

GREEN PRODUCT DESIGN

INTRODUCING INDUSTRIAL ECOLOGY

ST. PAUL, Minn.— With the presidential election over, conservative pundits are predicting that the new administration will saddle U.S. industry with a flood of environmental regulations that will ultimately cost tens of billions of dollars annually. But at least some in the biotechnology and chemical industries believe that a renewed focus on environmentalism by U.S. industry is not only necessary, but makes for improved profitability, too.

"We, in industry, need to increase our commitment to the environment, not only because it's what society wants, but because it makes good financial sense," says Jim Altemus, manager of plant science communications at Monsanto (St. Louis, MO). "At Monsanto, we're incorporating environmental concerns into every aspect of the design process, from start to finish, and we think this has not only improved our products and processes but also puts us in a strong position for future growth and profitability."

Today, U.S. industry generates more than 300 million tons of hazardous wastes and another 600 million tons of nonhazardous wastes. To meet existing regulations, U.S. industry spends more than \$40 billion annually on pollution control. Even more alarming, though, is that waste treatment and disposal costs are rising faster than the growth of industrial products, raising the specter of disposal costs becoming the dominant cost of industrial production.

Biotechnology's role

What Monsanto and other enlightened firms are doing represents a fundamental shift in the philosophy of environmental protection that goes by the name of industrial ecology. In a sustainable ecosystem, each process is as efficient as it can be, and what one organism leaves behind as a waste product becomes an energy source for some other organism. In the same way, industry must not only improve the efficiency of its internal processes, but find creative uses for its waste products.

For example, instead of spending time and money on cleaning up a waste stream at the end of a process, industrial ecology focuses on redesigning the process itself to reduce pollution along the way. "This means that we have less of a problem at the end, but it also means our processes are more efficient along the way, and that means we get a better return on our investment," says Sol Peltz, manager of environmental programs at ICI Americas (Wilmington, DE), maker of the first biologically produced commodity polymer, known as polyhydroxybutyrate-

polyhydroxyvalerate copolymer. "After all, money spent on waste treatment and disposal adds nothing to productivity. It just comes off the bottom line."

Peltz and others say that biotechnology will certainly be an important tool in making the switch to such "green designing," because biological processes are inherently less polluting. In addition, including biological reactions as part of a chemical process stream generally requires that inputs and outputs be less

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toxic. For instance, ICI Americas chose an aqueous extraction system instead of an organic extraction system to make its biologically produced polymer. Since the water could be recycled, the overall process was cheaper.

Of course, no reaction stream can be totally pollution free, which opens a cleanup niche for the biotechnology industry to fill. Celgene (Warren, NJ), for example, has focused its efforts on designing microbial processes that remove enough key pollutants that waste water can be reused in the process stream. James A. Romesser, vice president for research and development of Celgene's biotreatment systems, says the key for firms such as Celgene is to be involved in the entire design process. "It's much harder for us if we're an afterthought," says Romesser.

Clean Air Act

Romesser raises a key concern that industry must face if it is to embrace this new paradigm. Industrial ecology must be proactive rather than reactive. This means that industry must move in this direction itself rather than be mandated to move by law. It also means that environmental concerns must be designed into a product or process, not tacked on at the end.

The 1990 Clean Air Act may have a large impact on product design because it will result in restrictions on volatile organic compounds and hazardous air pollutants, as well as on chlorofluorocarbons and other ozone depleters. These chemicals are used widely in manufac-

turing processes and in a number of consumer products, such as paints and refrigerants. Reformulating these products to conform to the new law will require new materials, at least some of which could come from biological sources and processes.

For proponents of industrial ecology, Bill Clinton and Al Gore's election could not have come at a more appropriate time. Though campaign rhetoric portrayed the vice-president-elect as an environmental radical, the fact is that few elected officials have ever had such a keen understanding of both the science and economics of environmental protection. In fact, Gore's positions, as reflected in his book and by his senatorial record, suggest that he will strongly support government efforts to further the tenets of industrial ecology. In addition, the investment tax credit that President-elect Clinton will almost certainly push through Congress should free up the significant amounts of money that companies will need if they are to invest in the new technology and equipment that process redesign will require.

RCRA

The new Administration will also be in a position to influence debate on the upcoming reauthorization of the Resource Conservation and Recovery Act (RCRA) of 1976, the major federal statute dealing with solid waste. The reauthorization debate will involve many issues that could affect product design, including mandatory recycled content, reduced toxic-chemical content, government procurement of recycled products, and environmental labeling.

Recently, Congress's Office of Technology Assessment (Washington, D.C.) issued a report entitled "Green Products by Design: Choices for a Cleaner Environment." The report calls upon industry to embrace industrial ecology as a way of improving U.S. industrial competitiveness by reducing profit-sapping waste cleanup. The report says, too, that the 1990s should see the growing green ethic among consumers translate into a competitive advantage for those companies that are able to design high-quality, environmentally sound products.

Government can help industry make this transition by redesigning regulations to be more flexible. Some current regulations actually restrict redesign because they mandate pollution-control technology in addition to acceptable pollution levels. Also, some RCRA provisions make recycling hazardous wastes more costly than disposing of them.

—Joseph Alper