

Abstract

This research bachelor's thesis focuses on the occurrence of illicit drugs in municipal wastewaters and their removal in wastewater treatment plants. The thesis focuses in detail on four psychoactive substances, which are tetrahydrocannabinol, MDMA, cocaine and methamphetamine, and their most commonly monitored metabolites. The work provides an overview of their presence in the aquatic environment and in wastewaters at the influent to wastewater treatment plants. In surface water, substances are found in concentrations up to hundreds of nanograms per liter. Concentrations of drugs at the influent to wastewater treatment plants normally range from tens to hundreds of nanograms per liter, with increased consumption reaching several thousand nanograms per liter. The thesis also focuses to efficiency of removal of selected psychoactive substances and their main metabolites during different stages of wastewater treatment. The findings indicate that the primary treatment is significant for tetrahydrocannabinol, less so for other substances. Tetrahydrocannabinol and its metabolites, in contrast to the other investigated substances, are lipophilic and their sorption occurs on the solid phase of wastewater. High concentrations of cannabinoids occur in sewage sludge, where they can persist in lower concentrations even after its processing in sludge treatment. The subsequent reuse of processed sludge as fertilizer can lead to the presence of cannabinoids into the environment. The secondary biological treatment is a key to the elimination of all the mentioned psychoactive substances. The average removal efficiency of selected drugs after the secondary treatment reaches 75 % or more for most substances. The tertiary treatment increases the removal efficiency of all substances to an average value exceeding 85 %, with the exception of MDMA. The highest efficiencies are observed for the removal of amphetamine, slightly lower values of methamphetamine. Cocaine is eliminated with higher efficiency than its main metabolite benzoylecgonine. Benzoylecgonine occurs in higher concentrations in wastewater than cocaine and is more stable. Cocaine can also break down into this metabolite during treatment process. The lowest removal efficiency in all treatment stages is observed for MDMA. The reason for its low degradation and high stability in wastewater may be its chemical structure. Studies focusing on the reasons of low removal of MDMA during treatment process are lacking. Another gap in the knowledge of the issue is the lack of studies focusing on the effectiveness of specific tertiary treatment technologies. Studies also only investigate at a small number of illicit drugs and rarely together with their respective metabolites. The sampling methods and procedure for their evaluation are different in individual studies, and the results may not be easily comparable. Furthermore, there is a lack of studies describing the biodegradability of psychoactive substances, which could be essential for their behavior in wastewater treatment plants.

Key words

illicit drugs, wastewater, wastewater treatment plant, methamphetamine, cocaine, MDMA, cannabinoids