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Backgrounder: The Institute for Green Oxidation Chemistry

The Institute for Green Oxidation Chemistry at Carnegie Mellon University is a research, development and education center that pursues a holistic approach to sustainability science.

Led by Dr. Terry Collins, the institute focuses on one of the most important problem areas facing green chemists: replacing polluting technologies with benign alternatives (for more information, see the backgrounder on Sustainability and Green Chemistry).

Research Areas

Research programs focus on the scientific and technological development of Fe-TAML® (**T**etra**A**mido**M**acrocyclic**L**igand) activators which the Collins Group invented and which Carnegie Mellon has extensively patented and trademarked (for more information, see the backgrounder on Fe-TAML activators). Widely applicable and cost effective catalysts have thus far been absent from hydrogen peroxide technology, a problem that TAML activators attempt to rectify.

Hydrogen peroxide (H_2O_2) is commonly used together with another chemical compound, called a catalyst, to modify harmful chemicals rendering them less toxic or completely harmless. This process is called catalytic oxidative degradation.

Fe-TAML activators show great potential for bringing about a revolution in industrial and academic peroxide chemistry. One of the institute's overriding goals is to achieve as general a greening of oxidation technology as possible with catalyzed hydrogen peroxide processes.

Developing a safe, easy-to-use, inexpensive water disinfection technology based on TAML technology is the single most important long-term goal of the institute. The institute has already succeeded spectacularly with using TAML-activated hydrogen peroxide as a means of destroying chemical pollutants in water. In the field, the activators have already shown an unprecedented ability to destroy chlorinated pollutants that the Environmental Protection Agency views as high priority problems. They also are effective at removing dyes and other chemical substances from water.

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Pure research: Through design and synthesis studies, the institute pursues a long-standing catalyst design program that has led to a range of TAML activators, each of which brings distinct advantages to different applications. Mechanistic studies at the institute are clarifying the chemical behavior of the different activators. Studies are ongoing to optimize their activity and extend their application to new substrates.

Applied research: Together with many academic and industrial collaborators across the world, the institute is developing the use of TAML activators through laboratory studies and field trials for applications in many settings: wood pulp bleaching and effluent treatment, laundry science, water-borne dye effluent treatment, toxic chemical destruction and decontamination, sulfur reduction in fuels, destruction of chemical and biological warfare agents, pesticide abatement, and general water disinfection.

Educational Goals

The institute aims to educate government officials and policy makers, industry and corporate leaders, fellow scientists, future green chemists and the public at large about how chemistry can best adapt to confront successfully the technological problems inherent in the sustainability problem. TAML peroxide activators provide an on-site case study of the greening of chemistry in action by allowing researchers to view real-world examples of benign chemical alternatives that replace polluting technologies.

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