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Removal of Indigo from Textile Wastewater by Bioadsorption with Vegetable Waste Material

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Abstract. Textile industry is one of the most polluting industries in the world. An adsorbent is of low cost if it requires little processing, is provided in nature or is a by-product of waste material. The objective of this work was to explore the feasibility of water hyacinth and pineapple crown as low cost natural adsorbents, to remove the indigo present in the wastewater from a textile laundry. Biological materials were dried at 80°C 48h, the dry material was grinded until fine powder; 30, 60, 100, 130 or 160 mg of the powder were mixed with 3 mL of textile wastewater contaminated with indigo. The removal of indigo was determined by measuring the absorbance of the supernatant at 610 nm. The removal of the indigo present in 3 mL of textile wastewater was between 63 and 68% using 100, 130 and 160 mg of water hyacinth powder, whereas in the case of pineapple crown the adsorption was between 68 and 70% using 130 and 160 mg of the powder. The waste materials tested are an attractive and viable alternative for the treatment of textile wastewater, in such a way that the material acquires an aggregated value.

Keywords: Textile dye, bioadsorption, indigo, waste material, water hyacinth

INTRODUCTION

Textile industry is one of the most polluting industries in the world, because of the large quantities of water necessary for the processes and to the type and variety of chemical contaminants present in the wastewater. Frequently, this wastewater is discharged without any further treatment. The pollutants not

only add color to water, they are also toxic to the aquatic and other forms of life.[1] Textile industries are the largest consumers of dye stuffs, and it is estimated that 10-15% of the dye is lost during the dyeing process and is released mainly as sewage.[2] Effluents contaminated with colorants are usually treated by employing physical and chemical methods;[1,3] however, these methods are expensive, lead to the formation of hazardous by-products, and require high energy input.[4] The use of biological systems for the treatment of these wastewaters has become an interesting alternative.[5,6] Adsorption of contaminants from wastewater onto an adsorbent is a new and attractive dimension to the wastewater treatment technology. The adsorption process is more versatile and efficient than other methods such as coagulation, chemical oxidation, and froth flotation; other advantages are its ability to separate a wide range of chemical compounds and easy operational procedures. The most popular and efficient adsorbent is activated charcoal but is expensive and then its widespread use is restricted due to the cost of the treatment. An adsorbent is of low cost if it requires little processing, is provide in nature or is a by-product of waste material. In recent years, a number of studies have focused on the use of different potential agricultural materials as inexpensive adsorbents for the removal of dyes from aqueous solutions. The cellulosic surface of plant biomass has strong properties and characteristics of sorption, several agricultural products have been used as adsorbent for removal of organic and inorganic compounds.[3,7]

Water hyacinth is an invasive nuisance *planta non grata* in much of the world, where it often jams rivers and lakes with uncounted thousands of tons of floating plant matter, not only destroy native habitats, but it also seriously depletes water bodies of oxygen and increases water loss. Propagation can be so rapid that an infestation may double in size every week under ideal conditions. Extensive growth of water hyacinth can destroy native wetlands and waterways, killing native fish and other wildlife, can form dense mats that spread out across water surfaces eventually choking the entire water body, and interfere with navigation, fishing, recreation and agricultural activities.[8,9]

The objective of this work was to explore the feasibility of several dry vegetable wastes as low cost and easy to use natural adsorbents, like water hyacinth and crown of pineapple, to remove the indigo present in the wastewater from a textile laundry.

METHODS

Water hyacinth (w. hyacinth) and pineapple crown (p. crown) were dried at 80°C for 48 h, the dry material was grinded until fine powder; 30, 60, 100, 130 or 160 mg of the powder were mixed with 3 mL of textile wastewater from an industrial textile laundry contaminated with indigo, the mixture was stirred 2 h, then it was centrifuged at 800 rpm, 3 min. The removal of indigo was determined by measuring the absorbance of the supernatant at 610 nm and compared with the absorbance of the sample before the treatment.

RESULTS

In figure 1 can be observed that both materials adsorbed the colorant from the textile wastewater. With water hyacinth the adsorption with 100, 130 and 160 mg of powder was similar, between 63 and 68%; in the case of pineapple crown the adsorption was between 68 and 70% using 130 and 160 mg of the powder.

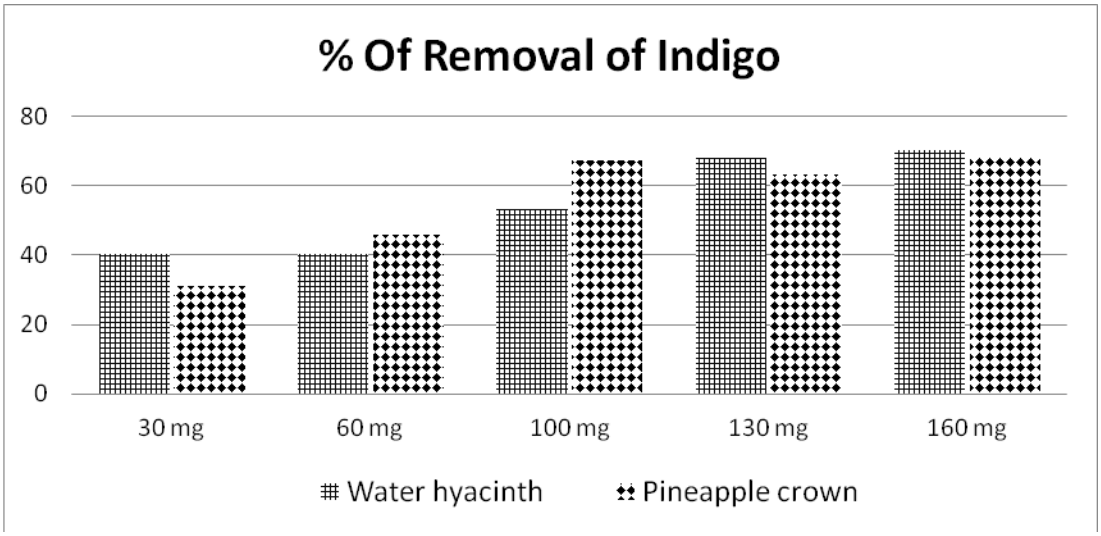

Figure 1: % of removal of indigo present in the textile wastewater using dried water hyacinth and pineapple crown

After de process of adsorption of the indigo present in the textile wastewater (TW), the solid was removed by centrifugation or sedimentation, and the supernatant doesn't have the blue color, the green color of the supernatant is due to the pigments present in the biological material (figure 2), that can be further degraded by a microbial process.

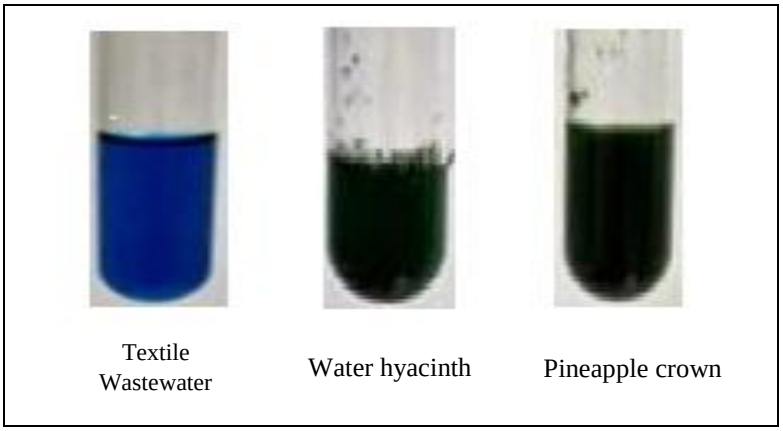

Figure 2: Decolorization of the textile wastewater using dried water hyacinth and pineapple crown.

CONCLUSIONS

The water hyacinth (considered as an invasive nuisance) and the pineapple crown (an agricultural waste) can be dried and used as a good, inexpensive and easy to use adsorbents of the indigo present in the textile wastewater of an industrial textile laundry. The waste materials tested are an attractive and viable alternative for the treatment of textile wastewater, in such a way that the material acquires an aggregated value. Besides, after the adsorption process, the contaminated biomass can be composted and obtain a fertilizer or used for the production of energy

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