Selective Flocculation Studies Of Iron Ore Fines Using Polyvinyl Alcohol Based Flocculating Reagents

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ABSTRACT: ***The wastewater treatment is being given more importance nowadays, especially those which are not from the biological processes. If the polymers used for flocculation purpose are so that they do not cause harm to the water bodies and are environment friendly then they are being given more importance. We propose here a very simple flocculant which is prepared by blending of Polyvinyl alcohol (PVA) and Polyacrylic acid (PAA). The proposed polymer has been successfully tried upon the iron ores flocculation tests.***
Keywords: Selective flocculation, Polyvinyl alcohol (PVA), Polyacrylic acid (PAA)

1. Introduction

As India is a developing country, Iron and steel industry is of more importance as it is a driving force behind country's development. The quality of ore is more importance for iron and steel industry [1], thus mining of iron ore is of most importance for any country [2]. In past days, mining was focused on high grade iron ore but high demand has led to low grade iron ores and highly mechanized mining which has lead to generation of high amount of fines [3-4]. The treatment of fines produced while mining and processing is becoming necessary and also slurry discarded without treating poses a significant environmental problem due to the presence of ultrafine particles. The removal of ultrafine form slurry is necessary as water bodies and soil is affecting.

Iron ore fines are processed by many physico-chemical methods like Froth Flotation, Electrostatic Separation, Magnetic Separation, Sedimentation, Elutriation etc, [5-6] and one of the most important is flocculation. Flotation processes are applicable to beneficiation of substantial tonnage [7]. In mining the amount of fines generated is more than 40% [10-13].

Higher molecular weight polymers have been used as flocculants for colloidal suspensions o separate and dewater solid-liquid (water) systems. Starch and polyacrylic Acid (PAA) represents the most widely used flocculants along with polyacrylamide (PAM) [14-15]. The interaction of polymers on the mineral surface depends upon the nature of polymers concentration of functional groups along with many other properties of polymer [15-22].

In present study, we have synthesized Polyvinyl alcohol and Poly Acrylic Acid called as blended polymer and used these polymeric blend on selective flocculation tests. Experiments were performed to compare the performance of above mentioned flocculants by changing various parameters like flocculant dose, pulp density and pH. It has been studied that with the increase in pulp density the settling rate decreases and with increasing flocculant dose the sedimentation rate also increases but up to a certain limit. The volume of filtrate increases with increasing flocculant dose. The different pulp densities used in this study were 5, 10, 15, 20% (w/w) and the flocculant dosages were 15, 20, 50 ppm as shown in Table 1.

The interaction of the mentioned flocculants with the iron oxide and clay has been studied and their effects have been reported in terms of plotted graphs. Effects of varying parameters have been studied and reported in terms of plotted graphs.

Table 1: The experimental parameters and levels

Parameters	Levels
Pulp Density	5, 10, 15, 20% Solids by wt.
Flocculant Dosage	0, 15, 20, 50ppm
pH	5.0, 6.4, 9.0

2. MATERIALS AND METHOD

2.1 Sample Preparation

The iron ore tailings were collected from Barsua iron ore mines (Sundergarh, Orissa) of RMD-SAIL. The sample was made to -80 micron feed size and they were used as it is without further treatment. Table 2 shows the chemical analysis of the iron ore sample.

Table 2: Chemical analysis of Iron ore sample

Element	Fe	SiO_2	Al_2O_3
%	52.6	7.8	7.3

2.2 Preparation of PVA-PAA blend

Polyvinyl alcohol (PVA) was purchased from Alpha chemica, Polyacrylic acid was purchased from Sigma Aldrich. To a 10% PVA solution, PAA was added after heating for 2 hrs at suitable temperature, the blends were obtained. For obtaining acidic medium (pH=5), Hydrochloric Acid solution and for obtaining alkaline medium (pH=9), Potassium hydroxide (KOH) solution were used.

3. EXPERIMENTAL PROCEDURE

Experiments were carried out by making slurry of -80 microns size fines with distilled water. Amount of iron ore fines and distilled water to be used, were calculated according to the pulp densities required. Slurry was made in a 500 ml graduated measuring cylinder. The cylinder was graduated by pasting a graph paper on its outer wall (for noting the height decrement of interface in terms of millilitre). Flocculant was added in the slurry according to the required dose. The effects of various flocculant dosages on different pulp densities were studied and compared by plotting graph. The data obtained were represented through graphs plotted.

4. RESULTS & DISCUSSIONS

Characterization Studies: The chemical analysis of the sample was done and it was found to be 52.6% Fe, 7.8% SiO_2 and 7.3% Al_2O_3 as shown in Table 2.

Flocculation Characteristics: The flocculation tests were done and the following results were obtained.

From Figure 1, it is clear that the flocculent dosage was varied to 15, 20 and 50 ppm and then they were analyzed for its % Fe analysis. The Pulp Density was also kept at 5, 10, 15, 20% by weight. It is found that as the flocculent dosage is increased from 15 to 50%, the % of iron recovered is more, which is maximum at a flocculent dosage of 50 ppm i.e. 70.37% of Fe at a pulp density of 20%.

Figure 2 shows the settling rate of the different flocculent dosage (FD) of 10% PD at different ppm of FD. It is found that as the % of FD increases from 0, 15, 20 and then to 50 ppm, the time required for the settling of the iron particles goes on decreasing. The minimum time required for the settling of the iron ores is 148 seconds which is almost half the time required without flocculent which 343 seconds is for zero dosage at a pulp density of 10%. As from the above graphs it can be clearly seen that with increasing in flocculant dosage the

initial settling rate is increasing up to certain limit, later there is no significant effect of dosage.

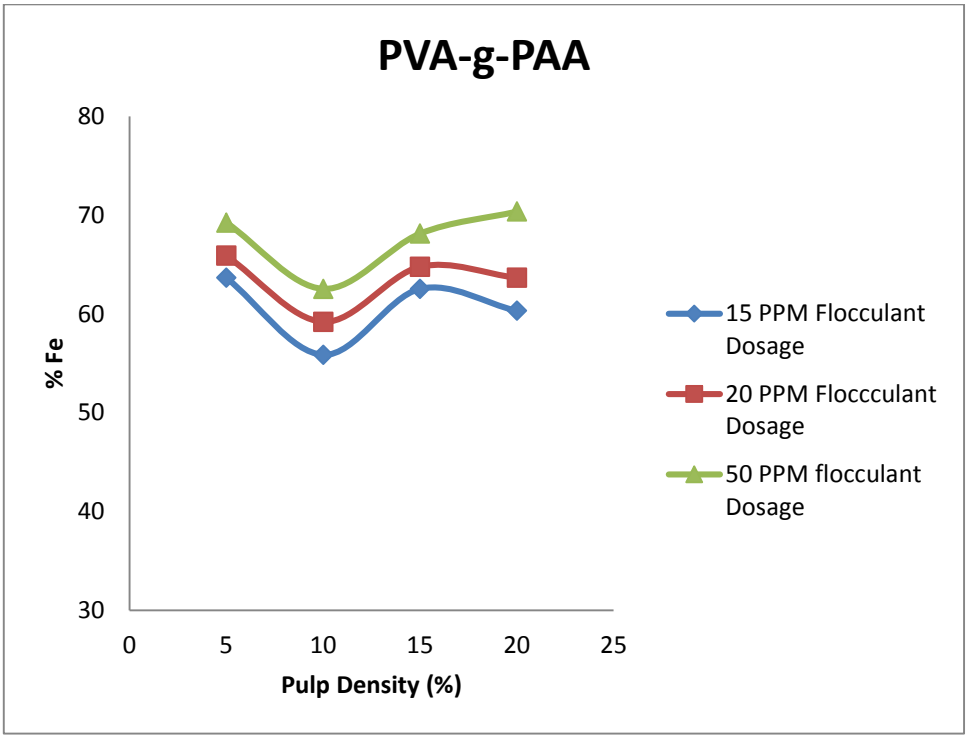

Figure 1: Settling characteristics of the polymeric flocculent at various dosages at 10% Pulp density.

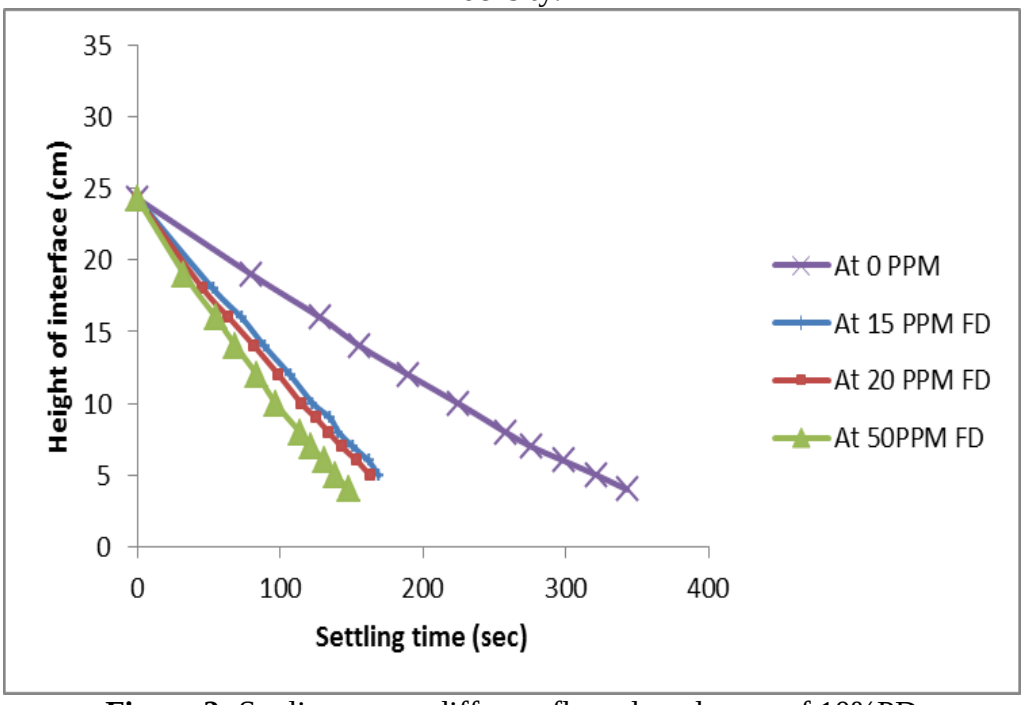

Figure 2: Settling rate at different flocculent dosage of 10%PD

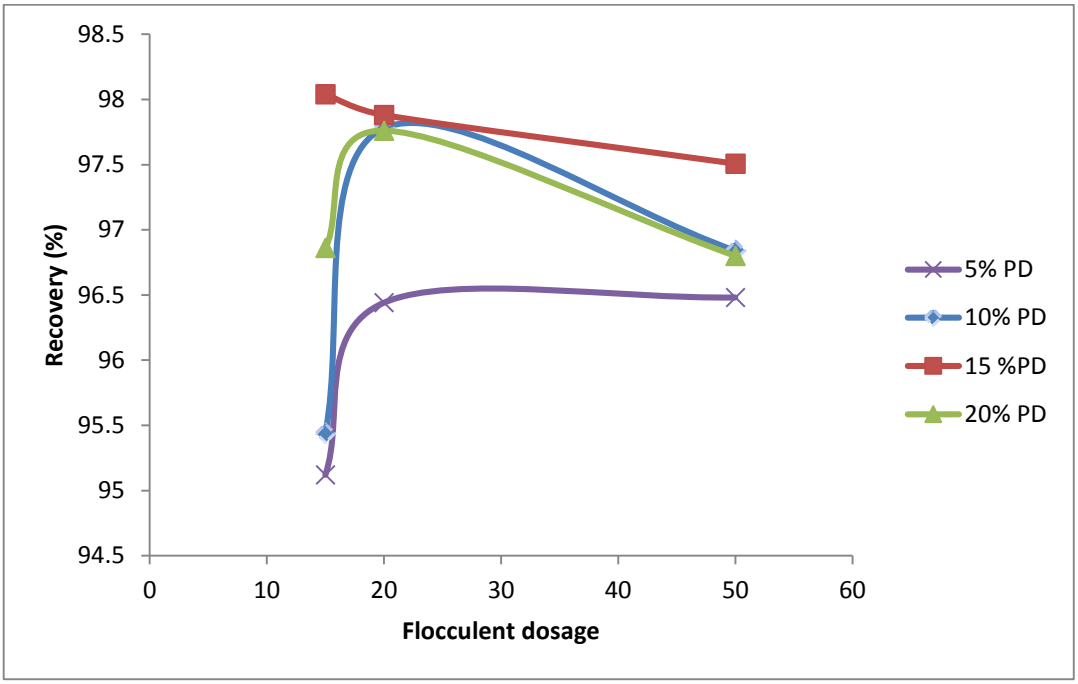

Figure 3: Comparison of flocculent dosage and recovery at 5,10,15 and 20% pulp density

Figure 3 shows the comparison of flocculent dosage and recovery at 5,10,15 and 20% pulp density. The 15% PD is showing the highest recovery of 98.04% at 20 FD, though it is following totally different trends compared to the 5, 10 and 50%PD. In all the cases it is lower at lower FD but it is increasing as the FD is increasing except 15% PD and then it is decreasing in a similar fashion. Thus one can say that at 15%PD the recovery is more.

5. CONCLUSIONS

PVA blended with PAA has been successfully tried on iron ores as the flocculant. Also the flocculent studies revealed that the polymer can be used as environment friendly polymer. It has been found that at 10% pulp density, higher dosage of the flocculent from 0 to 50 ppm, the particles are settling faster and it can be due to the increasing availability of flocculent to adsorb onto the surface and make bridges and initiating flocs formation. From the settling rate graph also it can be said that the increase in settling rate can be due to the enhancement in hindered settling because of the formation of larger flocs at high flocculent dosage. Also the percentage recovery is more for 15% PD at 20 %FD.

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6. REFERENCES

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