Comparison of Xe-Excimer (172 nm) and Low-Pressure Mercury Vapor Lamps (185/254 Nm) In Terms of Radical Generation Rate, Removal of Hazardous Organic Matter and Matrix Effect

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The ultraviolet (UV) radiation below 200 nm is named Vacuum ultraviolet (VUV) radiation**.** VUV photolysis is one of the Advanced Oxidation Processes (AOPs) for the elimination of pollutants from water and air and produce ultrapure water. In photo-initiated AOP applications, such as VUV photolysis, the lamp type determines the process effectiveness. There are two types of light sources commonly used in VUV photolysis: the low-pressure mercury vapor (LPM) lamps and the excimer lamps. The spectral radiation from low-pressure mercury plasma is dominated by the two Hg resonance lines at 254 nm and 185 nm. Among the excimer lamps, the Xe excimer lamp radiating at 172 nm is the most studied VUV light sources and are used in research related to water purification.

Due to the high energy of VUV photons, they are able to generate •H and •OH directly from water. There is a characteristic difference between the 185 nm and 172 nm radiated water: the penetration depth of 172 nm VUV photons is a fraction of a millimeter (0.04 mm), while that is about 11 mm for 185 nm light. The quantum yield of •OH formation is 0.42 and 0.33 for 172 and 185 nm light, respectively. In addition, an O_2-depleted layer forms in the solutions radiated with 172 nm VUV light, due to the high concentration of carbon-centered radicals and their reactions with O_2. In this work the efficiency of these two light sources were compared. The •OH formation rate was determined via formation of H_2O_2 in pure water and of 7-hydroxy-coumarin from coumarin. Effect of initial concentration of coumarin, dissolved O_2 concentration and •OH scavengers were studied and compared.

Both light sources were applied for the elimination of hazardous organic substances from waters. Model substances were sulfonamides (Sulfadimethoxine, Sulfamethoxypyridazine, Sulfamethazine and Sulfachloropyridazine) and their mixtures. The effect of reaction parameters (initial concentration, dissolved O_2 concentration, pH) and radical scavengers were investigated. The efficiency of VUV (172 nm) and UV/VUV (254/185 nm) photolysis was compared via transformation rate of organic substances, their mineralization rate, the quantum yield of the transformation, and electrical energy consumption. Effect of matrices (tap water, biologically treated water, industrial water purified via reverse osmosis) was also determined in both cases.

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