

Electrochemical Production of Potassium Ferrate

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Environmental Problem

Oxidizing agents such as chlorine, chlorine dioxide, hypochlorite, and ozone are used by many industries in the synthesis of fine chemicals and pharmaceuticals, as well as to treat hazardous industrial waste. Many of the currently available oxidants, however, require harmful starting materials and generate harmful byproducts. Because many of these oxidizing agents often have a detrimental impact on public health and the environment, new regulations are targeting many currently used oxidants as a problem that must be addressed. As a result, the industrial sector has been forced to identify, and put in use, environmentally friendly alternatives to traditional oxidizing agents. So far, however, a chemically effective alternative that could be affordably manufactured to meet the industry's needs has not been identified.

SBIR Technology Solution

With support from EPA's SBIR Program, Lynntech, Inc., developed a revolutionary new electrochemical method for the production of high purity, solid potassium ferrate (K_2FeO_4). Ferrate can exchange

any existing oxidizing agents (e.g., potassium permanganate, chlorine, peroxide, ozone, chromates, etc.) and can be applied in a wide range of applications for which environmentally benign oxidizers are needed (e.g., municipal disinfection, sterilization, decontamination, conversion coatings, etc.). Lynntech's process permits the bulk synthesis of highly crystalline K_2FeO_4 at one-tenth the cost of that required using conventional methods. Furthermore, the process is significantly more efficient than conventional electrochemical processes.

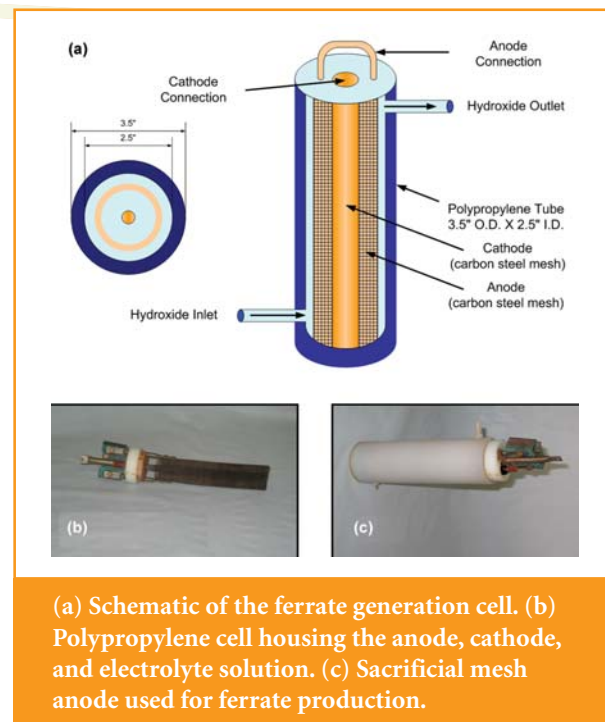
The use of a single chamber cell eliminates the need for expensive proton exchange membranes, and Lynntech's sodium hydroxide/potassium hydroxide electrolyte system allows for single-step production and separation of ferrate. Final ferrate purity is greater than 98%, the electrolyte can be recycled, and no potentially hazardous waste streams are produced. Online magnetic separation allows for continuous processing. Lynntech's process requires only low-cost stock chemicals, effectively lowering the cost of ferrate production.

This new process, which will facilitate the widespread use of ferrate, is cost competitive with other oxidants and is economically scalable for high volume, industrial synthesis. Furthermore, there are important treatment advantages, safety features of handling, and an absence of an environmental impact resulting from ferrate use. The unique single-chamber electrode configuration permits operation at a minimal cell voltage that significantly reduces operational costs and eliminates the need for expensive ion exchange membranes. The puri-

fied salt is nontoxic, environmentally benign, and safe to handle, making it an ideal replacement for traditionally used oxidants.

Commercialization Information

As a result of EPA's funding, Lynntech currently is involved in commercializing the electrochemically produced potassium ferrate salt. In general, the chemical marketplace is always trying to identify new environmentally friendly compounds. The need for low-impact oxidizing chemicals currently is seen in



the following industries: water and wastewater, nuclear and heavy metal waste remediation, organic synthesis (catalysts), metal finishing, and energy storage. Lynntech has teamed with one of the major worldwide chemical suppliers and has submitted samples for chemical quality analysis. Initial results meet the supplier's requirements for purity and Lynntech currently is generating a client base for the potassium ferrate salt product. It is anticipated that initial sales will begin in the next 6 months.

Company History

Lynntech, Inc., incorporated in 1987, is a privately owned company located in College Station, Texas. Lynntech develops scientific and engineering concepts and takes the resulting innovations to the marketplace. The company has a multidisciplinary staff of 153 scientists and engineers. Building on a core area of expertise in electrochemistry, Lynntech has developed products in the emerging markets of fuel cell test systems, proton exchange membrane fuel cells, and electrochemical ozone generations. In addition, Lynntech has successfully commercialized and spunoff two separate companies in the past year.

SBIR Impact

- Due to environmental concerns and stricter regulations, the industrial sector has been forced to adopt environmentally friendly alternatives to traditional oxidizing agents.
- Lynntech, Inc., developed a new electrochemical method for the production of high purity potassium ferrate (K_2FeO_4), an environmentally benign oxidizing agent.
- Lynntech's process permits the bulk synthesis of highly crystalline K_2FeO_4 at one-tenth the cost of conventional methods and is significantly more efficient than conventional electrochemical processes.
- Lynntech has teamed with a major worldwide chemical supplier to market their product.