Residual Substances in Wastewater Treated in Typical Treatment Plants

There are growing concerns regarding substances still left in treated wastewater. Hormones aren't the only concern. Triclosan, an antiseptic used in acne creams, has been found in surface water and groundwater in the United States.

Chemicals used in detergents and household cleansers also have been found in water samples. Limonene, a fragrance that gives a pleasant lemon-like odor to some cleansers, has been found in groundwater.

Chemicals called nitromusks are used in most consumer products with fragrance, such as cosmetics, detergents, and toiletries. The metabolites of nitromusks have been found in sewage, river water, numerous animals, and even human breast milk.

Breakdown products of nonylphenols, which are used in detergents, are commonly found in sewage effluent discharge. Caffeine from beverages has been commonly found in rivers downstream from sewage treatment plants, and in groundwater near household septic systems.

Recalcitrant chemicals can be difficult but not impossible to degrade. Much has to do with concentration, detailed molecular structure, toxicity level, adsorbability, solubility, its charge, the presence of suitable organisms, nutrient availability, presence of oxygen, pH, etc.

Current research shows that conventional wastewater treatment processes do not adequately breakdown and eliminate these chemicals, pharmaceutical drugs, hormones, pesticides, etc, resulting in the release of low levels of these compounds into the environment. However, the more advanced processes that are multi-stepped and include oxygenation and filtration are very effective in removing these compounds.

New research from the UK, Canada, Germany, Italy, Japan and the US demonstrates that natural and pharmaceutical estrogens present in human waste are the principal source of estrogen-like activity found in treated sewage. These studies contradict earlier suggestions that alkylphenols (APs) are the dominant estrogenically active substances in waste streams.

In fact, the new research shows that alkylphenol ethoxylates (APEs) are effectively biodegraded and removed in well-functioning sewage treatment plants and that APs, which are biodegradation intermediates - if detectable - are present in treatment plant effluents at levels too low to cause estrogenic effects.

A Japanese study (M. Fujita et al., Water Science and Technology, vol. 42, pp. 23-30, 2001) confirmed effective removal of APEs in 40 sewage treatment plants, with very low levels of APE

biodegradation products in sewage effluents, levels 100-1000 times lower than those required to cause estrogenic activity.

The microorganisms used in treatment plants are involved in the degradation of environmental pollutants to a varying degree depending on how much the compounds have been modified.

In laboratories, estrogens mixed with soil decompose very quickly. Wild animals excreting estrogen in their manure showed that the hormones broke down into water and carbon dioxide due to the availability of plentiful oxygen and microorganisms. However, when slurry was tested in anoxic conditions the rate of decomposition was much slower. Studies found that the estrogens adsorbed to organic matter found in the slurry. This made the estrogens less accessible to the decomposing microorganisms and less likely to degrade when they were exposed to oxygen.

There is a noted concern about how well treatment plants that turn sewage into reusable water remove these chemicals. New research shows that wastewater treatment plants that employ a combination of purifying techniques followed by reverse osmosis - a process by which water is forced through a barrier that only water can pass - do a good job of removing chemicals that may elicit health effects.

In research published in January in Analytical Chemistry, the UB chemists also found that iopromide, a pharmaceutical imaging agent that patients consume before taking MRI tests, is barely degraded in the conventional activated sludge process.

However, they found that when conditions in biological treatment systems are optimized for nitrogen removal, this imaging agent did degrade. It was noted that based on the team's findings, a combination of biological, chemical and physical processing techniques will be the most successful in removing completely pharmaceutical compounds and their metabolites from wastewater.