable" requires a complete chemical, physical, and economic analysis of that particular wastestream.

6.2.4 Benefits of the 180-day Rule

Though the 180-day rule may not be the main contributing factor, over 23,000 tons of F006 were diverted from landfill in 2001 as a result of recycling. This recycling is beneficial by diverting waste from landfill and by allowing metals to be recovered and reused.

BR data indicate that 23,104 tons of F006 waste were recovered in 2001. Recycling prevents strain on limited hazardous waste landfill capacity and eliminates the risk that these materials could leach into the soil or groundwater and cause environmental and health risks. Respondents note that the true benefit of F006 recycling is that the metals recovered from these waste streams are not put into a landfill. Metals recovered through recycling can be reused, limiting the need to mine for raw materials and limiting dependence on foreign metal supplies.

The exact quantity of metals recovered from F006 recycling is unknown. One trade association representative notes that platers themselves are frequently unaware of the metal content of their sludge. Regulatory requirements dictate that electroplaters perform an extraction procedure (EP) analysis prior to landfilling to assess the potential for metals to leach from the sludge. The respondent notes that this EP test, however, is not a true analysis of the metal content of the sludge, since there is no correlation between the metal content of the sludge and the quantity that leaches from it. This respondent further notes that recyclers are likely the only parties that know the true metal content of the sludge, but records from recyclers have never been compiled or organized.

While the quantity of metal recovered from this sludge is not known, a trade association representative noted that metals likely make up 10 percent of the weight of the sludge. Several analyses have been conducted to characterize the universe of F006 sludge (see Table 15). These results suggest that 10 percent metal content serves as an appropriate lower bound estimate for F006 sludges. A trade association representative noted that smelters typically recover between 50 - 75 percent of the metal content in a ton of sludge. These estimates suggest that the sludges recycled in 2001 contained 2,310 tons of metals, of which 1,155 - 1,733 tons of metals were recovered through recycling.

Source	Sample Size	Average Total Metal Content (%)
DPRA TRI Analysis[1]	• 9,099.7 tons of waste • 92 generators	10.5
F006 Benchmarking Study[2]	• 3,115 tons of waste • 21 generators	31.5
Printed Wire Board Industry Trade Association[3]	• 7 generators	12.09
Ad Hoc DPRA Data[4]	• 8 waste streams • 3 generators	24.18

Table 15 Total Metal Content of F006 Sludges
Sources:

[1]Gustafson, Dave and Craig Simons, DPRA. *Draft Memorandum to Paul Borst, EPA/OSW/EMRAD, Cost & Economic Impacts of F006 Recycling Exclusion from Definition of Solid Waste; DPRA WA 3941-0001-0022*.

[2]EPA Common Sense Initiative, Metal Finishing Sector. *Workgroup Report: F006 Benchmarking Study*. September 1998. IEc relied upon summary data provided in the DPRA report.

[3]Data provided to EPA by the Printed Wire Board Industry Trade Association. IEc relied upon summary data of this analysis as provided as background in the DPRA report.

[4]Samples collected in support of November 5, 2003 DPRA analysis (see note 1).

The 180-day rule provides additional qualitative benefits: increased communication between EPA and the industry, a path towards further regulatory changes, and clarification of existing policies.

One trade association representative noted that the 180-day rule has increased communication between the industry and EPA and has paved the way for subsequent regulations intended to further encourage F006 recycling. The discussions surrounding the 180-day rule and its promulgation have improved the working relationship between industry and the EPA. These conversations have created an environment where parties are interesting in working cooperatively, which benefits both industry and the agency. This respondent also believes that the 180-day rule may pave the way for an exclusion of F006 from the definition of solid waste under RCRA if it is recycled.[56] This respondent noted that often regulatory changes must be made in incremental steps; the 180-day rule represents the necessary first step toward the exclusion.

An F006 recycler noted that the 180-day rule clarifies the definition of F006 recycling and F006 wastes. The 180-day rule codified that F006 waste sent to an intermediate recycler for production of metal concentrate was defined as recycling. This metal concentrate is produced and sent to smelters for metals recovery. In addition, the recycler noted that the 180-day rule clarified that the metal concentrate produced by these intermediary recyclers was not exempt from the definition of hazardous waste. Thus, this recycler argued that F006 recyclers are required to obtain RCRA Part B permits and must apply for and receive a variance in order to declare that the metal concentrate end-product was a "commodity-like" product and thus not subject to handling as a hazardous waste. Despite the clarification provided by the 180-day rule, this respondent noted that these regulations have not been applied evenly, thus providing competitive advantage for some recyclers who are allowed to operate without a permit or without receiving a variance.

6.3 Conclusion

6.3.1 Summary of Key Findings

Recycling of F006waste does not appear to have increased as a result of the 180-day rule. Hazardous waste data from the 1999 and 2001 Biennial Reports and information collected as part of the SGP demonstrate that electroplaters reduced the quantity of F006 waste generated between 1999 and 2001. Recycling levels, however, have also decreased slightly over the same time frame in absolute terms and as a percentage of waste generated.

Respondents cited a number of factors that impact decisions about F006 waste management practices. While the underlying reasons are not clear, respondents do agree that F006 wastes are not being recycled to a large degree because of a lack of recyclers willing to accept and manage the F006 waste at a competitive price. Respondents cite sludge content, low metal concentration, the characterization as a listed waste, and the small size of the typical F006 waste stream as factors that make recycling F006 waste unprofitable.

Respondents agree that the 180-day rule has had limited impact on encouraging F006 recycling. While the rule may enable a limited subset of generators a level of flexibility and cost savings, respondents do not generally believe the rule offsets additional costs associated with transporting F006 sludges longer distances to recyclers or researching whether recyclers would accepted the F006 wastes generated. Most notably, by increasing storage time limits the 180-day rule focuses solely on reducing transportation costs for this limited subset of generators who recycle their F006 wastes. The rule has not made F006 sludges more attractive to recyclers and thus has not reduced recycling prices or increased recycling capacity.

The 180-day rule has increased communication between industry and EPA. These discussions may result in further regulatory changes to encourage recycling. As one trade

[56] This exclusion has yet to be proposed.

association representative noted, an important side benefit of the 180-day rule is the continued cooperation and communication it has ensured between EPA and the metal finishing industry. Stakeholders continue to discuss drivers and barriers to F006 recycling, most notably the exclusion of recycled F006 from the definition of solid waste that is currently being discussed. While, respondents disagree about the impact this proposed exemption may have on recycling, working cooperatively benefits both industry and EPA.

6.3.2 Points for Further Research and Recommendations for EPA

6.3.2.1 Increase Availability of Information Indicating Recycling Levels

The evaluation team relied upon data collected in EPA's hazardous waste Biannual Reports to assess the generation rates and recycling rates. In order to conduct this analysis, the evaluation team designated a range of treatment codes that likely indicate recycling. However, no single code or set of treatment codes are specifically designed to report on hazardous waste recycling. As a result, researchers analyzing BR data may not define "recycling" consistently. This creates difficulty when making comparisons across studies over time. More detail on how the evaluation team defined "recycling" for the purposes of this analysis is detailed in Appendix C. EPA could consider requiring facilities completing a BR to identify when the generated waste is recycled. In addition, EPA could revise the BR to allow generators to report when they are able to take advantage of the 180-day rule.

6.3.2.2 Continue Efforts to Increase Understanding of F0006 Recycling Options

Interviewees noted that some generators may not recycle F006 sludges because of uncertainty regarding viable recycling options. One interviewee suggested that generators may not know whether the sludges they generate can be recycled or how the wastewater treatment sludges could be made more attractive to recyclers. For example, by isolating sludges from different plating lines, platers may generate sludges that can more easily be recycled. As suggested by the interviewee, EPA could consider canvassing hazardous waste recyclers to define the characteristics of a F006 waste stream that would be accepted by a recycler (e.g., the metal content or mix of metals).

While interviewees were divided about the impact of excluding F006 wastewater treatment sludges from the definition of solid waste, EPA and industry representatives are currently exploring the benefits of this regulatory change. Some interviewees argued that if F006 wastewater treatment sludges were not defined as listed wastes, recycling levels could increase.

7. CONCLUSION

7.1 Summary of Key Findings

The three case studies reviewed for this evaluation represent a range of regulatory tools available to EPA to encourage recycling. On one end of the spectrum, the 180-day rule targets a specific regulation-related cost, transportation costs. On the other end, the exclusion for oil-bearing secondary materials eliminates all RCRA regulation-related costs. These case studies also cover a diversity of generator types, ranging from large generators of dozens of waste types to the consumer-focused Universal Waste rule. As a result of these multiple variables, it is difficult to draw conclusions comparing the effectiveness of each regulatory tool or of the readiness of each sector for additional recycling. However, several insights do emerge from comparing results across the case studies.

7.1.1 Co-regulator and Regulated Entity Awareness

The regulated communities affected by these rules were aware of the existence of these rules, as evidenced by interviews with representatives from both trade associations and individual facilities. In the case of the 1998 OBSM exclusion, however, interviews pointed to a lack of understanding of or confidence in the exclusion that may stem from the complicated legal and regulatory history of this exclusion. The regulated communities were aware of these rules through the efforts of trade associations, and as a result of contact from companies seeking to provide recycling services. According to interviewees, EPA helps to promote awareness among regulatory entities during the development of the rules, but not following their promulgation.

Co-regulators involved in enforcement or who were industry specialists were also aware of these three rules. Co-regulator interviewees who are responsible for overseeing the adoption and authorization process noted that their primary source of information about new rules is an EPA website that posts information about new clusters of amendments. Interviewees found this mode of communication to be sufficient in general, but noted that they were unaware of any special efforts by EPA to make co-regulators aware of rules to encourage recycling.

7.1.2 State Adoption and Authorization of Rules

State and territorial adoptions and authorizations for these rules vary in accordance with the age of the rule. The oldest rule, the 1995 UWR, has been adopted by 42 states, while the 2000 180-day rule has been adopted by 32 states. If the rule is part of an otherwise large or complex cluster, then authorization may be delayed. Co-regulator interviewees suggested several characteristics recycling that might slow their adoption, though these factors were discussed abstractly, rather than from their experience with the case study rules specifically. They noted that states might take longer to adopt rules that would complicate enforcement, rules that conflicted with existing state law, and rules that were not mandatory or less stringent. Co-regulator interviewees were not aware of any special processes on either the state or federal level for the adoption of and authorization for rules to encourage recycling. EPA Regional interviewees cited backlogs of state authorization packages and inadequate state authorization packages as the main causes of delay in authorizing states. These procedural causes worked along with substantive ones, such as concerns about the state's program or conflicts about the equivalence of a state's regulations. If states cluster their roles, then this can also delay authorization, if certain rules in the same cluster are controversial or otherwise have problems.

Delays in authorization apparently have little effect of the regulated community's behavior. Both industry and regulator interviewees said that the state's adoption of a rule was generally the "go-ahead" for changing waste management practices. Only one of the top five refining states, California, has not adopted the 1998 OBR exclusion; California has a state regulation very similar to the exclusion, but has not formally adopted nor sought authorization for this regulation. In contrast, three of the four states with the largest presence of F006-generating facilities have not yet adopted the 2000 180-day rule. It is unclear how the delay in adoption has affected facilities in these states. The 1995 UWR addresses the widespread generation of nickel-cadmium batteries, so it is not relevant to examine adoption by states with concentrations of the affected industry.

7.1.3 Impact of Recycling Rules on Waste Management Practices and Factors Impacting Recycling

Recycling has increased in two of three cases: the Universal Waste Rule and the exclusion for oil-bearing secondary materials. We found that the rule with the largest impact was the Universal Waste Rule for NiCd batteries, which has resulted in a dramatic increase in the volume of these batteries recycled. The exclusion for oil-bearing secondary materials has also increased recycling by allowing transfers between refineries and providing a lower-cost recycling option for these materials. The 180-day rule does not appear to have resulted in an increase in recycling of F006 sludges, because any possible reduced transportation costs were not sufficient to encourage an otherwise uneconomical waste management practice.

We found that rule changes have the largest impact when the infrastructure and capacity to recycle are already in place, and when regulation or regulation-related costs represent the *primary* barrier to recycling. For example, states and the Recycling Corporation had established programs to collect, consolidate, and transport NiCd batteries to recyclers. The UWR simply eased this process by significantly reducing costs and enabling a much wider group of handlers to collect and consolidate batteries. On the other hand, while the F006 180-day rule may lead to reduced transportation costs, it has not impacted the overall costs, capacity and market for F006 wastes, and appears to have had little impact on recycling levels. With regard to the OBSM exclusion, prior to1998, refineries with petroleum cokers were already recycling secondary materials in-process at the optimal level, considering process limitations. Refinery interviewees, with suitable recycling units on-site, noted that the exclusion did result in cost savings, but did not encourage them to recycle more secondary materials in-process, because the rate was determined by other factors. In contrast, refinery-to-refinery transfers of secondary materials for recycling in the coker were not permitted prior to 1998. Removing this restriction enabled more refineries to send secondary materials off-site for in-process recycling, leading to an overall increase in the levels of in-process recycling. Overall, regulatory changes can enable or encourage an activity where the wheels are already in motion, but regulation itself does not seem to be sufficient to encourage recycling if economic factors are not already in place.

7.1.4 Changes in natural resource use and impact

Of the three case studies, the 1995 UWR has had the greatest effect on natural resource use and the largest environmental impact. The UWR has facilitated the collection of thousands of tons of NiCd batteries which might have otherwise been disposed of in the municipal solid waste stream. In 2000 alone, as much as 555 tons of cadmium may have been diverted from the municipal solid waste stream, where the metal can leach into ground and surface waters and be released into the air during incineration. Given the public health risked posed by cadmium ingestion, this reduction of cadmium in the environment is an important benefit. In addition to avoiding environmental and health damages caused by cadmium in the environment, recovery of the two valuable metals contained in these batteries reduces the demand for virgin production and its associated environmental impacts. About half of this recovered cadmium is used to produce new batteries, the remainder is reused in surface plating and in fertilizers. Nickel is in high demand and can be used in stainless steel production.

The environmental impacts of the 1998 OBSM exclusion are unclear, in large part because of uncertainty about the amount of new recycling spurred by this exclusion. The purpose of in-process recycling of oil-bearing secondary materials is to recover the hydrocarbons, which would otherwise be disposed of. However, unlike the recovery of cadmium and nickel mentioned above, recovery of these hydrocarbons does not necessarily reduce the amount of virgin material extracted. The reinsertion process does reduce the volume of the secondary materials that are ultimately disposed, but no data were available to quantify this benefit. Some interviewees expressed concern about negative environmental impacts of the exclusion, including risks stemming from a lack of regulation of secondary material management and from the increased concentrations of hazardous content in petroleum coke which is released during combustion. However, no data were available to provide a more exact understanding of these risks.

The 180-day rule does not appear to have resulted in an increase in recycling of F006 waste, and consequently has had very little effect on natural resource use or environmental impact. Some small benefits may arise from the reduced number of trucks that are needed to transport the F006 wastes from the generator to the recycler, but these benefits could not be quantified.

7.2 Recommendations for EPA

Due to limitations in the methodology for this study and in data availability, several of the evaluation questions remain unanswered. One of the most significant is an understanding of the impact of the 1998 OBSM exclusion, for which no industry-wide data are available. These data could be obtained using a broader survey of refineries, particularly those with units suitable for recycling secondary materials. Specific recommendations are in each chapter of the report. In addition, we have identified some general recommendations for EPA to consider in examining future exclusions.

<u>Enhance Communication Efforts Regarding Implementation of Rules</u>

From our analysis of the authorization and adoption of the three rules evaluated to our individual assessment of each rule, we consistently heard the need for increased outreach and communication from EPA (and in some instances from the States). This communication is especially important when dealing with rules and regulations that are voluntary in nature. Interviewees noted that EPA could make more of an effort to inform States that rules have been promulgated and EPA Regions could work more proactively with states to help ensure that rules are adopted and sent to the Regions for authorization in a manner that will facilitate Regional reviews. In addition, interviewees noted that lack of common understanding about the rules sometimes lead to uneven enforcement in different states. Among the other key points we heard were the following:

- Despite the efforts of the PRBA and the Recycling Corporation, there is still limited awareness of the UWR exclusion for Nickel Cadmium batteries among consumers and many businesses) are not aware of the rule. Consumers especially need to become more engaged if the rate of recycling is to increase and EPA needs to help in this communication effort.

- Increased communication efforts are needed to help clear up questions and uncertainties within the regulated communities about some of the rules. Some refinery representatives expressed the idea that uncertainty about the legality of some recycling practices limited the amount of recycling that they did. One IPR contractor noted that he distributed a letter he received from EPA clarifying many aspects of the exclusion and that this lead to a better understanding of the rule. Similarly, one industry representative noted that there was still uncertainty over the exclusion of oil bearing wastewater prior to primary treatment.

<u>Consider Improving StATs database</u>

EPA's database for tracking adoptions and authorizations (StATS) does not contain comprehensive information on state adoption dates. EPA staff noted that states are not required to report this information, but may do so voluntarily. The lack of complete data on state adoption dates makes it difficult to assess how quickly states are adopting rules and how much delay exists between adoption and authorization. Adoption dates are not a critical piece of data for understanding the implementation of regulations that are automatically implemented in the states. However several regulations are not implemented until the rule is adopted by the state. Therefore, rules to encourage recycling are generally not available to the regulated community until adopted by the state, increasing the significance of the adoption date. EPA should consider requiring states to report adoption dates, particularly for rules that encourage recycling, in order to increase understanding of the implementation of these rules.

Recognize that other EPA objectives, such as waste reduction or pollution prevention measures, may interfere with efforts to encourage recycling of hazardous wastes.

When evaluating rules to encourage recycling, EPA should consider how industry initiatives to comply with other environmental statutes or to reduce waste generation will affect the apparent impact of the rule on recycling. For example, increased efficiency and pollution prevention activities may be depressing the value of F006 waste recycling by decreasing the metal content in the sludge. Sludges with low metal content are less likely to be recycled because the recoverable value is less. Similarly, interviewees in the refining sector noted that generation of some hazardous wastes have decreased as refineries have improved maintenance practices that prevent debris from entering wastewater treatment systems.

Consider imposing reporting requirements to effectively assess the impacts of rules intended to encourage recycling.

If wastes are excluded from the definition of solid waste, they will not be reported in annual biennial reports, thus eliminating the BR as a source of data to identify the impacts of the rules. For example, prior to the UWR, facilities that managed their waste were required to report the quantity of batteries managed annually in the BR. Similarly, refineries were required to report the quantity of secondary materials generated annually. Since the 1998 exclusion and the UWR were promulgated, this reporting was no longer required and thus these sources of data are no longer available.

Fortunately, information on NiCd battery recycling is readily available because of the detailed records kept by the industry sponsored Recycling Corporation and the recycler. In considering future rules to encourage recycling under RCRA, EPA could consider working with affected industries to establish reporting frameworks that allow the industry to publicize the environmental benefits of their efforts and allow regulators to understand the impact of the regulations.

GLOSSARY

Adopt: State program office notifies EPA that the state has developed a rule analogous to the federal rule or that the state has incorporated the federal rule by reference. It is only during the authorization process that EPA makes a determination as to the equivalency of the state analogue.

Authorize: EPA publishes a notice in the Federal Register affirming that the state rule is equivalent to, and consistent with, the federal rule.

In-process recycling contractors: This term, which was coined for this evaluation, refers to contractors who assist refineries with managing secondary materials prior to and during their reinsertion in the refining process.

Recycling: For the purposes of this report, this term refers to activities that are also sometimes referred to as reuse or reclamation. Use of this term does not imply that a material is waste, only that it may be considered waste under certain circumstances (e.g., if the material is not recycled).

Exclusion: Rule that withdraws RCRA jurisdiction over certain industrial materials, by excluding the material from the definition of solid waste. Because hazardous wastes are a subset of solid wastes, a material excluded from the definition of solid waste is also not a hazardous waste.

REFERENCES

American Electroplaters and Surface Finishers Society, Inc. website, *Surface Finishing Basics*, http://www.aesf.org/finishingbasics.html. Viewed May 18, 2004.

Better Health Channel. Cadmium. http://www.betterhealth.vic.gov.au/bhcv2/bhcarticles.nsf/ pages/Cadmium Open Document. Viewed August 10, 2004.

Buchmann, Isidor. *Battery Statistics*. http://www.batteryuniversity.com/parttwo-55.htm Viewed May 19, 2004.

Buchmann, Isidor. *The Nickel-Based Battery, Its Dominance and the Future.* Http://www.batteryuniversity.com/partone-4.htm Viewed May 19, 2004.

California Health and Safety Code, Section 25143.2(c)(2)(d)(2)(c)(ii).

DPRA. 1995. *"Other Benefits" from Recovery of Oil in Coker Processing Units.* Memorandum to Andy Wittner. August 24.

DPRA. 1998. *Cost Impact Analysis of the Coking Exemption on Crude Oil Sludge and Clarified Slurry Oil Sludge Compliance Costs from Listing as a RCRA Hazardous Waste.* Memorandum to Andy Wittner. January 10.

DPRA 2000. *Regulatory Impact Analysis of the Final Rule for a 180-Day Accumulation Time for F006 Wastewater Treatment Sludges.* Prepared for U.S. EPA, Office of Solid Waste and Emergency Response. January 14.

DPRA. 2003. *Draft Memorandum to Paul Borst, EPA/OSW/EMRAD, Cost & Economic Impacts of F006 Recycling Exclusion from Definition of Solid Waste; DPRA WA 3941-0001-0022.* November 5.

Energy Information Administration. *Petroleum Supply Annual, 2004. Table 36. Number and Capacity of Operable Petroleum Refineries by PAD District and State as of January 1, 2004.* http://www.eia.doe.gov/pub/oil_gas/petroleum/data_publications/. Viewed August 18, 2004.

Fishbein, Bette. INFORM, Inc. *Industry Program to Collect Nickel-Cadmium (Ni-Cd) Batteries.* http://www.informinc.org/recyclenicd.php. Viewed March 31, 2004.

Industrial Economics, Inc. *Estimation of Cadmium Discards in Municipal Solid Waste*. September 1995.

Kruck, Peter. U.S. Geological Survey. *Mineral Commodity Summaries: Cadmium.* January, 1996.

Linstead, John S. *F006: Compositional Characterization A Generation After Listing.* Plating and Surface Finishing. May 1999.

Morrow, Hugh. International Cadmium Association, *Recycling Cadmium Products*. Prepared for *Recycling Metals from Industrial Waste, Colorado School of Mines, Golden Colorado, June 23, 2004.*

O'Leary, Jim. Office of Solid Waste, *Where RCRA Meets Sectors: Metal Finishing Sector*. RCRA National Meeting. August 12, 2003.

Organization for Economic Cooperation and Development, *Recycling Rate Calculation Methodologies: A Review of Techniques for the OECD Expert Group on Recycling Rate Calculation Methodology*.

Peterson, D.J. and Sergej Mahnovski. *New Forces at Work in Refining: Industry Views of Critical Business and Operations Trends.* RAND Institute, MR-1707-NETL. 2003. http://www.rand.org/publications/MR/MR1707/index.html.

Phelan, Robert. *Workshop Summary: Secondary Materials Recovery and Reuse in the Petroleum Refining Section: A Workshop and Roundtable Discussion.* July 11, 2002. Houston. Available from EPA upon request.

Plachy, Jozef. U.S. Geological Survey. *Cadmium Recycling in the United States in 2000: U.S. Geological Survey Circular 1196-0*. http://pubs.usgs.gov/circ/c1196o/. Viewed March 3, 2004.

Plachy, Jozef, David Buckingham. U.S. Geological Survey. *Cadmium Statistics.* August 28, 2002.

Plachy, Jozef. U.S. Geological Survey. *Mineral Commodity Summaries: Cadmium.* February, 2000.

Plachy, Jozef. U.S. Geological Survey. *Mineral Commodity Summaries: Cadmium.* January, 2004.

Port of Long Beach. *Healthy Harbor website*. http://www.polb.com/html/4_environment/ air quality/Particulate.html. Viewed May 26, 2004.

Portable Rechargeable Battery Association. *PRBA Goals.* http://www.prba.org/. Viewed May 19, 2004.

Rechargeable Battery Recycling Corporation. Cell phone collection and recycling program presentation.

Rechargeable Battery Recycling Corporation. *Year in Review*. http://www.Recycling Corporation.com/newsroom.html. Viewed May 19, 2004.

Rechargeable Battery Recycling Corporation website. *OEM/Licensee*. http://www.Recycling Corporation.com/licensee/index.html. Viewed May 19, 2004.

Rodríguez, Maribelle, Hannah Arnold, Syd Gernstein, Katherine Craig, and Jenny Peters. ICF Consulting. *Memorandum to James Kent: 2002 Annual Export Report Data.* December 5, 2003.

Strategic Environmental Analysis, Inc. Letter to EPA in response to Proposed Rulemaking 60 FR 57747. November 5, 1997. Docket F-97-PRA-FFFFF, PRA-L0010.

Strategic Goals Program data, *Sludge Generation at SGP Companies (based on dry solids)*, http://www.strategicgoals.org/reports2/t12har.htm. Viewed April 8, 2004.

U.S. EPA. *Summary of 1993 Hazardous Waste Exports Arranged by Country, Treatment/Disposal Method, Waste Type*.

U.S. EPA. Common Sense Initiative, Metal Finishing Sector. *Workgroup Report: F006 Benchmarking Study*. September 1998.

U.S. EPA. 1999. National Biennial RCRA Hazardous Waste Report Data Files.

U.S. EPA. 2001. National Biennial RCRA Hazardous Waste Report Data Files.

Appendix A

List of Interviewees and Interview Questionnaires

Table A-1

Case Study Interviewees

Interviewee	Affiliation	Group
1995 UWR for Nickel-Cadmium Batteries		
Hugh Morrow	International Cadmium Association	Trade Association
Norm England	Portable Rechargeable Battery Association / Rechargeable Battery Recycling Corporation	Trade Association / Collection Agent
John Onuska	Inmetco	Recycler
Steve Victor	Fedco Electronics	Battery Pack Assembler
Stan Rodriguez	Makita	Power Tool Manufacturer
1998 Oil-Bearing Secondary Materials		
Barry Hogan	Duratherm	TSDF
Neil Carman	Sierra Club -- Lone Star Chapter	ENGO
Cindy Gordon, Ralph Colleli	American Petroleum Institute	Trade Association
Tom Yarnick, Keith Truman	ExxonMobil	Refinery
Peter Day	Conoco Phillips	Refinery
Robert Phelan	Environmental Issues Management	In-process recycling contractor
Rob Short	Tetra Process Services	In-process recycling contractor
2000 180-day Rule		
John Onuska	Inmetco	Recycler
Jim Cigan	Horsehead Recyclers	Recycler
Rick Schlegel / Lee Rice	World Resources	Blender
George Cushnie	National Metal Finishing Resource Center	Trade Association
Jeff Hannapel	Policy Group, represents National Association of Metal Finishers	Trade Association
John Linstead	Artistic Plating	Job Shop
Co-Regulator Interviewees		
Jack Price	Florida	State contact
Todd Marvel	Illinois	

Table A-1 Case Study Interviewees		
Interviewee	**Affiliation**	**Group**
Tom Weirich and Jesse Boultinghouse	Texas	
Sharon Parker	Louisiana	
Regional Interviewees		
Adolph Everett	Region 2	
Luis Pizarro	Region 3	
Sue Brauer	Region 5	
Karl Bremer	Region 5	
Michelle Pease	Region 6	
Rich Vaille	Region 9	
EPA Headquarters		
Allison Watanabe	Permits and State Programs Division	
Paul Borst		
Ross Elliott	Office of Solid Waste	

QUESTIONS FOR REGIONAL CONTACTS

1. Can you describe the overall mission of your office, and what your role is within the office? How long have you been in this position?

2. To what extent are you involved in authorizing states for new federal rules? To what extent did you work on the three rules we are examining for this evaluation?

3. How long do states in your Region generally take to adopt RCRA rules and modifications? What factors affect this process?

4. How much time do you generally need to review and authorize states' adoption packages? What factors affect this process?

5. When a federal rule is promulgated, when would you expect the regulated community to change its practices? How does the length of time it takes to adopt and/or authorize a rule impact behavior? How do circumstances differ for HSWA and non-HSWA rules?

6. To what extent does the adoption / authorization process differ for RCRA rules that encourage recycling than for other kinds of new RCRA rules (e.g., new listings, new LDR requirements, etc...)? If so, how and why?

7. What strategies do you use to encourage states to adopt exemptions or rules that encourage recycling under RCRA? Are there other strategies you could employ to better encourage states to adopt these kinds of rules?

8. Our understanding is that the 1996 Mercury-Containing and Rechargeable Battery Management Act implemented the Ni-Cd battery components of the Universal Waste Rule nationally. Thus, until states adopt and are authorized for the UWR, EPA is responsible for implementing the rule. Is this correct? Has this approach to

implementation promoted more recycling than otherwise would have occurred? Do you think this mechanism could be used to speed implementation of other rules?

9. How has the Ni-Cd battery component of the Universal Waste rule impacted the rate of recycling of Ni-Cd batteries?

10. To what extent has the 1998 exclusion for oil-bearing residuals in petroleum refining changed recycling practices within that industry? What other regulatory or economic factors are important in refiners' decisions about whether to recycle oil-bearing residuals?

11. How have F006 waste management practices changed as a result of the 180-day rule? To what extent do other regulatory or economic factors are important in generators' decisions about whether to recycle F006?

12. Who else should I talk to in order to learn more about the impact of these rules intended to encourage recycling under RCRA?

13. Do you know of any documents or reports that I can refer to for more information?

14. Is there anything else we have not discussed that could be important for our evaluation?

SAMPLE QUESTIONS FOR STATE REGULATORS

1. Can you describe the overall mission of your office? What is your role? How long have you been in this position?

2. Are you involved in preparing authorization packages for new federal rules? Did you work on Louisiana's adoption of any of the three rules we are examining for this evaluation?

3. Are you aware of EPA regulations to encourage recycling of oil-bearing residuals from petroleum refineries, F006 wastes and nickel-cadmium batteries? If so, when and how did you learn about these rules? What strategies should EPA could use to inform you about changing regulations?

4. Does Louisiana have more stringent regulations regarding any of these waste streams or sectors?

5. How has the Ni-Cd battery component of the Universal Waste rule impacted the rate of recycling of Ni-Cd batteries?

6. How has the 1998 exclusion for oil-bearing residuals in petroleum refining changed recycling practices within that industry? What other regulatory or economic factors are important in refiners' decisions about whether to recycle oil-bearing residuals?

7. How have F006 waste management practices changed as a result of the 180-day rule? To what extent do other regulatory or economic factors are important in generators' decisions about whether to recycle F006?

<u>Adoption</u>

8. When did you adopt the F006 180-day and the Universal Waste rules?

9. Why did you adopt all three of these rules?

10. What steps did EPA take to encourage you to adopt these rules?

11. How long does it generally take to adopt a new federal rule? Is this length of time any different for recycling rules? What factors impact the length of time for adoption?

12. How heavily did industry interests lobby your state to adopt these rules?

Authorization

13. When do you expect to be authorized for the Oil-Bearing Residuals exclusion and the F006 180-day rule?

14. How long does it generally take to be authorized for a new federal rule? Is this length of time any different for recycling rules? What factors impact the length of time for authorization?

15. Our understanding is that the 1996 Mercury-Containing and Rechargeable Battery Management Act implemented the Ni-Cd battery components of the Universal Waste Rule nationally. Thus, until states adopt and are authorized for the UWR, EPA is responsible for implementing the rule. Is this correct? How has this approach to implementation promoted more recycling than otherwise would have occurred? How could this mechanism be used to speed implementation of other rules?

16. What strategies do you use to inform the regulated community of new rules to encourage recycling?

17. When a federal rule is promulgated, when would you expect the regulated community to change its practices? How does the length of time it takes to adopt and/or authorize a rule impact behavior? How do circumstances differ for HSWA and non-HSWA rules?

18. Does Louisiana collect any additional data from hazardous waste generators that you do not report to EPA and are not included in BRS?

Summary

19. Who else should I talk to in order to learn more about the impact of these rules intended to encourage recycling under RCRA?

20. Do you know of any documents or reports that I can refer to for more information?

21. Is there anything else we have not discussed that could be important for our evaluation?

SAMPLE INTERVIEW QUESTIONS FOR OIL-BEARING RESIDUALS CASE STUDY

1. Can you tell me a bit about API and its mission, and what your role is for them? How long have you been at API? In this position?

2. To what extent do you and your organization deal with regulatory issues that might affect waste management practices at refineries?

3. To what extent are refineries aware of the 1998 exclusion? What factors influence which refineries are aware of this exclusion? What role did outreach by EPA and the states play in the awareness of your member companies?

4. In your view, what has been the impact of the 1998 exclusion for oil-bearing residuals on recycling practices in the sector?

5. What other factors impact a specific refinery's decision about whether to recycle, or what portion of the waste will be recycled? For example, how do transportation, treatment and disposal costs factor into decisions about recycling?

6. To what extent has industry-wide capacity for reusing oil-bearing residuals changed over the last 10 years? What factors have impacted this change (e.g., proposed exemptions, available technology, changes in the nature of input crude)?

7. What are the environmental impacts of any changes in how oil-bearing residuals from petroleum refining are managed?

8. How do you generally learn about new rules and regulations that may affect the refining sector? To what extent do you communicate this knowledge to your member companies?

9. What are some strategies that EPA or the states could use to better inform your member companies about exclusions affecting your sector? Why do you think these strategies would be effective?

10. What other steps could EPA take to encourage recycling in this sector?

11. Can you recommend anyone else in the industry to whom I should talk to learn more?

12. Do you have any documents or reports that I can refer to for more information?

13. Is there anything else we have not discussed that could be important for our evaluation?

SAMPLE INTERVIEW QUESTIONS FOR F006 CASE STUDY

I. Can you tell me about your organization and its objectives? What is your role within the organization?

Awareness

II. To what extent do you and your organization deal with regulatory issues that might affect waste management practices?

III. To what extent are electroplaters aware of the rule for a 180-day accumulation time for F006 wastewater treatment sludges (180-day rule)?

IV. How do you generally learn about environmental regulatory changes affecting your sector? How do the affected businesses generally learn about rules that might affect their operations?

V. What factors impact awareness? What role did outreach by EPA and the states play in your awareness of the 180-day rule?

VI. What are some strategies that EPA or the states could use to inform you or F006 generators about relevant rules? Why do you think these strategies would be effective?

Waste Management Practices

VII. To what extent has the 180-day rule affected waste management practices?

VIII. What have been the recent trends in F006 waste generation? What factors have affected these changes?

IX. Approximately what proportion of F006 waste is recyclable based upon the metal type and concentration in the sludges? Has this proportion changed over time?

X. How has the level of F006 waste recycling changed over time?

XI. What factors impact electroplaters' decisions to recycle F006 wastes (e.g., transportation costs, disposal costs)? How has the 180-day rule affected these factors?

XII. To what extent has the capacity to recycle F006 wastes changed over time? What factors have impacted this change (e.g., changing regulations, available technology)?

XIII. What else could EPA do to encourage increased recycling of F006 wastes (e.g., technical assistance, proposed rule to exclude F006 wastes)?

Benefits of the 180-Day Rule

XIV. While we understand sludge metal concentrations will affect recovery levels, on average how much metal is typically recovered from one ton of F006 waste?

XV. Can you estimate the total amount of metal that has been recovered from recycling F006 wastes?

XVI. What environmental benefits result from F006 recycling?

XVII. Have electroplaters seen other benefits as a result of the 180-day rule or increased F006 recycling?

Summary

XVIII. Who else should I talk to in order to learn more about F006 generation or recycling?

XIX. Do you know of any documents or reports that I can refer to for more information?

XX. Is there anything else we have not discussed that could be important for our evaluation?

SAMPLE INTERVIEW QUESTIONS FOR NiCd BATTERY CASE STUDY

I. Can you tell me more about your organization and its objectives? What is your role within the organization?

Awareness

II. To what extent do you and your organization deal with regulatory issues that might affect waste management practices?

III. To what extent are businesses and institutions aware of the Universal Waste Rule (UWR) for Ni-Cd batteries and the 1996 Mercury-Containing and Rechargeable Battery Management Act (Battery Act)? What about communities and local governments?

IV. How do you generally learn about rules that might affect your industry? Do you know how communities and local governments become aware of rule changes?

V. What factors impact awareness? What role did outreach by EPA and the states play in your awareness of the UWR?

VI. What are some strategies that EPA or the states could use to inform Ni-Cd generators about relevant rules? Why do you think these strategies would be effective?

Waste Generation and Ni-Cd Battery Recycling

VII. How has your company's rate of Ni-Cd battery generation changed over time?

VIII. How has the amount of batteries you recycle changed? What proportion of the used Ni-Cd batteries you generate are recycled?

Factors Impacting Recycling

IX. How has the UWR and the Battery Act impacted your recycling decisions?

X. What impact have collection corporations, such as the Rechargeable Battery Recycling Corporation, had upon recycling levels?

XI. What other factors impact your decision about whether to recycle Ni-Cd batteries (e.g., transportation costs, disposal costs)?

XII. What incentives or market changes could further increase the level of Ni-Cd battery recycling?

Benefits of the Ni-Cd Battery Recycling

XIII. How much metal has been recovered from your recycling of Ni-Cd batteries?

XIV. What are the benefits of increasing recycling of Ni-Cd batteries?

Summary

XV. Who else should I talk to in order to learn more about Ni-Cd generation or recycling?

XVI. Do you know of any documents or reports that I can refer to for more information?

XVII. Is there anything else we have not discussed that could be important for our evaluation?

Appendix B

Methodology for Adoption and Authorization Status of RCRA Recycling Case Studies

We relied on several sources of information to determine if, and when, states have adopted and are authorized for the three rules and when adoption / authorization occurred. We used the EPA database known as StATS (State Authorization Tracking System), as well as the adoption and authorization reports generated from the StATS database that are available on EPA's website.[57] The first step in accessing this information was to identify the Checklist numbers for each of the three case studies, which are then used to locate the rule in the StATS records.[58] We obtained an MSAccess 2000 version of the StATS database from EPA's Permits and State Programs Division (PSPD) containing information current as of December 31, 2003. This database was compiled from a series of older databases and spreadsheets and consequently contains a number of artifact and duplicate fields that are no longer updated. For instance, the *STATS* and *AUTHORIZATIONS* tables in this database contain many of the same field, but occasionally, different data populate these fields. We queried both the *STATS* and *AUTHORIZATION* tables within the most recent version of the StATS database and identified discrepancies between these tables and between the StATS database and the information available online.[59]

In consultation with PSPD staff, we developed a series of decision rules to address conflicts in the available data.

- Where information about the adoption and authorization status for a particular rule in a particular state differed between the Access database and the online information, we opted for what was noted in the summary table online.
- Where information about the adopt dates in the database differed, we used the date provided in the *AUTHORIZATION* table of the database, on the recommendation of PSPD staff.
- Where authorization dates conflicted between Access and online versions of the database, we used the value online.
- Where the database indicated that the rule was not adopted/authorized, but provided a date for the same event, we changed the information in the database to note that the rule had been adopted/authorized.

---

[57]EPA Office of Solid Waste and Emergency Response, *Authorization Status for All RCRA / HSWA Rules Listed by Checklist Number*, December 31, 2003, http://www.epa.gov/epaoswer/hazwaste/state/stats/stats_rulespecific.htm.

[58]Checklist Numbers: http://www.epa.gov/epaoswer/hazwaste/state/stats/maps/allrules.pdf

[59]StATS Records online: http://www.epa.gov/epaoswer/hazwaste/state/stats/maps/authall.pdf

States are not required to provide information about the data on which they adopted rules, and consequently, only about half of these dates are included in the database. In order to conduct the analysis of the rate of adoption, we worked with EPA to collect additional information from the states on adoption dates (See Table B-1). We did not receive responses from a number of states, so the states for which adoption dates which are missing from the analysis are shown in Table B-2.

Table B-1

Adoption Dates Information Provided by States

State	1995 UWR	1998 OBR	2000 180-day rule
Arkansas	01/21/1996	--	--
Connecticut	10/31/2001	--	--
Florida	05/11/1995	--	--
Georgia	12/06/1995	10/27/1999	--
Idaho	–	–	03/30/2001
Mississippi	04/12/1996	–	--
Missouri	–	09/04/2001	09/04/2001
Nevada	–	01/26/2000	10/06/2000
New Hampshire	10/13/2001	–	10/13/2001
New Mexico	06/14/2000	06/14/2000	--
Ohio	07/28/1997	12/07/2000	--
Oklahoma	06/01/1997	–	06/11/2001
Tennessee	–	–	10/17/2001
Washington	02/12/1998	–	--
Wisconsin	06/01/1998	–	–

Source: EPA personal contact with state representatives on EPA's Definition of Solid Waste task force

Table B-2 States for which Adoption Dates are Unknown		
Rule	**Count**	**States**
1995 UWR	12	VT, VA, WV, AL, KY, SC, NC, IL, IN, LA, TX, WY
1998 OBSM	7	NC, SC, IL, IN, CO, MT, UT
2000 180-day rule	3	SC, LA, UT

For the analysis of adoption and authorization rates, we used only the year information of the adoption, authorization, and promulgation dates of the rule.

Using these data, we analyzed several metrics:

- Number and percent of states that have adopted the rules
- Number and percent of states that have been authorized for the rules
- Rates at which states adopted and were authorized for the rules
- Regional differences in adoption and authorization rates.
- Rates of adoption in states with a significant presence of industry affected by the rules versus rates of adoption states without such an industry presence.

Appendix C

Supplemental Information for 1998 Oil-Bearing Secondary Materials Exclusion

Table D-1

Number of Refineries in U.S. States

State	Number of Refineries
Texas	30
California	24
Louisiana	18
Illinois, Pennsylvania	10
New Jersey, Ohio	7
Indiana, Kansas	6
Oklahoma, Utah, Washington, Wyoming	5
Mississippi	4
Alabama, Colorado, Michigan, Montana, New Mexico	3
Alaska, Arkansas, Hawaii, Kentucky, Puerto Rico	2
Delaware, Florida, Georgia, Minnesota, North Dakota, New Hampshire, Oregon, Tennessee, Virginia, Wisconsin, West Virginia, Virgin Island	1
Arizona, Connecticut, District of Columbia, Guam, Iowa, Idaho, Massachusetts, Maryland, Maine, Missouri, North Carolina, Nebraska, Nevada, New York, Rhode Island, South Dakota, South Carolina, Vermont	none

Source: Facilities reporting under NAICS 32411 to the 2001 Biennial Report. Site ID Form, Item 6.

Appendix D

Methodology for 180-Day Rule for Wastewater Treatment Sludge

In order to assess impacts of the 180-day rule, IEc analyzed 1999 and 2001 hazardous waste data as reported in the annual Biennial Reports (BR). Using this data, IEc assess both the quantity of F006 waste generated and the quantity of waste recycled. IEc used an analysis conducted by DPRA in November 2003, *Cost & Economic Impacts of F006 Recycling Exclusion from Definition of Solid Waste; DPRA WA 3941-0001-0022*, as the model for the analysis. IEc's analytic steps are outlined below. Key differences from the DPRA analysis are explained in footnotes throughout.

1. Queried F006-Only Wastes

IEc located all waste streams including F006 waste by querying the MSAccess databases. IEc first identified all waste streams that contained F006 waste using the waste code. IEc then limited the results to those waste streams that contained only F006 by eliminating all wastes streams with more than one associated waste code. We summed the total number of waste streams and the tons generated; the results are presented in Exhibit D-1.

In order to convert the quantities reported in the Biennial Report to tons for the purposes of aggregation, IEc relied upon a formula developed internally. This formula takes into account all unit conversions, including conversions based on density and specific gravity. The results of IEc's formula differ from the tons EPA calculated and included in the 1999 hazardous waste database. IEc opted to use the IEc-formula after thorough QA/QC of the results and a conversation with Dave Levy, EPA/OSWER.

Exhibit D-1

Waste Streams Containing Only F006

Reporting Year	Number of Waste Streams	Tons of Waste
1999	2,599	2,294,925
2001	3,385	458,954

2. Limited the Results to Solids and Sludges

Because F006 wastewater treatment sludges should be in either solid or sludge form, IEc limited the results to only solids and sludge wastes using the form code associated with each waste stream in the BR databases. A total of 66 form codes are associated with the 2,599 streams of waste reported in 1999. IEc identified 37 form codes within the F006-only waste streams reported in the 2001 BRS. IEc limited waste streams to those classified by the solid or sludge form codes.

IEc also eliminated solid and sludge waste streams with form codes that indicate that they are clearly not electroplating treatment sludges. IEc removed wastes with the following form codes from the 1999 results:

- B301, Soil contaminated with organics;
- B302, Solid contaminated with inorganics only;
- B307, Metal scale, filings, or scrap;
- B308, Empty or crushed metal drums or containers;
- B309, Batteries or battery parts, casings, cores; and
- B310, Spent solids filters or absorbents.

In the 2001 BR wastes in the form of B301, B302, B309, and B310 were reclassified as mixed media wastes and debris. As a result, these wastes were automatically limited from the 2001 data queries when IEc limited the results to waste with solid and sludge form codes. IEc did eliminate metal scale, filings, or scrap (form code W307, formerly form codes B307 and B308) from the 2001 BR results. Ultimately, IEc analyzed wastes with 27 different form codes in 1999 and 20 form codes in 2001.[60] The results of these analyses are presented in Exhibit D-2.

---

[60]In their November 2003 analysis, DPRA also eliminated B510, degreasing sludge with metal scale, wastes from their analysis. IEc found three F006-only waste streams with this code reported in 1999, totaling only 6.225 tons. When EPA made changes to the BR in 2001, B510 wastes were grouped with B505, untreated plating sludge without cyanides, wastes in a new consolidated code, W505, metal bearing sludges (including plating sludge) not containing cyanides. Wastes previously classified as B505 are likely wastewater treatment sludges and should be included in the analysis. As a result, to ensure consistency between the 1999 and 2001 analyses, IEc did not remove the wastes formerly classified with code B510.

Exhibit D-2 Solid and Sludge Wastes Containing Only F006		
Reporting Year	**Number of Waste Streams**	**Tons of Waste**
1999	1,690	233,429
2001	1,510	142,547

III. Eliminated Source Codes

IEc eliminated wastes which, based upon the generation source code, do not appear to be F006 wastewater treatment sludges. For example, IEc removed one-time or intermittent wastes and wastes derived from remediation or closure. A complete list of the source codes IEc eliminated is included in a table at the end of this Appendix.[61] The total number of waste streams and quantity of waste generated is reported in Table D-3.

Table D-3 Solid and Sludge Wastes Containing Only F006 From Appropriate Sources		
Reporting Year	**Number of Waste Streams**	**Tons of Waste**
1999	1,451	225,888
2001	1,352	137,170

IV. Eliminated NAICS code 562

IEc eliminated all wastes generated by Waste Management and Remediation Services facilities, as these facilities are clearly not eligible for the 180-day extension. Generators reported

[61] Guidance on source codes also provided by Dave Guftason, DPRA.

SIC codes in the 1999 BR and NAICS code in 2001. IEc eliminated all wastes generated by facilities with SIC code 4953 in 1999 and NAICS 562 in 2001. Generators may report several SIC or NAICS codes; for the purposes of this analysis, IEc relied upon the first code they reported. After eliminating waste streams with this source code, IEc recalculated the number of waste streams and quantity of waste generated. These results are presented in Table D-4.

Table D-4

Solid and Sludge Wastes Containing Only F006

From Appropriate Sources Not Generated by Waste Management Facilities

Reporting Year	Number of Waste Streams	Tons of Waste
1999	1,413	220,964
2001	1,313	118,478

I. Analyzed Method of Waste Management

IEc analyzed the reported treatment method of those waste streams included in the analysis. Some generators provided information on both onsite and offsite treatment for a given waste stream. In addition, in some cases multiple methods were used to treat a single portion of waste or distinct portions of the same waste stream. To account for waste streams treated using multiple management methods, IEc relied upon the waste information presented in the management information tables. In some cases, the quantities reported managed for a given waste stream differ slightly from the quantity reported generated. Thus the total tons of waste in subsequent Tables differs slightly from the total presented in Table D-4.

In order to prevent double counting, IEc examined each waste stream that contained information on both on and offsite treatment and every waste stream where the total tons of waste treated greatly exceeded the quantities generated. Using the management method codes, IEc assessed whether distinct portions of a single waste stream were being treated, or whether treatment information for the same portion of waste was being reported multiple times. Where a portion of waste was being reported multiple times, IEc relied upon the offsite management information, as this treatment was likely secondary to any treatment conducted onsite (e.g., offsite landfilling following dewatering onsite). The quantity of waste treated on and offsite is presented in Table 5.

Table D-5 Treated F006 Wastewater Treatment Sludges by Management Location				
Location	**1999**		**2001**	
	Number of Waste Streams	**Tons of Waste Managed**	**Number of Waste Streams**	**Tons of Waste Managed**
Offsite	1,372	126,745	1,292	105,151
Onsite	26	90,435	23	12,430
Total	**1,413**[1]	**217,180**	**1,313**[2]	**117,581**

[1] Seven waste streams are managed both on and off site. Twenty-two waste streams have no management information or the quantity reported managed is 0.

[2] Ten waste streams are managed both on and offsite. Eight waste streams have no management information or the quantity managed is 0.

The management methods used to treat the F006 waste are illustrated in Table C-6. Note that the waste stream quantities do not sum to total because many waste streams are treated using more than one management method. Double counting is avoided when summing tons managed because only the portion of the waste stream managed with a given management method is assigned to that management type category. The specific management method codes included in the management type categories are in a table at the end of this Appendix.

Table D-6 Treated F006 Wastewater Treatment Sludges by Management Type				
Management Type	**1999**		**2001**	
	# of Waste Streams / Tons of Waste Managed		**# of Waste Streams / Tons of Waste Managed**	
	Onsite	**Offsite**	**Onsite**	**Offsite**
Metals Recovery	1 / 2	522 / 36,859	0 / 0	437 / 23,104
Stabilization	0 / 0	413 / 34,698	0 / 0	330 / 23,591
Land Disposal	4 / 18,784	135 / 8,396	1 / 5,208	222 / 14,268
Aqueous organic/inorganic, sludge, or other treatment	9 / 6,017	264 / 41,204	14 / 7,168	236 / 29,363
Transfer facility storage– waste was not treated, recycled, disposed	7 / 24	217 / 4,829	8 / 55	226 / 11,853
Other	5 / 65,609[1]	70 / 758	0 / 0	90 / 2,971
Total	**26 / 90,435**	**1,372 / 126,745**	**23 / 12,430**	**1,292 / 105,151**

[1] One facility reports discharging 65,605 tons of waste directly to a sewer/POTW. This facility is likely reporting the electroplating wastewaters, rather than the F006 sludge.

II. Analyzed Portion of Waste Recycled and Disposed

Aqueous organic / inorganic treatment, sludge treatment, or other treatment is likely the first unit process in a treatment train ultimately leading to disposal or recycling. These initial treatments are done to consolidate the sludge or prepare the material for final disposition.[62] Because of large number of generators provided information on this initial step in the treatment process, IEc cannot determine the final disposition method (e.g., metals recovery, landfilling). As a result, these

[62] Personal communication with Paul Borst, EPA, and Dave Guftason, DPRA, May 18, 2004.

quantities are not included in the final results. Because of uncertainty regarding the final method of disposal and concerns with reporting accuracy, IEc also excluded those wastes in the "other" row and those reporting transfer facility storage. Table D-7 presents the quantity and percentages of wastes land disposed, stabilized, and sent for metals recovery.

Table D-7

Management Summary of F006 Wastewater Treatment Sludges

Management Method	**1999**		**2001**	
	Number and Percent of Waste Streams	**Quantity and Percent of Waste**	**Number and Percent of Waste Streams**	**Quantity and Percent of Waste**
Metals Recovery	523 (49%)	36,861 (37%)	437 (44%)	23,104 (35%)
Stabilization	413 (38%)	34,698 (35%)	330 (33%)	23,591 (36%)
Land Disposal	139 (13%)	27,180 (28%)	223 (23%)	19,475 (29%)
Total	**1,075**	**98,739**	**990**	**66,171**

Excluded Source Codes

Excluded Source Codes		
Description	**Source Codes Excluded From 1999 BRS**	**Source Codes Excluded From 2001 BRS**
Waste received from off-site and not recycled or treated on-site	• Origin Code 4 Records	• G61– Hazardous waste received from off site for storage/bulking
One-time and Intermittent Waste Records	• A57– Discarding Off-Spec Material • A58– Discarding out-of-date products or chemicals	• G11– Discarding off-specification or out-of-date chemicals or products
	• N/A, new code in 2001	• G12– Lagoon or sediment dragout and lechate collection
	• A09– Clean our process equipment	• G13– Cleaning out process equipment
	• A38– Tank Sludge Removal • A39– Slag Removal • A60– Sludge Removal	• G14– Removal of tank sludge, sediments, or slag
	• A56– Discontinued Use of Process Equipment	• G15– Process Equipment Change-Out or Discontinuation of Equipment Use
	• A54– Oil Changes • A55– Filter/Battery Replacement	• G16– Oil Changes and Filter or Battery Replacement
	• A59– Other Production-Derived One-Time and Intermittent Processes • A91– Clothing and Personal Protective Equipment	• G19– Other One-Time or Intermittent Processes
	• N/A, new code in 2001	• G31– Accidental contamination of products, materials, or containers
	• A53– Cleanup of Spill Residues	• G32– Cleanup of Spill Residues
	• A51– Leak Collection • A92– Routine Cleanup Wastes	• G33– Leak Collection and Floor Sweeping

Excluded Source Codes		
Description	**Source Codes Excluded From 1999 BRS**	**Source Codes Excluded From 2001 BRS**
	• N/A, new code in 2001	• G39– other cleanup of current contamination

Excluded Source Codes		
Description	**Source Codes Excluded From 1999 BRS**	**Source Codes Excluded From 2001 BRS**
Remediation Derived and Closure Waste	• A64– RCRA Closure of Hazardous Waste Management Unit	• G41– Closure of Hazardous Waste Management Unit Under RCRA
	• A63– RCRA Corrective Action at Solid Waste Management Unit	• G42– Corrective Action at a Solid Waste Management Unit Under RCRA
	• A61– Superfund Remedial Action • A62– Superfund Emergency Response	• G43– Remedial Action or Emergency Response Under Superfund
	• A93– Closure of management unit(s) or equipment other than by remediation specified in codes A61 - A69	• G44– State program or voluntary cleanup
	• A65– Underground Storage Tank Cleanup	• G45– Underground storage tank cleanup
	• A69– Other Remediation	• G49– Other Remediation

Definition of Management Type Categories

Management Methods Codes		
Management Type	**1999 Management Method Codes**	**2001 Management Method Codes**
Metals Recovery	M011– High Temperature Metals Recovery M012– Retorting M013– Secondary Smelting M014– Other Metals Recovery for Reuse (ion exchange, reverse osmosis, acid leaching) M019– Metals Recovery, type unknown	H010– Metals Recovery, including retorting, smelting, chemical
Stabilization	M111– Stabilization/Chemical Fixation Using Cementitious and/or Pozzolanic Materials	H111– Stabilization or Chemical Fixation Prior to Disposal at Another Site
	M112– Other Stabilization	H112– Macro-encapsulation Prior to Disposal at Another Site
	M119– Stabilization, type unknown	No corresponding code
Land Disposal	M131– Land Treatment/Application/Farming	H131– Land Treatment or Application (to include on-site treatment and/or stabilization)
	M132– Landfill M133– Surface Impoundment (to be closed as a landfill)	H132– Landfill or Surface Impoundment that Will be Closed as Landfill
Aqueous organic/inorganic, sludge, or other treatment	M071 - M079 Aqueous Inorganic Treatment	H071 - Chemical reduction H073 - Cyanide destruction H077 - Chemical Precipitation
	M081 - M089 Aqueous Organic Treatment	H081 - Biological treatment
	M091 - M099 Aqueous Organic and Inorganic Treatment	No wastes with corresponding codes

Management Methods Codes		
Management Type	**1999 Management Method Codes**	**2001 Management Method Codes**
	M101 - M109 Sludge Treatment	H101 - Sludge treatment and/or dewatering
	M121 - M129 Other Treatment	H121 - Neutralization only H122 - Evaporation H124 - Phase separation H129– Other Treatment
Transfer Facility Storage - waste was shipped offsite without treatment, disposal, or recycling	M141 - Transfer facility storage	H141 - Storage, bulking, and/or transfer offsite
Other	All other codes	All other codes

APPENDIX E

QUALITY ASSURANCE PLAN

Title: Program Evaluation of RCRA Recycling Regulations that Foster Increased Recycling of Hazardous Wastes

Plan Summary: This evaluation will mine data from EPA reports and will interview key informants to describe the processes and outcomes associated with OSW's hazardous waste exclusions. These data collection methods will generate a mix of qualitative and quantitative data. These data will be triangulated across sources and research methods; consistent results will suggest that the data are reliable and valid, while inconsistencies will suggest greater uncertainty and less validity. The data will be portrayed as such. The actual product will be an evaluation report, which will contain recommendations and lessons learned to help improve EPA's program. The report will be shared with interested study participants. At this time, it is not clear if the report will be made available to the general public.

Organization: National Center for Environmental Innovation, OEPI.

EPA Project Leader: Mike Mascia, OPEI

Mary Beth Sheridan, OSWER

EPA Quality Manager: Mike Mascia

Date: November 30, 2004

Date: