Available online at www.CivileJournal.org

Civil Engineering Journal

Vol. 6, No. 3, March, 2020

# Heavy Metal Removal Investigation in Conventional Activated Sludge Systems

Magdi Buaisha [a], Saziye Balku [b], Şeniz Özalp-Yaman [a*]

[a] *Department of Chemical Engineering and Applied Chemistry, Atilim University, Ankara, Turkey.*

[b] *Department of Energy Systems Engineering, Atilim University, Ankara, Turkey.*

Received 31 October 2019; Accepted 01 February 2020

**Abstract**

The combination of industrial and domestic wastewater in municipal WWTPs (waste water treatment plants) may be economically profitable, but it increases the difficulty of treatment, and also has some detrimental effects on the biomass and causes a low-quality final effluent. The present study evaluates the treatment process both in the presence and absence of heavy metals using ASM3 (activated sludge model no.3) so as to improve the model by means of incorporating other novel inhibitory kinetic and settler models. The results reveal that the presence of heavy metal, a case study for copper and cadmium at a concentration of 0.7 $mgL^{-1}$ in a biological treatment system has a negative effect on heterotrophic bacteria concentration by 25.00 %, and 8.76 % respectively. Meanwhile, there are no important changes in COD (chemical oxygen demand), SS (total suspended solids) and TN (total nitrogen) in the final effluent in the conventional system. However, all these parameters are acceptable and consistent with EU Commission Directives. The results indicate that ASM3 can predict and provide an opportunity of the operation for an activated sludge wastewater treatment plant that receives the effluent from an industrial plant.

*Keywords:* Activated Sludge; ASM3; Heavy Metal; Heterotrophs; Kinetic Models.

## 1. Introduction

Industrial wastewater discharged from the industries such as textile dyeing, petroleum, metal finishing, automobile, electro-plating, and leather tanning cause heavy metals entering into the life cycle. So, this becomes one the most important environmental problem in the world. The detrimental effects generally depend on the type and the concentration of the heavy metals. The most frequently encountered heavy metals present in the industrial effluents are copper, mercury, zinc, lead, cadmium, iron, chromium, cobalt and nickel. There are many treatment technologies applied for the removal of heavy metals from wastewaters. Among them the most frequently studied technologies are ion-exchange, adsorption and membrane filtration [1]. Ong et al. [2] give the following ranking of the toxicity of the heavy metals for biological treatment: Cd > Cu > Zn > Cr > Pb, which differs from previously mentioned rankings as these have focused on the human organism. The effect on the wastewater treatment process is mainly the direct impact on the metabolism of microorganisms, but in the case of human beings the focus is mostly on the nervous system and cells [2, 3]. The concerns on metals in urban wastewater treatment plants (WWTPs) are mainly related to its contents in discharges to environment, namely in the final effluent and in the sludge produced. In the near future, more restrictive limits will be imposed to final effluents, due to the recent guidelines of the European Water Framework Directive (EUWFD). Concerning the sludge, at least seven metals (Cd, Cr, Cu, Hg, Ni, Pb and Zn) have been

* Corresponding author: seniz.ozalpyaman@atilim.edu.tr

http://dx.doi.org/10.28991/cej-2020-03091484