Treatment of coke oven wastewater in an anaerobic–anoxic–aerobic moving bed bioreactor system

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ABSTRACT

In this work, sequential moving bed bioreactor (MBBR) system with mixed heterogeneous biomass was selected for the treatment of coke oven wastewater (CW). The reactors were arranged in anaerobic (R1)–anoxic (R2)–aerobic (R3) sequence. CW was collected from an industrial site which contains phenol, ammonia, sulfate, iron, oil, and grease. Few heavy metals (cadmium, lead, and cobalt) were also detected in CW at low concentrations. Raw CW was pretreated by primary settling process to remove high solid concentrations. Thereafter, CW was spiked with synthetic pollutants to make the picture of model industrial wastewater. Phenol (1,350 mg/L), ammonia-N (500 mg/L), thiocyanate (800 mg/L), pyridine (50 mg/L), m-, o-, and p-cresols (50 mg/L each) were added as synthetic pollutants in CW. The system was operated at 6 d hydraulic retention time. R1 showed only less phenol (2–5%) and chemical oxygen demand (COD) (~2%) removal. However, R2 and R3 removed significant amount of thiocyanate (>85%), cresols (~88%), and pyridine (>48%) along with the residual phenol (R2: 88%; R3: 98%) and COD (R2: 58%; R3: 79%). Also, denitrification efficiency of R2 was ~94% throughout the study. Ammonia-N removal by R3 was 64–71% comprising 75–77% of total nitrogen removal. Hence, three stage sequential MBBR could be successfully used to treat high strength CW to achieve the discharge limit of effluent.

Keywords: Moving bed bioreactor; Coke oven wastewater; Phenol; Thiocyanate; Nitrification–denitrification