Exopolysaccharide Production by a Marine Cyanobacterium *Cyanothece* sp.

Application in Dye Removal by Its Gelation Phenomenon

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Abstract

Cyanobacterium *Cyanothece* sp. ATCC 51142 has been shown to produce an exopolysaccharide (EPS) at a high level. EPS production was found to be influenced by the concentration of salt, pH, and type of nitrogen source. Maximum polysaccharide production was found to occur at a 4.5% (w/v) NaCl salt concentration, pH 7.0, and in the presence of NaNO₃ as the nitrogen source. The gelation of EPS in alkaline conditions was employed to remove the dyes from the effluents. The effect of organic molecules and metal ions on the efficiency of dye removal capacity was investigated. A laboratory-scale reactor was prepared to treat artificial textile effluent.

**Index Entries:** *Cyanothece; cyanobacterium; dyes; exopolysaccharide; gelation; wastewater treatment.*

Introduction

Because of the growth of industries in the last few decades, a wide variety of man-made (anthropogenic) compounds have been generated worldwide, and the production of such compounds is associated with the formation of large amounts of wastes. Although the process of industrialization is important for nations’ prosperity, the pollution caused by the industries cannot be neglected. With the increasing awareness for the need to protect the environment, the treatment and disposal of industrial wastes have acquired great significance.

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The wastes generated by the food coloring, cosmetics, paper, and textile industries are polluted by dyes, which are relatively recalcitrant. When these colored effluents enter rivers or other bodies of water, they upset the biological activity. They can cause water-borne ailments such as nausea, hemorrhage, ulceration of the skin and mucous membranes, dermatitis, perforation of the nasal septum, severe irritation of the respiratory tract, and cancer, or may also enter the food chain (1,2). Furthermore, such wastes are esthetically objectionable. Therefore, there is a considerable need to treat such effluents prior to discharge.

Although physical and chemical methods are available for the treatment of such wastes, they do not show any significant effectiveness or economic advantage (3). Moreover, they are found to be resistant to biooxidation. Dye color removal by adsorption is a better treatment option (4,5). The use of biological materials as adsorbents in the removal of color from either synthetic solutions or textile effluents has recently attracted much attention (3,6,7). We have found that the marine cyanobacterium *Cyanothece* sp. ATCC 51142 possesses an ability to produce exopolysaccharide (EPS); EPS exhibits an excellent property of gelation that can be exploited for dye removal.

The present study deals with EPS production by *Cyanothece* under various conditions and describes the phenomenon of gel formation and its exploitation for removal of dyes from industrial effluents.

**Materials and Methods**

**Microorganism**

*Cyanothece* ATCC 51142 was obtained as a gift culture from Prof. D. O. Hall, King’s College, London. It was maintained at 27°C in ASN III medium with a light/dark cycle of 16/8 h under fluorescent light of 3000 lux light intensity.

**Growth and Polysaccharide Production**

The EPS production and growth pattern of *Cyanothece* were studied under batch process. Growth of the culture was monitored spectrophotometrically measuring the optical density (OD) at 660 nm. Polysaccharide estimation was carried out by gravimetric analysis, and the results presented are in g% (w/v).

The effect of salt concentration, pH, and type of nitrogen source on EPS production was studied by modifying the ASN III composition as required.

**Extraction of EPS**

EPS was separated by centrifugation at 10,000g for 10 min at 4°C using 30-d-old *Cyanothece* culture grown in ASN III medium.