Arsenic removal of high-arsenic wastewater from gallium arsenide semiconductor production by enhanced two-stage treatment

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Received 21 October 2013; Accepted 11 May 2014

ABSTRACT

High concentrations of arsenic and phosphate have been found in wastewater, from gallium arsenide (GaAs) semiconductor production facilities, which poses a threat to aquatic environments and human health in China. Arsenic removal by an enhanced two-stage process for this kind of high-arsenic wastewater was studied in this work. The process involves primary treatment, oxidation, secondary treatment, and post-treatment. Primary treatment was performed and enhanced with ferric chloride and polyacrylamide to effectively remove most of the arsenic, phosphate, and colloidal silica. The high-arsenic wastewater, which had an initial turbidity of 184 NTU and was milk-white, became clear and transparent with a turbidity of less than 10 NTU after the primary treatment. The bench-scale results showed that arsenic and phosphate concentrations were reduced dramatically from 63 mg/L and 270 mg/L to 0.08–0.13 mg/L, and 0.9–1.5 mg/L, respectively. Then, sodium hypochlorite was used to oxidize residual As(III) to As(V). In the secondary treatment, enhanced coagulation with powder bentonite and ferric chloride was applied and about 80% of residual arsenic could be removed. Based on the bench-scale results, a full-scale sequencing batch two-stage process followed by conventional sand filtration was conducted in a GaAs semiconductor production factory in Beijing. The combined process was successful in producing cleaned effluent with residual arsenic concentrations of below 0.02 mg/L, which met the permitted total discharge amount, and was of great demonstration significance for the high-arsenic wastewater treatment from the GaAs production industry.

Keywords: Arsenic wastewater; Enhanced coagulation; Ferric chloride; Gallium arsenide; Bentonite

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