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Atenolol degradation using hybrid processes of ultraviolet/peroxymonosulfate/microwave: modeling and optimization with artificial neural network and PSO algorithm

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ABSTRACT

Atenolol (ATN) belongs to a class of drugs known as β-blockers. This medicine works on the heart and blood vessels by blocking the action of some natural chemicals in the body. ATNs are present in surface water and sediments from hospitals and wastewater treatment plants. In the current study ATN degradation using hybrid processes of peroxymonosulfate (PMS)/ultraviolet (UV)/microwave (MW) were investigated. The reaction kinetics and scavengers' effects were also evaluated. Experiments were carried out in a 1.5-L reactor with UV lamp and MW and then analyzed by high-performance liquid chromatography. Artificial neural networks was implemented for modelling and particle swarm optimization technique was used to specify the optimal status for ATN degradation. According to the result, only MW power and PMS parameters had a linear relationship with efficiency, and other parameters had non-linear relationship. Moreover, increasing PMS dosage and MW power in neutral pH has a significant effect on ATN degradation. As per our result, optimum conditions in the experiments were pH 6.2 and 28.8 mg/L ATN initial concentration, 3.05 mg/L PMS concentration, 14.30 min UV time, 19.90 min MW time and 630 W MW power. In this situation the ATN degradation rate was about 97% which according to the sensitivity analysis by Pearson correlation method, pH had the greatest effect on the degradation efficiency in the range of 3–7. Nitrate (NO_3^-), chloride (Cl^-) and humic acid (HA) were used as scavengers. The findings showed that increasing the concentration in HA and NO_3^- decreased the efficiency, but Cl^- did not have much effect on the results. According to the results, this method can be efficient for the degradation of ATN.

Keywords: Advanced oxidation; Artificial neural networks modeling; Atenolol; Hybrid processes; Particle swarm optimization

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