Medicated Waters: Pharmaceutical Contamination Of Surface Water

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Abstract

Water is essential for human life. However, our supply of freshwater is threatened by many sources of pollution. Surface water near centers of human development is becoming increasingly polluted with chemicals that did not exist prior to this century. Water systems are becoming polluted with pharmaceutical waste products with unknown consequences. Pharmaceutical contaminants in surface and ground water are a major contributor to water contamination, and endocrine disruptors from pharmaceuticals are merit cause for alarm. We do not know what the long term consequences of low levels of exposure to these chemicals are or what problems they will present in the future. What effects are pharmaceuticals in our water having, and what can be done to remove pharmaceuticals and other contaminants from our water? Pharmaceutical contamination of water is a problem that must be solved through changes in regulation of both water treatment and pharmaceuticals, and contaminants must be removed in order to protect human health and the environment.

Methods

This project was completed using an extensive literature review of primary sources discussing pharmaceutical contamination of water and the environmental impacts of endocrine disruptors on the environment. Estrogenic endocrine disruptors were chosen as a case study because of their abundance in the environment because they exhibit effects at low concentrations. The case study investigates the most effective methods to remove the three most common estrogenic compounds found in the United States. Technical feasibility, scale of usage, cost, and drawbacks of the treatment type were analyzed.

Blue Water. N.d. Photograph. Photos Public Domain, Http://www.photos-public-domain.com/2012/04/10/blue-water-texture/.

Daughton, C. G. (2007). Pharmaceuticals in the environment: sources and their management. Analysis, Fate and Removal of Pharmaceuticals in the Water Cycle. M. Petrovic and D. Barcelo, Elsevier Science. Volume 50: 1-58.]

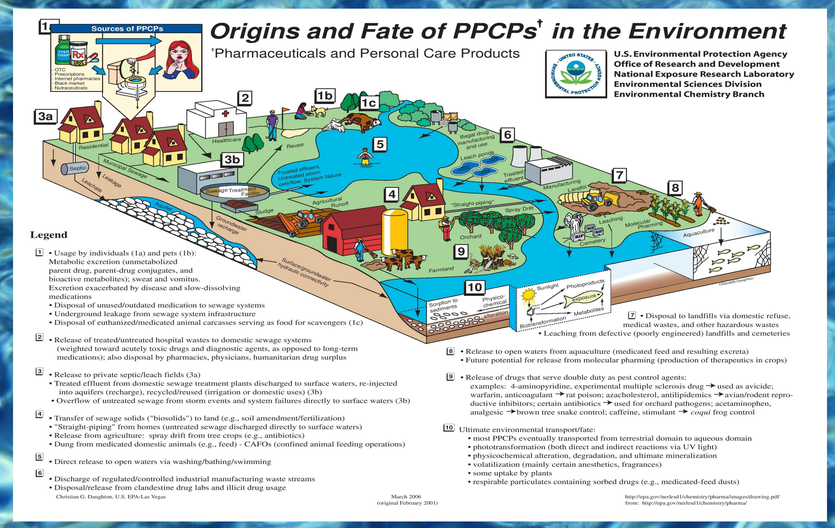

Figure 1: This figure, published by the EPA shows how pharmaceuticals and personal care products get into and cycle within aquatic systems.

Results

For municipal scale wastewater treatment granular activated carbon was the clear winner. Granular activated carbon (GAC) has been successfully implemented in some of the most water poor areas of the country because it is highly efficient at removing contaminants from water. Once GAC has been used it can be reactivated many times before it must be disposed of. Reverse Osmosis as a method for purifying municipal water was far too costly in many ways. It had the highest cost per individual, has an efficiency rate of 75%, meaning that for every four gallons of water processed 1 is unusable. Reverse osmosis also consumes large amounts of electricity.

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Conclusions

Buildup of pharmaceutical contaminants in the hydrologic system is a threat to human health and the environment. Allowing bioaccumulation of hazardous substances with unknown long term consequences in our water system is dangerous and unwise. The systems currently in place for water treatment do not adequately address contaminants, and for this reason changes need to be made within our governmental system to address them.

Municipal wastewater treatment systems need to be retrofitted to remove dangerous substances from water. Granular activated carbon filtration systems are the most efficient and cost effective technology to do so .

To make this change possible two things need to happen. A production tax needs to be implemented on companies that produce potentially harmful chemicals to pay for their removal from water systems; and governmental agencies need to adopt the precautionary principle as a the basis for regulation of pharmaceuticals, and update regulations accordingly. Lastly, the EPA needs to be given greater power to enforce regulations.

Table 1: Results of case study on the most effective way to remove estrogenic endocrine disruptors from water.

Method Of Purification	Rate of Estrogen Removal from water	Feasible at a City Water Treatment Scale?	Places Implemented in other areas	Cost (averaged Per 1,000 Users)	Drawbacks Of Solution
Powdered Activated Carbon	95%	No	N/A	N/A	Not available at an industrial scale.
Granular Activated Carbon (GAC)	90%	Yes	Phoenix, AZ Glendale, AZ	$9,600 $3,590	Carbon must be replaced and maintained. Yearly cost of carbon reactivation for Glendale is roughly $800,000. Solution needs a consistently clean water source.
Nano-filtration	40-100%	No	N/A	N/A	Not available at an industrial scale.
Reverse Osmosis	80-100%	Yes	Madison, MN Ottawa, IL	$157,800 $86,486	High cost, high energy consumption, 1/4 of water is lost