Emerging and Conventional Contaminants Discharging into the Dnieper River, Kyiv, Ukraine

Michaela A Cashman, Robert M Burgess and Kay T Ho (U.S. EPA, ORD/NHEERL, Atlantic Ecology Division, Narragansett, RI, USA); Igor Konovets, Artem Lyashenko, Sergey Afanasiev, Kateryna Zorina-Sakharova (Institute of Hydrobiology, National Academy of Sciences, Kyiv, Ukraine); Mikhail V Milyukin , Ganna V Terletska (A.V. Dumansky Institute of Colloid Chemistry and Water Chemistry, National Academy of Sciences, Kyiv, Ukraine); and Anatoly V Lyakchovsky, A.V.Bogatsky Physico-Chemical Institute, Odesa, Ukraine

Abstract:

The Dnieper River runs through the center of Ukraine from Belarus and Russia in the north and empties into the Black Sea in the south. En-route, the Dnieper River passes through several large Ukrainian cities including Chornobyl, the capital Kyiv, Dnipropetrovsk, and Kherson, and serves as a major reservoir of drinking water to the country. While it is recognized that these cities are sources of conventional and emerging contamination (CCs and ECs, respectively) to the Dnieper River, little is known about the actual concentrations of these contaminants in the municipal effluent and riverine waters. The objective of the current study was to quantify the concentrations of CCs and ECs discharging into the Dnieper River from Kyiv's largest municipal wastewater treatment plant (MWTP). For this investigation, we measured the concentrations of CCs and ECs in Fall 2011 and Spring 2012 at up to seven stations. Samples included the MWTP influent, effluent, and drainage channel stations emptying into the Dnieper River as well as stations upstream and downstream of the channel,. Conventional contaminants included industrial chemicals and pesticides (e.g., DDTs, α-, β-, γ-hexa chlorocyclohexane) while ECs included several categories (e.g., stimulants, antibiotics). Industrial chemicals including PCBs, PAHs, DDTs, and other pesticides demonstrated concentrations ranging from 2.77 to 53.3 µg/L, 11.6 to 400 µg/L, 0.9 to 15.9 µg/L, and not detected to 22.5 µg/L, respectively, with higher concentrations often occurring in Spring 2012. Removal of industrial chemicals from the MWTP influent varied with chemical and season but was frequently limited. In addition, there was evidence of additional sources of contamination, other than the MWTP, also contributing to the river. In contrast, total metal concentrations (2.51 to 148 µg/L) were higher in the influent in the Fall 2011 and showed substantial reductions in concentrations in the effluent (e.g., 53 to 64% lower). The ECs, dominated by stimulants, had elevated concentrations in both seasonal influents (5.48 µg/L to 29.4 µg/L) but concentrations decreased by 96% in the post-MWTP effluent. In addition, there was no evidence of additional sources of ECs to the Dnieper River. Results suggest the MWTP serves as a source of several CCs to the Dnieper River along with other sources. In contrast, the ECs appear in the MWTP influent but are effectively removed prior to discharge into the effluent stream.