How effective is sewage treatment at removing chemical pollutants?

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"Conventional sewage treatment technologies were not designed to deal with modern classes of chemical pollutants, so it is critical that we determine which options work best for removing these compounds", explains Dr Steven Melvin.

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Assortments of chemical compounds, such as those found in various medications and common household products, are frequently detected in the aquatic environment. "These compounds are a concern for wildlife, because many can cause unexpected health effects in animals at low concentrations", says Melvin. The discharge of treated wastewater can be a major contributor of chemicals entering the environment, so it is important that we identify treatment options that can effectively reduce the levels of these contaminants from sewage.

Results from a recent study published in the journal Environment International (http://dx.doi.org/10.1016/j.envint.2016.03.031) suggest that the most widely used treatment technology in the world may actually do the poorest job at eliminating important classes of emerging chemical pollutants.

Image: Dr. Melvin's research at the Australian Rivers Institute explores the removal of chemical pollutants through wastewater treatment, and the toxicity risks that poorly removed compounds pose for aquatic wildlife.

In the path towards improved sewage treatment, a logical starting point is to evaluate what we are currently doing to see what is working. Unfortunately, this is no simple task and experimental studies can only take us so far. "It is simply not logistically possible to collect quality data on a large geographical scale, and this makes it very difficult to meaningfully compare technologies", says Melvin.

Dr Melvin and his collaborator on the study, Associate Professor Frederic Leusch, addressed this problem by developing a meta-analysis approach that allowed chemical removal data to be compared from existing studies. Melvin has applied similar approaches to study ecological (http://dx.doi.org/10.1007/s00442-012-2260-9) and toxicological (http://dx.doi.org/10.1016/j.chemosphere.2013.07.036) datasets. For the present study, the researchers compiled 976 published removal estimates for 20 organic micropollutants, and evaluated their comparative removal efficiencies from major sewage treatment technologies being used around the world.

The results indicate that the most widely used sewage treatment technology in the world, conventional activated sludge (CAS), offers the poorest overall removal for most of the studied contaminants. Advanced treatment technologies such as Membrane Bioreactors were found to be more effective than CAS, but these options are expensive to operate and require large amounts of energy, which can also be a source of pollution. Oxidation Ditches may offer a good compromise between efficiency and operational costs, and were found to provide the best overall removal for highly potent estrogenic contaminants.

Melvin stresses that the most suitable option may differ from one location to the next, stating "choosing the most appropriate technology will depend on various environmental, social, and economic considerations". It is also important to note that the study focussed on removal of organic micropollutants, and CAS and other technologies may be more efficient at removing risks posed by pathogens, nutrients or metals. Nevertheless, the study provides a unique global assessment of sewage treatment technologies, and represents an important step towards identifying effective treatment options for reducing levels of chemical contaminants in the aquatic environment.

References
[1] Melvin SD, Houlahan JE. 2012 Tadpole mortality varies across experimental venues: do laboratory populations predict responses in nature? Oecologia. 2012 1;169(4):861-8.
[2] Melvin SD, Wilson SP. 2013 The utility of behavioral studies for aquatic toxicology testing: a meta-analysis. Chemosphere. 30;93(10):2217-23.
[3] Melvin, S. D. and F. D. L. Leusch. 2016. Removal of trace organic contaminants from domestic wastewater: A meta-analysis comparison of sewage treatment technologies. Environment International 92–93:183-188.