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Short Communication

Preparation and characteristics of bioflocculants from excess biological sludge

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HIGHLIGHTS

- ▶ Hydrochloric acid was used to disintegrate excess sludge to extract bioflocculant.
- ▶ 99.5% flocculating rate for 4 g/L kaolin clay was achieved with sludge bioflocculant.
- ▶ Sodium hydroxide could separate flocculant activity ingredient from solution effectively.
- ▶ The main component of the purified sludge bioflocculant is polysaccharide.
- ▶ Performance test showed that the sludge bioflocculant had moderate thermostability.

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ABSTRACT

In this study the feasibility of preparing bioflocculant from excess biological sludge was investigated. Hydrochloric acid was used to disintegrate sludge to prepare bioflocculant. The effects of acid dosage and flocculating conditions were studied. The optimized disintegration conditions was that acid dosage was 10 mL for 50 mL sludge suspension. Factors such as bioflocculant dosage, pH and temperature of the flocculant system were also tested. The optimal conditions were flocculant concentration 3.0% (v/v) and pH 10.5 of flocculating suspension. Under these conditions, 99.5% of flocculating rate for 4 g/L kaolin clay was achieved. Ethanol and sodium hydroxide were applied to purify the crude sludge bioflocculant together or separately. Results showed that sodium hydroxide could separate the bioflocculant from aqueous solution more effectively than ethanol. Analysis of the purified bioflocculant by Fourier-transform infrared spectrophotometer (FT-IR) and chemical methods indicated that the main component was polysaccharide. Performance test showed that the sludge bioflocculant had moderate thermostability.

1. Introduction

A large amount of excess biological sludge are produced from wastewater treatment plants when wastewater is treated through biological process due to the consumption of organic pollutants in the wastewater and the concomitant microbial growth (Jung et al., 2001). This brings about serious excess sludge disposal problems. To date, excess sludge has mainly been dealt with by soil application, landfill, combustion and ocean dumping (Hwang et al., 2008). The capital and operating costs associated with excess sludge are known to be as high as 50% of the total cost of the wastewater treatment plant (Zhang et al., 2007; Wei et al., 2003). Therefore, it is considerable essential to explore and develop technologies for the efficient disposal and recycling of excess sludge. (Jung et al., 2001).

Bioflocculants is derived from the natural secretions of bacteria during growth. The predominant components of bioflocculants are glycoprotein, polysaccharide, protein, and nucleic acid. In recent years, bioflocculants have attracted wide attention in water treatment research field, because they are safety to human health, biodegradable, and free of secondary pollution risk (Gao et al., 2009). At the present time most of research focused on screening for microorganisms, culture conditions, mechanism of flocculation, chemical structure, and the combined use of bioflocculants. (Deng et al., 2005; Bo et al., 2012; Zhao et al., 2012). However, high production costs associated with relatively expensive substrates limit their practical application (Li et al., 2003). Thus it is necessary to seek for low-cost substrates to reduce the production cost.

Excess biological sludge is aggregate of microorganisms organism and inorganism. The main constitutes of the microorganisms were macromolecules compounds such as polysaccharide, protein, cellulose, lipid acids, esters and so on. Some of these macromolecules compounds have flocculating activity (Tenney and Stumm, 1965). Thus excess biological sludge is supposed to be a source

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