U.K. to tackle endocrine disruptors in wastewater

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England and Wales are likely to become the first places in the world to actively remove endocrine-disrupting chemicals from their sewage. The Environment Agency of England and Wales has proposed a £40 million demonstration project to assess how estrogenic substances can be prevented from entering sewage effluent or can be removed from effluent. The effort follows a report released in July that finds that sexual disruption in fish is widespread throughout rivers in England and Wales (Environ. Sci. Technol. 2003, 37, 331A–336A).

"We know fish are affected, and the source is sewage effluent," says Geoff Brighty, the science manager of the Environment Agency's ecosystems section. "We now have enough data to act as a policy trigger for taking action. But what we need to do to sewage treatment to remove these chemicals is not well understood and potentially very costly. We now need water companies to evaluate the potential for sewage treatment to remove these substances." The most significant substances were the natural steroid hormones 17-estradiol and estrone and the synthetic hormone ethinylestradiol, which are excreted from women either naturally or as a result of taking medicines such as the contraceptive pill or hormone-replacement therapy.

The agency is working with water companies and advocating the construction at two sites of full-scale demonstration projects that will use enhanced granular-activated-carbon treatment. The proposal also calls for 17 smaller projects in which existing treatment options will be monitored. "This would be ground-breaking and could result in a step change in sewage effluent treatment," says Brighty. "Treatment would be applied to achieve environmental benefits, not to meet specific standards or regulations. Applying drinking-water treatment technology to effluents put back into rivers for environmental purposes has never been done before."

Zoologist Louis Guillette of the University of Florida agrees that enough data now exist to warrant action of some kind. "[The report] now shows categorically for the first time that the [endocrine-disruption] phenomena is widespread, not just isolated to a few rivers or species or sewage treatment facilities," he adds. "It is the definitive work in this field." However, he is optimistic that the endocrine disruptors can be treated. "It should take a couple of years for demonstration projects to tell us what we need to know. But fish could start feeling the benefits of any removal technology after three or four years," he says.

However, Thomas Ternes at the Bundesanstalt für Gewässerkunde in Koblenz, Germany, points out that although the activated-carbon technology removes endocrine disrupters very efficiently, it is an extremely expensive option for wastewater treatment because the carbon needs to be replaced regularly. He favors ozonation techniques instead, which involve adding ozone gas to water. "We found in two pilot ozone trials that this technique removed 99% of estrogens," he reports.

The independent water-industry regulator in the United Kingdom will decide in September whether to include the removal program in the industry's plan of work for 2005–2010. Funding would come from water companies' customers through higher bills. Full costs for installation and operation of the additional treatment over a five-year period are on the order of £20 million per plant. But Brighty says that only a "few tens of plants" would need this highly effective, top-of-the-range approach; other plants that emit lower estrogen levels could use cheaper techniques. The program would also study the most appropriate regulatory approach: a biological test based on fish response, or a chemical limit based on minimum concentrations.

"We have set a threshold exposure limit for steroid estrogens, which we use in risk assessment, but because of estrogenic substances' interactions, a bioassay may be the best regulatory approach for discharges," says Brighty. The thresholds are 0.1 nanograms per liter (ng/L) for ethinylestradiol, 1 ng/L for 17-estradiol, and 3 ng/L for estrone. A total threshold value based on 17-estradiol has also been set, because endocrine-disrupting effects are additive. No other country has set standards for steroid estrogens in sewage effluent.

Some sections of the water industry remain to be convinced that endocrine disrupters are a priority and have voiced concerns about how their removal could be managed and funded. However, a spokesperson for the industry association Water UK took a more cautious approach: "We are taking the issue very seriously and are committed to investigating implications for wastewater treatment."

The move to treat wastewater arises from research by the agency and Exeter and Brunel Universities, which surveyed more than 1500 roach fish at 50 river sites and found that over one-third of male fish exhibited female characteristics and were less able to reproduce (Environ. Sci. Technol. 2002, 36, 270A). The number of fish affected and the severity of the effects were related to the amount of sewage effluent in the river. They observed these effects in a range of coarse fish—freshwater fish caught only for sport—and noticed that young fish were particularly vulnerable to duct disruption. Some effects, such as eggs in male testes, worsened with age and exposure. The team has used these data to develop a risk-assessment model to predict estrogenic impacts on roach for any effluent discharge. This means the agency could identify high-risk sites and target cleanup efforts.

“This is the only complete data set of its kind in the world, with a long history and significant findings,” says Taisen Iguchi from Japan’s National Institute of Basic Biology. “The whole world is following closely this research.” —MARIA BURKE

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