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Short Communication

Performance of combined process of anoxic baffled reactor-biological contact oxidation treating printing and dyeing wastewater

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Abstract

A study of the treatment of printing and dyeing wastewater was carried out using the combined process of anoxic baffled reactor-biological contact oxidation. The results showed the pH ascended continuously and the oxidation-reduction potential dropped gradually from compartment 1–6 in ABR. When hydraulic retention time was 12 h, color removal efficiency was 92% and the color of effluent of ABR could satisfy the professional emission standard (grade-1) of textile and dyeing industry of China. The total COD removal efficiency of the combined process was 86.6% and the COD of effluent could satisfy the professional emission standard (grade-2) of textile and dyeing industry of China.

Keywords: Printing and dyeing wastewater; Anoxic baffled reactor; Biological contact oxidation; Oxidation-reduction potential

1. Introduction

A large numbers of synthetic dyes are produced worldwide every year for printing and dyeing and a portion is discharged with wastewater (Robinson et al., 2001). There are some dyestuff, slurry, dyeing aid, acid or alkali, fiber and inorganic compound in printing and dyeing wastewater. Furthermore, some dyestuff contains nitryl, amidocyanogen and heavy metals, such as copper, chrome, zinc and arsenic and so on (Yang and Huang, 2002). The components will be changed because of different dyestuff category, dyeing process, dye concentration and equipment scale (Delee et al., 1998). So the wastewater quality is unsteady. Generally speaking, the printing and dyeing wastewater is alkalescent, have large flow rate, high color concentration, composed of complex components, heavily polluted and difficult to be biodegraded (Huang et al., 2001). Therefore it is difficult to meet the discharge criterion only using of simple biological treatment processes, while physical chemistry treatment processes need high operation expense (Pearce et al., 2003). At present, researchers gradually discovering new treatment processes, one of which the wastewater is firstly hydrolyzed under anoxic condition, and then is treated under aerobic condition (Lourenco et al., 2000; Yu et al., 2000). Anoxic hydrolysis-aerobic treatment of the printing and dyeing wastewater has been considered to have some advantages over the conventional processes. For anoxic hydrolysis, the hydraulic retention time (HRT) is short, and non-degradable organic compounds of wastewater can be transformed into degradable matter, i.e., the degradable performance of the wastewater is improved greatly. Simultaneously, a portion of COD can be removed. Taking into consideration the slow growth rate of many

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anoxic microorganisms, the key objective of the efficient reactor design must be large quantity of anoxic sludge with very little loss of anoxic microorganisms from the bioreactor. So the residual aerobic sludge circumfluence is utilized to increase the quantity of anoxic sludge. At the same time, sludge in the whole treatment process will be in equilibrium (Chen et al., 1999).

Anoxic baffled reactor (ABR) as a hydrolysis process was adopted in this study. There were several small compartments in ABR that phase-split anoxic condition could be come into being in every compartment along the wastewater current. The flow type of the reactor was approximately piston flow. Besides these, ABR has the preferable virtues of resisting shock load and toxicity. It has some other characteristics, such as easily start-up and without short streaming, jam and back streaming (Li et al., 2001; Xu et al., 2002). Hence, the combined process, an ABR as a hydrolysis process and biological contact oxidation as an aerobic process was used in this study.

2. Methods

2.1. System configuration

Schematic diagram of experimental set-up is shown in Fig. 1. The opening ABR was made up of six compartments where the front five compartments acted as hydrolysis tank and compartment 6 acted as sedimentation tank. Every compartment had two sampling cocks at the upside and downside of its profile, and the upper was a water-sampling cock, while the lower was sludge sampling one. Setting a baffle in every compartment, hydrolysis room was separated into two portions. One was down-flow room and the other was upper-flow hydrolysis room. At the bottom of the baffle, there was a 45° guide baffle. It ensured that wastewater was mixed with the sludge adequately in the reactor room. The ABR had a size of $441 \times 156 \times 353$ mm ($l \times w \times h$) and the biological contact oxidation tank had a size of $430 \times 150 \times 400$ mm ($l \times w \times h$). The elasticity stuffing was filled in biological contact oxidation tank. The sludge of the sixth compartment in ABR and sedimentation tank was pumped to the front of ABR by sludge circumfluence pump.

2.2. Characteristics of raw wastewater

Raw wastewater was printing and dyeing combined wastewater from certain printing and dyeing corporation, Nanjing city, PR China. The characteristics of wastewater were as follows: apparent color purple; color value 200 times; pH value 12.2; COD 1201.7 mg L^{-1} and temperature 17.8 °C.

2.3. Experimental methods

The pH of raw wastewater was adjusted to 7.05. Subsequently, the wastewater was pumped into ABR by creep pump. The HRT of ABR was controlled at 12 h. After being hydrolyzed, outflow of ABR entered the biological contact oxidation tank for aerobic treatment. Finally, the mixed liquid entered the sedimentation tank and sludge was deposited in this tank. At steady condition, water samples of ABR and biological contact oxidation tank were collected. Color concentration and COD in these samples were measured. Simultaneously, in order to show the stability of reactor, oxidation-reduction potential (ORP) and pH were also measured for inspecting and controlling the normal running of the combined treatment system.

3. Results and discussion

3.1. ORP and pH in ABR

Generally, in the biological treatment of printing and dyeing wastewater, dissolved oxygen, pH and ORP are usually used to inspect and control the running of biochemical reactor, and to show the stability of biochemical process. But in non-aerobic condition, only pH and ORP could be used for the same purpose. Traditionally, pH is a parameter applied to control anaerobic digestion, while ORP is a parameter applied to control wastewater biological treatment containing all oxidation reduction scope, that is to

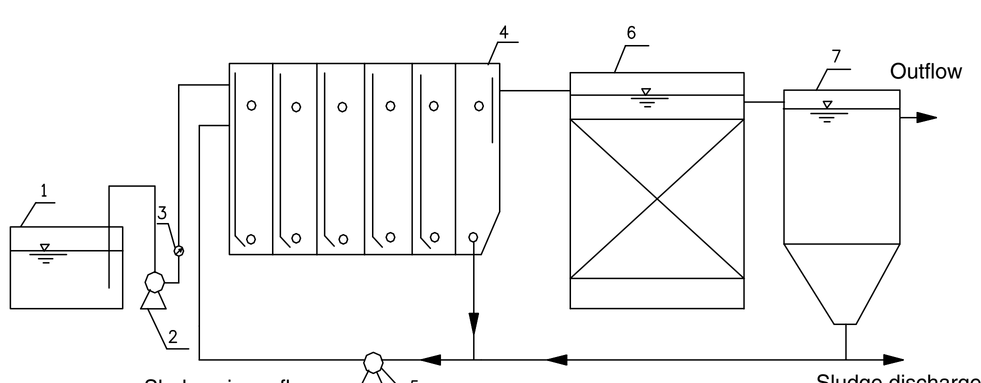

Fig. 1. Schematic diagram of experimental set-up (1. wastewater tank; 2. creep pump; 3. liquid flowmeter; 4. hydrolysis reactor; 5. sludge circumfluence pump; 6. biological contact oxidation tank; 7. sedimentation tank.).