

Biodiesel Health Effects

Biodiesel Tier 2 Summary

Steve Howell

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Biodiesel Tier 2 Background □

National Biodiesel Board Contracted with Lovelace Respiratory Research Institute (LRRI)

Work Conducted at LRRI Jan-June, 1999 □

Exposed 10 wk old F & M F344 rats

- 6 hrs/day, 5 days/wk for 13 weeks
- Whole diluted emissions, 1998 Cummins B5.9
- 100 % biodiesel produced from soybean oil
- 3 levels (H, M, L) plus negative control □

Tier 2: Health Evaluations

General Toxicity:

- Body Weight & Feed Consumption
- Clinical Observation
- Mortality
- Hematology (cell counts)
- Clinical Chemistry (liver & kidney function)

Pathology (gross and histopathology, all organs)

Tier 2: Health Evaluations

Ophthalmology

Neuropathology

- Histopathology of brain, spinal cord, nerves
- Brain glial fibrillary acidic protein

Reproduction

DNA Damage:

- Micronucleus in bone marrow red blood cells
- Sister chromatid exchange in lymphocytes

Tier 2 Exposure Conditions

	<u>High</u>	<u>Med</u>	<u>Low</u>	<u>Control</u> □
NO _x , ppm	50.7	25.6	5.2	0.6
CO, ppm	36.5	15.3	2.2	0.5
HC, ppm	0.5	0.3	0.1	0.1
PM, mg/m ³	1.1	0.5	0.1	0.0

LRRI-Biodiesel Tier 2 Results

No Significant Exposure-Related Effects
On:

- Feed Consumption
- Clinical Condition
- Mortality
- Ophthalmology
- DNA (Micro-nucleus, Sister Chromatid)
- Neural Parameters
- Reproduction (Fertility, Teratology)

LRRI-Biodiesel Tier 2 Results

Minor Exposure Effects Deemed Not
Biologically Significant

– **Body and Organ Weights:**

Lower liver weight

Higher relative lung weight in F

Higher relative testis weight in M

– **Clinical Chemistry:**

4 Liver-related parameters decreased

Glucose increased

LRRI-Biodiesel Tier 2 Results

Minor Exposure Effects:

– Lung Histopathology:

Dose-related increase in macrophages containing particulate matter

Minor alveolar cell changes in 4/30 females in the high level group

Caused by particles, but not toxic effect

Effect diminished after 28 days non-exposure

LRRI Biodiesel Tier 2 Conclusions

Only Biologically Significant Biodiesel Exhaust Exposure Effect was a Small Effect in Lungs at the High Exposure Level:

- Increased macrophages in M & F
- Slight increase in F lung weight
- Cellular changes in a few F

Based on this, the No Observable Adverse Effects Level (NOAEL) was the Medium Level

Biodiesel Use in Fuel Cells: □ The Renewable Fuel Cell Fuel □

Most fuel cell research is on fossil fuel derivatives which contribute to global warming and other spill hazards:

- Natural Gas, Methanol, Gasoline, Petrodiesel

Biodiesel is a renewable fuel that reduces life cycle CO₂ by almost 80% compared to petrodiesel

Biodiesel energy balance is 3.2 to 1

Biodiesel is non-toxic, biodegradable with high flash point (over 130 C)

Biodiesel Use in Fuel Cells: □ The Renewable Fuel Cell Fuel □

Biodiesel Composition:

- 76.25% Carbon
- 12.50% Hydrogen
- 11.25% Oxygen
- < 3 ppm sulfur (from soybean oil)
- Straight chain molecule (no aromatics)
- High energy density (B100 8% lower than #2 petrodiesel)

Biodiesel Use in Fuel Cells: □ The Renewable Fuel Cell Fuel □

Entities investigating biodiesel use in fuel cells: □

- Ag Environmental Products (AEP)—Soygold
- Iowa Soybean Association (ISA)
- National Renewable Energy Laboratory

Biodiesel has been successfully used in commercial reformers

Biodiesel Use in Fuel Cells: □ The Renewable Fuel Cell Fuel □

AEP Preliminary Results

Idatech Reformer

- 12 ml/min bio-diesel feed rate
- 18 sL/min high purity hydrogen
- Enough to run 1.5 kW fuel cell

Hydrogen purity:

- >99.98% hydrogen
- <1 ppm CO
- <3 ppm CO₂

Biodiesel Use in Fuel Cells: □ The Renewable Fuel Cell Fuel □

Further Research On-going, AEP/ISA: □

- Further investigation of various reformers
- Analysis of fuel cell type (alkaline, PEM, phosphoric acid, molten carbonate, solid oxide)
- Selection and installation of 1-10 kW unit for real world trial
- Scale up to commercial size (200-250 kW)

NREL research on various oils, fats, trap greases and biodiesel.