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REVIEW

Removal of heavy metals and antibiotics from treated sewage effluent by bacteria

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Abstract The increased loads of antibiotics and heavy metals in sewage lead to bacterial cells acquiring resistance to both heavy metals and antibiotics. Therefore, these bacteria can play an important role for removal of pollutants from sewage. The utilization of the microbial processes such as biosorption and enzymatic biodegradation processes has increased during the recent years. These processes are significantly inexpensive and eco-friendly. Enzymatic techniques known as white biotechnology have the ability to degrade complex compounds. Hence, these can be applied to industrial processes. In the current review, the removal of heavy metals and antibiotics from treated sewage effluents by heavy metal/antibiotic-resistant bacteria will be discussed.

Keywords Heavy metals · β-Lactam antibiotics · Removal · Bacteria · Sewage effluents

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Introduction

A treated sewage effluent is the sewage generated from sewage treatment plant (STP). Sewage can be classified into three classes. These include domestic sewage that is identified as complex mixture containing organic and inorganic constituents and large numbers of bacteria (U.S. EPA 2003). Second, hospital sewage generated from the hospitals includes sewage and wastewater resulting from the cleaning of healthcare facilities. The hospital sewage consists of antibiotics and antibiotic-resistant bacteria (Pauwels and Verstraete 2006; Jury et al. 2010). Industrial wastewaters are identified as the third class, which include wastewaters associated with high concentrations of heavy metals and other constituents (Rao et al. 2012).

Sewage effluents are seriously contaminated with toxic metal ions., The most common are Zn^{2+}, Ni^{2+}, Cu^{2+}, Cd^{2+}, and Pb^{2+} (McLaren and Smith 1996). Ni^{2+} can cause stomach cancer, prostate, cavity and kidney diseases (Habib-ur-Rehman et al. 2006). Zn^{2+} is a toxic element with high-to-moderate importance as a trace element, and Cu^{2+} is not only an important metal for many organisms as cofactor, but is also very dangerous at high concentrations (Nies 1999). Cd^{2+} and Pb^{2+} are both classified as toxic metals (Nasrazadani et al. 2011).

Most antibiotics and their metabolites excreted by humans after administration, find their way into the sewage. However, more than 90 % of non- metabolized β-lactams are excreted through faeces and urine into sewage (Avisar et al. 2009). The sewage-treatment processes are insufficient to remove antibiotics. Many antibiotics have been detected in large quantities in sewage-treated effluents and activated sludge (Spongberg and Witter 2008). Cephalexin presents in sewage effluents in high concentrations due to its resistance to biodegradation (Lin et al. 2009; Guo et al. 2010).