

## Removal of polycyclic aromatic hydrocarbons from municipal sludge using UV light

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### ABSTRACT

This study includes research into using UV light to remove Polycyclic Aromatic Hydrocarbons (PAHs) from municipal sludge. The effectiveness of  $TiO_2$  as a photocatalyst on this UV application was also determined. Sludge samples that were taken from an urban wastewater treatment plant (UWWTP) were exposed to UV-C light in a specially designed setup. The total concentration of  $\Sigma_{12}$  PAH in the sludge, which was  $1339 \text{ ng g}^{-1}$  of dry matter initially, decreased by 2–77% after 24 h of UV application. The concentrations of some PAH isomers increased after the UV application, which revealed that isomer transformations could emerge due to the effects of temperature and photodegradation. UV light was found to remove 3-ring light compounds more effectively than 4–6-ring heavy compounds. A total PAH decrease of 77% was achieved by adding an amount of  $TiO_2$  equal to 0.5% of the dry weight of the sludge although the removal rate of PAHs from the sludge decreased when the  $TiO_2$  dosage was increased. It is possible that the decreased number of titanium particles caused UV light to scatter and be absorbed in the reaction environment.

**Keywords:** Municipal sludge; PAH; UV-C;  $TiO_2$ ; Temperature; Treatment

### 1. Introduction

The amount of urban wastewater, and thus the sludge volume, increases every year due to increasing populations and rapid urbanization. In 2005, 8 million tons of wastewater treatment sludge was produced in Europe [1], while 27,000 tons of dry matter were produced in Turkey in 2006 [2]. The rapidly increasing amount of sludge causes waste management problems. A possible solution to sludge management problem is its use for agricultural purposes.

There are various semi-volatile organic compounds (SVOC) in urban wastewater treatment sludge, along with pathogens such as bacteria and viruses [3,4]. It is known that Polycyclic Aromatic Hydrocarbons (PAHs), one of the

major classes of SVOCs, emerge due to incomplete combustion of organic matters and are introduced to the environment from natural or anthropogenic sources [5]. PAHs reach wastewater treatment plants from soil by infiltration, from surface soils by entering the sewer system, and from the atmosphere by wet and dry deposition [3,4,6]. It is expected that these pollutants will be held within precipitated sludge by binding to the active sludge mass because of their hydrophobic and lipophilic nature [1,7,8]. PAHs in sludge that is applied to soil can have potential mutagenic/carcinogenic effects when they eventually reach the food chain [9]. European Union brought limitations and defined the limit value for the sum of 11 PAH compounds as  $6 \text{ mg kg}^{-1}$  regarding the agricultural application of sewage sludge [10]. Therefore, these pollutants should be removed from the sludge body [1].

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