

Occurrence and Removal of Pharmaceutical and Hormone Contaminants in Rural Wastewater Treatment Lagoons

With an increasing population in rural areas, the use of pharmaceuticals and personal care products (PPCPs) and naturally produced steroid hormones is also increasing. However, rural wastewater treatment plants were not specifically designed to remove PPCPs or hormones. Are these compounds being removed from water supplies? If they are, how effectively are they being removed and which treatment process is most effective?

Samples from a rural wastewater treatment plant in Illinois were collected at each stage of the treatment process. Samples were taken twice, in September and November 2011. In addition, one sample each from upstream and downstream of the effluent discharge was taken in September. All the same samples were taken in November with the addition of a sample from the Mackinaw River downstream of the small stream to which the wastewater effluent discharges. Samples were extracted and analyzed in the lab for PPCPs and hormones via a new method developed by ISTC researchers.



Stages of the rural wastewater treatment plant (Li, Zheng, and Kelly, 2013)

The researchers analyzed the water for 13 PPCPs, including:

- caffeine,
- carbamazepine,
- diphenhydramine,
- erythromycin,
- fluoxetine,
- gemfibrozil,
- ibuprofen,
- naproxen,
- sulfamethazine,
- sulfamethoxazole,
- triclocarban,
- triclosan, and
- trimethoprim;

and eight hormones, including:

- 17 α -estradiol-3-sulfate,
- 17 β -estradiol-3-sulfate,
- estrone-3-sulfate,
- estriol,
- 17 α -estradiol,
- 17 β -estradiol,
- estrone, and
- ethynylestradiol.

Overall, 10 of the 13 PPCPs analyzed were detected in the lagoon. Of the 10 PPCPs detected, all had a removal rate of 88–100%, except for carbamazepine, which became concentrated through the treatment process in both September and November, and gemfibrozil and trimethoprim, which became concentrated through the treatment process only in November. Carbamazepine became concentrated in both warm and cold months, indicating that aerated lagoon microbes are not capable of utilizing carbamazepine. The microbes that can use gemfibrozil and trimethoprim may be less active in colder temperatures, thus explaining why these compounds only become concentrated in colder months.

The same 10 PPCPs detected at the rural wastewater treatment plant were also found downstream of the plant discharge point, except for caffeine. Five of the 10 PPCPs were found upstream of the discharge point. All 10 were found in the Mackinaw River, but some were diluted. Caffeine was not present in the stream, but was found in the river, and sulfamethoxazole maintained its concentration. These results suggest another source for PPCPs in the Mackinaw River besides the sampled rural wastewater treatment plant.

Only three of the eight hormones (estrone, estriol, and estrone-3-sulfate) were detected in the influent, and all three were not detected in the effluent, nor were any hormones detected upstream or downstream of the treatment plant effluent or in the Mackinaw River. The researchers suggested that these results are similar to others and suggest that aerated lagoons are an effective strategy for removing hormones.

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2016 PPCPs in the Environment Conference

2017 Emerging Contaminants in the Aquatic Environment Conference

2018 Emerging Contaminants in the Aquatic Environment Conference

2019 Emerging Contaminants in the Environment Conference

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