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PAH removal effectiveness comparison from hydraulic fracturing model wastewater in SBR reactors with granular and flocked activated sludge

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ABSTRACT

The paper discusses changes in removal efficiency of 16 polycyclic aromatic hydrocarbons (PAHs) in individual unit phases of the sequential biological reactor (SBR) reactor. The experiments were carried out in model SBR reactors operating with aerobic granulated and flocculated activated sludge. The model wastewater was prepared on the basis of PN-72/C-04550.09 and adjusted to the parameters of actual effluents generated during hydraulic fracturing. The scope of analytical determinations included chemical oxygen demand, NH_4^+, NO_3^-, total N, PO_4^{3-}, total P, acenaphthalene, acenaphthene, anthracene, benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[ghi]perylene, benzo[a]pyrene, chrysene, dibenzo[a,h]anthracene, fluoranthene, fluorene, indeno[1,2,3-cd]pyrene, naphthalene, phenanthrene, and pyrene. The work focused on the removal rates of the PAHs tested in the individual SBR processing phases. 16 PAH sum removal rate during mixing phase occurred in similar way in both reactors up to the PAHs dose of 1,800 μg/L. Above this level, PAHs were removed at higher rates in granular sludge reactor. Similar dependence was also observed in the aeration phase; however, more pronounced changes in the rates of PAHs removal in individual reactors were present above 2,200 μg/L. Laboratory work has shown that aerobic granular activated sludge allows the removal of PAHs with greater efficiency as compared with the flocculated sludge. Also granular activated sludge shows higher resistance to increase in the amount of supplied toxic agent as compared with flocculated sludge.

Keywords: Granular aerobic activated sludge; Polycyclic aromatic hydrocarbons; Hydraulical fracturing wastewater

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