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Brownian Motion and Coagulation Process

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Abstract: This review discusses the Brownian motion and coagulation/flocculation (C/F) in water/wastewater treatment. In water/wastewater treatment processes, pertinent questions relating to Brownian motion and C/F are often asked. Some of these questions are: Brownian motion and molecular agitation are favourable or not to separation processes? As high salinity (seawater) decreases disorder, increasing surface water salinity would be a convenient water treatment process or not? The processes of C/F are used to remove dissolved substances and colloids from water in order to assure efficient settling.

Keywords: Colloid, Brownian Motion, Coagulation, Flocculation, Water/Wastewater Treatment

1. Introduction

In water treatment engineering, some questions are asked: Brownian motion and molecular agitation are favourable or not to separation processes? After coagulation/flocculation (C/F) and settling, two separate phases (limpid water + mud) are present, disorder is minimised or not? Freezing decreases disorder or not? Freezing treats or not water? High salinity (seawater) decreases disorder or not? Increasing surface water salinity would be a convenient water treatment process or not? In other words, this review tries to find links between Brownian motion and coagulation.

The processes of C/F are used to remove dissolved substances and colloids from water in order to assure efficient settling [1,2].

2. Colloids

Colloidal particles are defined as aggregates of atoms and/or molecules; their density is near to water density (~1) and their diameters are small enough that gravity is not able to settle them. Consequently, they remain in suspension [3]; this is why they are called stable dispersions [4]. Their stability originates from the reciprocal repulsion between colloids [5]. However, their stability may be disturbed by applying some chemical products. Coagulation is defined as the key unit process where such reactants are injected in order to destabilise the colloids repulsion, thus pushing them to form bonds together [6]. This chemical process is usually encountered before the unit operation of flocculation [7]. The colloids are frequently responsible of the turbidity and sometimes of the colour that make water undrinkable; consequently, these fine particles should be completely eliminated from water [8].

This section reviews some prerequisite topics, which are indispensable in the comprehension of C/F process, including behaviour and stability of colloids and Zeta potential [8,9].

2.1. Colloid Behaviour

In its great fraction, the suspended solids in surface waters are constituted with materials, such as silica, with density of 2.65 [10]. As their sizes are ranged from 0.1 to 2 mm, they may be easily removed from water by settling. On the other hand, when their diameter is less than 10^{-5} mm (10 µm), they