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Application of bentonites as an agent for the purification of solid matter contaminated waters

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ABSTRACT

In this study possibilities of the application of optimum conditions of the adsorption and coagulation treatment with bentonites was explored and optimized and effects of the treatment were focused on, water contaminated with dispersions of different organic polymers, water contaminated with food particles and waste water characterized by emulgated and fine dispersed solids. The turbidity and SS of the treated wastewater were reduced with the increase of bentonite dosage, and reached minimum at the same dosage which was about 250mg/L. The pH 6 as the optimum value was under consideration not only the treated efficiency but also the cost of the treatment

Keywords: Bentonites, water contamination, organic polymers, water purification

INTRODUCTION

Bentonite is a clay rock of which the active mineral is montmorillonite (Jahn, 1977). The activation of bentonite does not change, in principle, the natural characters of this rock, and, therefore, the application of activated bentonites lowers or eliminates the need of the addition of chemical electrolytes into the waste water which can be observed from the environmental point of view as secondary contaminators (Liu and Zheng, 2008; Duan *et al.*, 2010). Activated bentonites destabilize different dispersion systems, which are decomposed by creation of flakes as impurities are being adsorbed on particles of bentonites (Gunister *et al.*, 2006). Bentonite particles saturated with impurities are relatively heavy, they sediment quickly & hence can be used, on the type of impurities, they are liquidated or exploted in different low-waste technologies.

METHODOLOGY

Sewage water samples were collected from Nagpur city at locations Paungaon, Mahalgaon and Parshad along Nag River and Pili River area, for a period of one year, December 2015 to January 2016.

In the laboratory, the sewage samples were preserved in the refrigerator at 4°C and examined when needed so that the potential for volatilization or biodegradation of the samples can be minimised. Collection and preservation of samples for the pH, COD, iron, and turbidity were done according to the Standard Methods for the Examination of Water and Wastewater (APHA, AWWA, and WEF 2005).

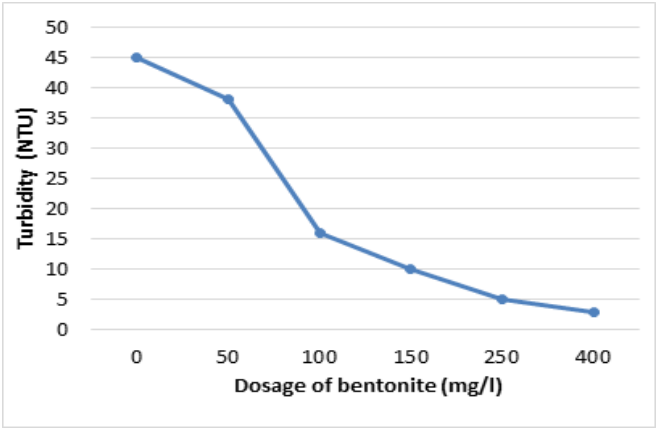
Activated bentonites are supplied in bags or bulky as a dry powder with the maximum grain size 0.3 mm up to 3.0 mm. They stored under the roof on pallets or transported into bins. Before being applied activated bentonites are mixed in a propeller mixture with water during 0.5 until 2.0 hours. The resulting slurry contains various Bentonite dosages of, 50g, 100g, 150g, 250g and 400g of dry matter per one liter. Such slurry can be pumped into the purification station.

Waste water, from which bigger foreign matters are removed in the traditional way, is pumped into the mixing basin where the predetermined amount of specially activated bentonites is added during the continuous mixing. After about 60 seconds, pH of the mixture can be regulated if necessary. For this purpose, hydrated lime or a mineral acids are added. After another one minute mixing, the slurry is transferred into a sediment basin. Bentonites saturated with impurities gets sediments, while purified water flows over the upper edge of the sedimentary device.

RESULTS AND DISCUSSION

Effect of the Bentonite Dosage:

As shown in Figure 1a and 1b, the turbidity and SS of the treated wastewater were reduced with the increase of bentonite dosage, and reached minimum at the same dosage which was about 250mg/L. It is because that the SS of the treated water was devoted by fines concentration. The light beam will be scattered and reflected by the small particles. This is exactly corresponds with the determination theory of turbidity.



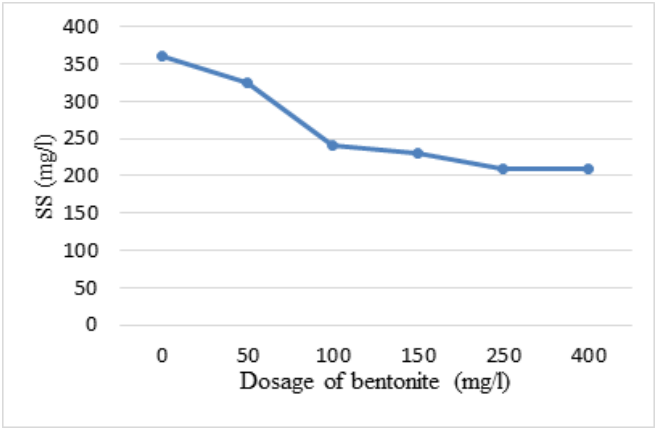
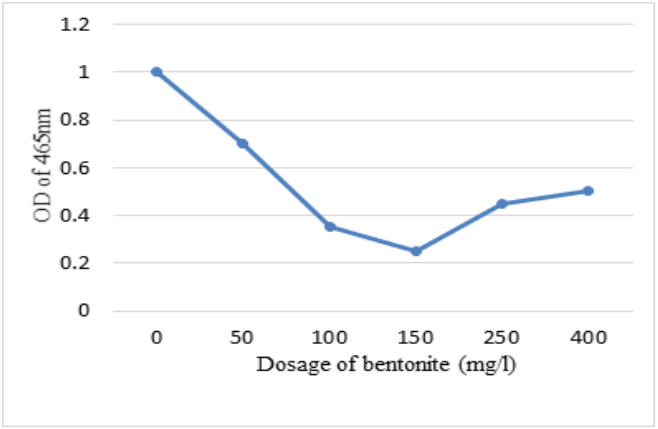


Figure 1 (a) Effect of the bentonite dosage on Turbidity **(b).** Effect of the bentonite dosage on Suspended Solid (S.S.)



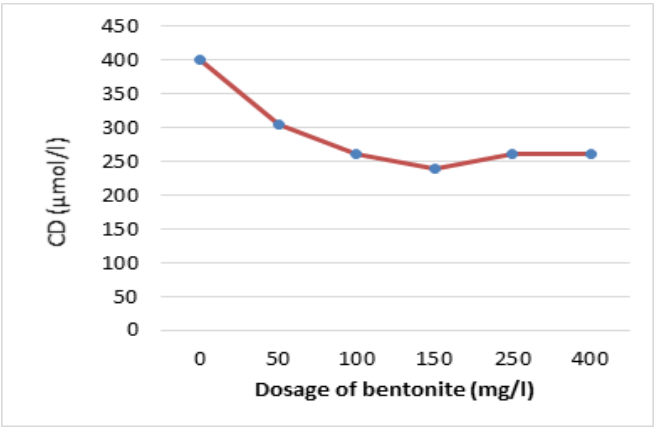


Figure 1 (c). Effect of the bentonite dosage on Optical density (O.D.). (**d).** Effect of the bentonite dosage on Cationic Demand (C.D.)

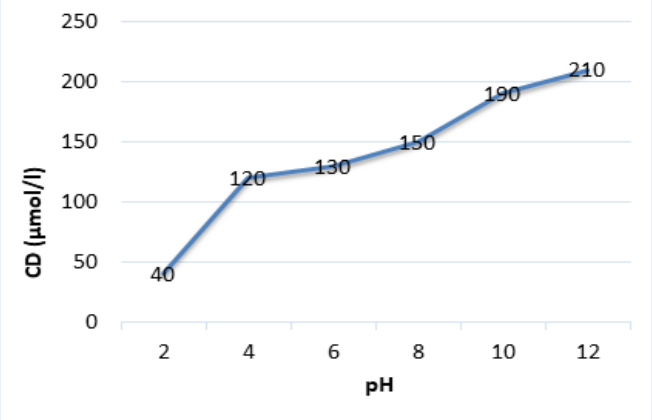
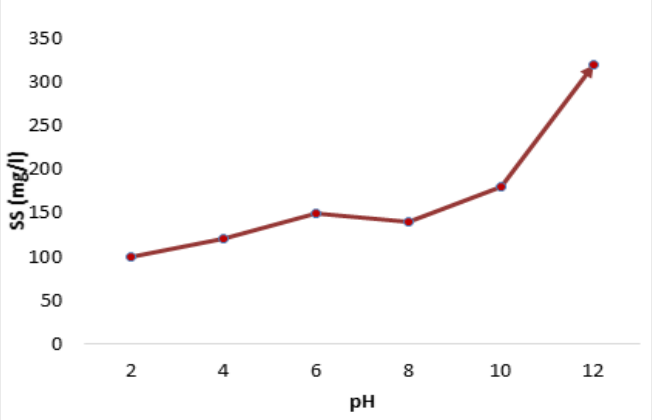


Figure 2 (a). Effect of pH on Cationic Demand (C.D.)



(b). Effect of pH on Suspended Solid (S.S.)

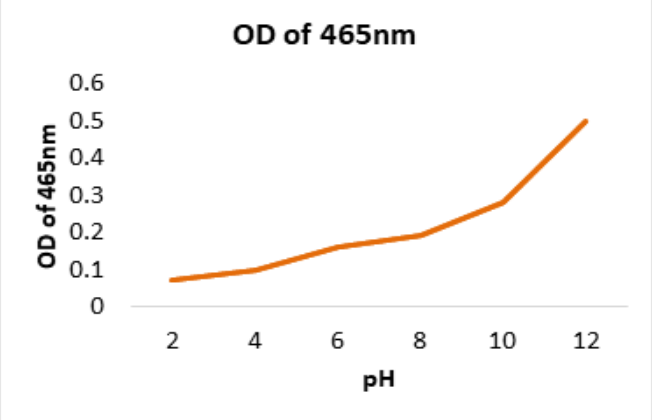
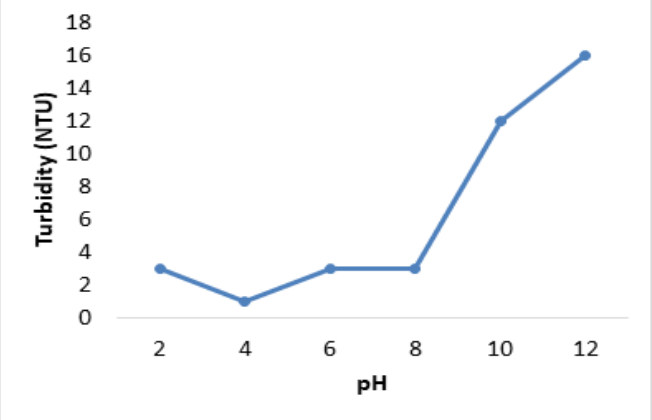


Figure 2 (c). Effect of pH on Optical density (O.D.).



(d). Effect of pH on Turbidity.

So the turbidity of water in this study was linear with the content of SS. The CD and 465 nm OD of the of the treated water were decreased with increase of bentonite dosage and reached the minimum at about 150mg/L dosage, but increased at the dosage of 250mg/L, then drop again while the dosage reached at 400mg/L (Figure 1c and 1d). This was most likely caused by removal of CD and colour substance due to two ways: adsorption and coagulation mechanism.

Figure 1 further showed the removal of the four indices were significant only when the dosage from 50 mg/L to 150 mg/L. So, the 150 mg/L was the optimal bentonite dosage.

Effect of the initial pH

Figure 2a, 2b, 2c, 2d showed the effect of initial pH on the bentonite treatment. As a whole, all of CD, SS, 465nm OD and turbidity of the treated water were increased with the initial pH value increased. The colour and CD of the treated water increased slightly with increased of pH, the acidic property water becomes stronger, the CD and colour of treated water will become smaller. It is different that the colour of the treated water altered little with pH from 2 to 6 to that of raw material puling effluent.

The colour of raw material puling effluent will change very significantly because the acidic precipitation of lignin that contributes to the colour of these effluents. The SS of the treated water increased slightly with pH from 2 to 6, and from 8 to 12, but decreased at pH 8. The turbidity decreased with pH from 2 to 4, and then increased from pH 4 to 8, after pH 8, with the increase of pH value, the turbidity increased significantly. It was maybe due to good dispersion of bentonite at alkaline environment. The dispersion of absorbed water and expanded bentonite in water caused the increasing of turbidity. The above mentioned factors should be under consideration choice of pH value. Except for the SS of treated water, the other three indexes are good enough for the treatment at pH 6. Choose the pH 6 as the optimum value was under consideration not only the treated efficiency but also the cost of the treatment.

Table 1 : Dosage of Bentonite

Sr. No.	Type of waste water	Dosage of bentonite / mg/L	Neutralization
1	slightly oil polluted water	50-300	With hydrated lime to pH 3-5
2	Strongly oil polluted water	100-400	Usually not necessary
3	Waters with dispersions of organic polymers	100-200	Usually not necessary
4	Water from cattle breeding	100-250	Usually not necessary or with hydrated lime to pH 6
5	Waters from food industry	50-250	Alternatively H_2SO_4 or Hydrated lime
6	Didested sludges from biological sewage plants mechanical dewatering	100-400	Usually not necessary

Average specific consumption of specially activated bentonites and eventually other supporting matter is presented in table 1. It has to be notified, that the exact consumption of bentonites must be determined experimentally depending on the type of waste water.

The best result of the application of bentonites for water treatment is reached in water with pH between 5-8. This is consistent with finding of Inglezakis *et al*., (2007) and Aziz *et al.*, (2007). Therefore, the regulation of water acidity is recommended. Alkaline waste waters, therefore, need the neutralization with the acid.

The specially activated bentonite, being blended with water in the recombined ratio, show the acidic reaction with pH 3.5 after the bentonite slurry is blended into waste waters, the pH of the mixture is lowered proportionally. If then the acidity of mixture fall bellow pH 5, hydrated lime is to be added in order to maintain the acidity of the slurry between pH 5-8 again.

Through the studies of influence factors we draw up the optimal conditioned for water treatment. The optimal condition were bentonite dosage 150mg/L and pH value 6.4.

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