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Physical parameters affecting coagulation of turbid water with *Opuntia ficus-indica* cactus

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ABSTRACT

The *Opuntia ficus-indica* cactus (also known as the nopal or prickly pear) indigenous from Mexico is being tested as a flocculating agent. The performance of coagulation–flocculation and the quality of treated water was evaluated by measuring the residual turbidity. The results showed the effectiveness of different solutions of *Opuntia* with the best removal of 0.5 NTU for the most turbid water, by using 0.2 mg/L of cactus concentration. This natural coagulant functions by means of adsorption mechanism followed by charge neutralization or polymeric bridging effect. Utilization of this coagulant represents important progress in sustainable environmental technology.

1. Introduction

Water treatment has become a very important researching task, therefore. For many years, scientific community has been testing new methods for water treatment. Some processes are rather well known, such as filtration, disinfection or coagulation, but new cheaper and affordable water treatment processes are needed (Alila and Boufi, 2009; Antov et al., 2012). One of the most effective methods of removing turbidity from water is via the process of coagulation. There are currently two main chemicals used to aid coagulation in the developed world; these are aluminum sulphate ($Al_2(SO_4)_3$) and ferric sulphate ($Fe_2(SO_4)_3$), termed alum and ferric, respectively (Betatache et al., 2014). Coagulants have a positive charge, whereas colloidal particles that cause turbidity in water are negatively charged. Coagulants cause flocculation during water treatment via charge neutralization, after which the flocs settle under gravity leaving a supernatant with reduced turbidity. The limited availability and relative expense of alum and ferric, has led to research into the potential of biological coagulants. One of the most effective methods of removing turbidity from water is via the process of coagulation. Coagulants have a positive charge, whereas colloidal particles that cause turbidity in water are negatively charged. Coagulants cause flocculation during water treatment via charge neutralization, after which the flocs settle under gravity leaving a supernatant with reduced turbidity. The limited availability and relative expense of alum and ferric (WHO, 2008), has led to research into the potential of biological coagulants; in particular:

The *Opuntia ficus-indica* cactus: Also known as the nopal or prickly pear is native to the United States, Mexico and South America, but it grows well in other areas, including Africa, Australia and the Mediterranean region. Mucilage extracted from the *Opuntia* spp. acts as an efficient coagulant in surrogate turbid water (Miller et al., 2008).

The use of plant-based coagulants for water treatment represents important progress in sustainable environmental technology. It is a vital effort in line with the global sustainable development initiatives.

2. Materials and methods

2.1. Natural coagulant

Opuntia spp. pads were collected from Tipaza. They were repeatedly washed with distilled water to remove dirt particles, Dissections of fresh *Opuntia* spp. pads were performed by hand: skin was peeled from the pad; the outer pad was considered the

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