Environmental Case Study
North
Precarious Toilets: Rising Estrogen in Human Sewage

Introduction

Few people find it pleasing or polite to think about the things that are flushed down the toilet daily. Then again, maybe people should be more aware of what they flush as a courtesy for others and for the environment. Septic systems and sewage treatment plants regularly endure deterioration or failure as inappropriate materials make their way into the toilet. The most noticeably offensive things thrown down the toilet are household hazardous chemicals that are difficult to dispose of by other means. Many people resort to disposing cleaning agents, paints, pesticides, and solvents down the toilet. These chemicals disrupt the microorganisms in the septic systems and sewage treatment plants rendering the technologies ineffective. The microorganisms are needed to breakdown many of the sewage pollutants and help displace pathogenic microorganisms.

Unbeknownst to most people, the most common environmental pollutants dumped into the toilet are medications. The United States Environmental Protection Agency estimates that hundreds of tons of medications are dumped down the drain or into the toilet each year. It is ironic that people are using common sense to dispose of expired or unused drugs. However, the method of dumping into the sink or toilet is not environmentally sound. People are not paying attention that the medications ultimately end up in the waterways. So, what type of problems can be caused my medications in sewage? It is not known for sure, but antibiotics might disturb the microorganisms in the septic systems and sewage treatment plants. The effects of other medications are not completely studied.

The fact that many human medications do not break down in sewage treatment plants raised concerns about the disposal of contraceptive patches. These patches, used in place of birth control pills, contain a hormone called ethinylestradiol. Like other medications, ethinylestradiol most likely persists after sewage treatment and may end up going into the environment and even into drinking water. The nature of ethinylestradiol is spurring scientists to meticulously investigate the fate of this drug in sewage and its possible environmental impact.

Background

The Conceptive Patch

Strategies for keeping females from getting pregnant during intercourse go back to the first recorded history. Most of the techniques were not very effective or harmed one or both individuals. Female contraception today is commonly achieved by taking some sort of hormone therapy that stops ovulation. Ovulation prepares the egg for fertilization by sperm. Estrogen and related chemicals that act like estrogen in the body are given in certain doses to inhibit ovulation. A woman is rendered infertile if the egg is not prepared to meet the sperm at the appropriate time.

The earliest hormonal birth control was in the form of a pill that had to be taken faithfully to be effective. A missed pill meant the chance of an unexpected or unwanted pregnancy. Plus, taking the pill orally caused problems with adjusting the dosage. Different people absorbed the hormones at unpredictable rates causing overdoses or undermedication. New pills were developed to make them more effective and more convenient. However, it did not solve the problem of women forgetting to take the pill when needed. Some research showed that women could forget to take 3 to 5 pills over a three-month period. This concern led to the development of the contraceptive patch.
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Contraceptive patches use the same hormonal strategy as birth control pills for inhibiting ovulation. The contraceptive patch contains a synthetic estrogen called ethinylestradiol. Ethinylestradiol dissolves slowly out of the patch and passes through the skin into the blood supply. The patch is worn for three weeks per month. It has a residual effect that carries the inhibition of ovulation over through the forth week. A large amount of ethinylestradiol has to be added to each patch to get the correct dosage into the bloodstream over the three-week period. At the end of the three weeks there is still much ethinylestradiol remaining in the patch. According to the manufacturer’s literature, the patch is meant to be disposed of by folding in half to seal in the contents and then placing it in the trash. Disposal in the toilet is not recommended.

Environmental Estrogens & Endocrine Disruptors

Many natural and synthetics chemicals act the same way as hormones do in the bodies of animals and plants. Therefore, they are called endocrine disruptors. The chemical nature of the endocrine disruptor permits them to fit onto hormone receptors on cells. This causes them to signal the body to carry out physiological changes determined by the timing and concentration of the substance. Substances such as herbicides kill plants because the chemicals to interfere with the action of plant hormones needed for survival. The same is true for many pesticides designed to kill insects and a variety of parasites. Any chemical that gets in the way of the endocrine system is called an endocrine disruptor. Some endocrine disruptors mimic hormones while others block the action of hormones. Environmental estrogens are endocrine disrupters found in pollution that affect the body’s response to estrogen.

Endocrine disruptors can be naturally occurring or synthetic chemicals released into the environment in a variety of ways. Natural endocrine disruptors are found in plants and enter the environment through the food chain or when vegetation decays and leaks decomposition components into the soil and water. Synthetic endocrine disruptors include a variety of chemicals ranging from pesticides to certain metals. Many studies show conclusively that the endocrine disruptors acting as estrogen polluting lakes and rivers are affecting animal populations. Fish and frogs are showing developmental defects indicative of unusually high levels of estrogen. Almost all animals respond the same way to estrogen. So, any pollutant that acts like estrogen in humans could affect any animal that takes in the pollutant.

Sewage Treatment

Even the most modern commonly used sewage treatment technologies cannot ensure water that is 100% safe to drink. Septic systems are one of the simplest sewage treatment methods used in North America. In a septic system, wastewater from one or two houses flows into a nearby buried tank. Microorganisms in the tank break down organic materials in the waste and replace many of the pathogenic microorganisms found in human wastes and kitchen scraps. After sitting a while the wastewater flows into the soil where many of the contaminants are broken down further by soil microorganisms and physical decay. Large particles that cannot be broken down settle to the bottom of the tank and must be periodically removed.

Cities use complex sewage treatment systems that can serve many homes up to several miles away. Preliminary treatment uses large screens to remove large materials such as cloth, paper, plastic, and wood that can clog up the rest of the treatment facility. Soil particles are also removed as they settle out in a holding tank. The wastewater enters primary treatment composed of large settling tanks.
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Chemicals are sometime added to the settling tanks to remove solid organic materials. These solids are removed and dried. They can be disposed in a variety of ways or sold as fertilizer as long as it has low amounts of pathogenic microorganisms and toxins. Secondary treatment is the next step, using microorganisms to break down organic molecules and reduce the number of pathogens. The remaining liquid wastes can be released into nature or passed along into tertiary treatment. Tertiary treatment uses a variety of methods to disinfect the remaining wastes killing off almost all of the microorganisms. In spite of all the treatment many organic chemicals will pass through sewage treatment systems.

The Issues

Dr. Joakim Larsson of Goteborg University in Sweden alarmed European government officials and the public when he pointed out a major environmental concern with the use of contraceptive patches. He had surmised that excess ethinylestradiol in contraceptive patches can leak out into the environment after disposal. Data from Johnson & Johnson showed that discarded patches retain at least 600 milligrams of ethinylestradiol. This ethinylestradiol can still leak out of the patch when the patch is disposed in landfills or in water. Larsson calculated that the ethinylestradiol released from patches being disposed in small cities could produce large amounts environmental estrogens.

Larsson's findings were not an overestimation of the potential problem of patch disposal. Studies carried out in Sweden’s Medical Products Association confirmed that the patch could cause harm to wildlife from ethinylestradiol leakage after disposal. Studies on water downstream from sewage treatment plants showed that environmental estrogens purported to be the ethinylestradiol from patches flushed down toilets were affecting fish. It was also determined that enough ethinylestradiol could leak out of patches and contaminate nearby waterways.

The news of these findings in Sweden made its way around the world and created concerns in the Great Lakes states. Much of the sewage and landfill runoff from the northern states can make its way into the Great Lakes. Canada and the United States discharges treated sewage water into the lakes. Unfortunately, the sewage treatment processes do not destroy many of the compounds found in household chemicals and medications. Included in this list is the ethinylestradiol found in the contraceptive patch. The United States Geological Survey already found traces of many harmful chemicals in 30 states including those using the Great Lakes as a water source. Antibiotics, antidepressants, estrogen, heart medicines, and painkillers were detected in the water. Caffeine was even found because of all the coffee and cola drinkers releasing their wastes into the sewer systems.

The greatest evidence about the presence of environmental estrogens in Great Lakes waters comes from fish studies in Minnesota. Dr. Deb Swackhamer of the University of Minnesota discovered that male fish are changing sex downstream of sewage treatment plants. The effect is not found where wastewaters are absent. She associates the sex change to a variety of environmental estrogens passing through sewage treatment plants. Similar findings were noted in Hawaii by researchers at the Hawaii Institute of Marine biology. All the researchers believe that the contraceptive patch could increase the amount of endocrine disruptors entering wastewaters released into the environment.
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References

Literature


Web Sites


Key Principles

1. Contraceptive patch
2. Endocrine disrupter
3. Environmental hormone
4. Sewage treatment
5. Wastewater
6. Water pollution

Ethical Considerations

1. Should pharmaceutical companies be responsible for any environmental decay caused by the medications flushed down the drain and toilets?
2. Do the disposal problems associated with the contraceptive patch warrant governmental regulations controlling where it can be sold and used?
3. What is the responsibility of citizens to learn about the disposal of medications and household chemicals?
4. Should a medication designed purely for convenience be discontinued if it creates environmental problems?

Civic Engagement & Service Opportunities

1. Volunteer for a local community group involved in monitoring water quality in your area.
2. Write or e-mail your local politicians about potential endocrine disruptor issues in your area.
3. Form a student group having an environmental preservation mission.
4. Set up a public forum at your school discussing the possibility of endocrine disruptor pollution in your area.

Learn more about community service as part of your educational enrichment by visiting the following websites: [http://www.learnandserve.org/](http://www.learnandserve.org/), [http://www.servicelearning.org/](http://www.servicelearning.org/).

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