Comparative Studies On Settling,Pulp Density, Settling Velocity, Flocculant Dose, And Filtration Of Iron Ore Slime By Graft Copolymers And Commercial Flocculants .

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Abstract

The present paper reports the settling velocity,flocculats dose and filtration behaviour using synthesized and imported flocculants.The settling rate decreases with increasing pulp density.

Water from slime ponds overflow remains contaminated with very fine particles which are difficult to settle and cause environmental pollution. Homopolymers suffer from various drawbacks such as, shear instability, uncontrolled biodegradability and varying inefficiency. During the wet processing of iron ores a substantial amount of fine particles known as slimes is generated in down stream which need to be recovered effectively for their usage. The settling rate decreases with increasing pulp density. A varialtion in the flocculant dose has more pronounced effect on the settling rate at 10% pulp density compared to higher pulp densities.

Key word:Settling,filtration,flocculants,flocculation

Introduction

Water-soluble starch and plyacrylamides with various iconicity play a considerable role in solid-liquid separation related to mineral processing and red mud treatment (1-3). Flocculation of mineral suspensions using polyaryalmides and polysaccharides has been well investigated (4-6). It has been established that while starch is bio-degradable, polyacrylamide degrades on shearing (7). In order to eliminate these draw backs, various graft copolymers have been synthesized at Materials Science Centre, I.I.T. Kharagpur, by grafting polyacrylamide chains on polysaccharides using redox initiated solution polymerization technique (8). Previous studies have established that these synthesized graft copolymers are efficient turbulent drag reducers and have better flocculation characteristics than the commercially available flocculants (9,10). It was postulated that graft copolymers are more effective compared to linear polymers because of their greater approachability to the contaminants, which could be due to the spreading effect of the dangling grafted chains on the rigid polysacchaide backbone. In the present investigation, these flocculants along with commercial ones have been used to investigate the flocculation, settling and filtration characteristics of iron ore slimes.

Experimental

In the present instigation, the settling and filtration studies of iron ore slime from Joda mines of M/s. TISCO Ltd., situated in Singhbum district of Jharkhand (India) were conducted by laboratory synthesized flocculants and commercial flocculants. Following flocculants were used

Magnafloc (1011) were procured from M/s. Allied Colloids Ltd., U.K.

(i) Super floc (N-300), DOW chemical, USA

(ii) AP-g-PAM, SAG, CMC-g-PAM, and SAM-II synthesized at Materials Science Centre, IIT, Kharagpur (Table-5.1)

The synthesize details of the laboratory synthesized flocculants we given in the tables (.1).

Table.1

Synthesis details of graft copolymers

Polymer	Polysaccharide (gms)	Acrylamide (mole)	CAN (Molex 10^4)	% c Conversion	Intrinisic Viscosity (η) dL/g
SAG-I	2.5	0.12	1.003	83.76	6.75
SAG-II	2.5	0.12	2.006	84.58	6.63
Ap-g PAM 2	2.5	0.21	2.006	90.95	6.95
Cam1	1.0	0.14	0.500	29.60	1150
SAM-II	1.0	0.14	0.300	88.69	820

c. Percentage conversion is calculated from the relation:

% conversion = [{ wt. Of graft copolymer –wt. Of polysaccharide}/amount of acryl amide]x100

Settling test

The settling test following the flocculation of the particles was carried out in a 100 ml graduated cylinder by recording the movement of the suspension liquid interface as function of time. By varying solid concentration and flocculants dose, the consequent effect on settling and filtration was studied.

Filtration Test

The filtration was studies by observing the amount of filtrate passing through a membrane as function of time. The effects of varying solid concentration and flocculants dose were used for filtration test.

Results and Discussion

In this investigation the suspension of iron ore slime were taken. The particles size distribution was measured by Malvern particle size analyzer using gravity mode its average size is 38.80 micron .

Settling studies

Simple plots of height of interfaces versus time are shown in figure.1. The effect of varying amount of flocculants is indicated in the same figure, using magnafloc (1011 in the suspension of iron ore slime of pulp density 10%. It is reported as ppm solid/solid weight basis for all sets of experiments. An increase in settling rate with increasing amount of flocculants in the suspension is due to the fact that with increasing the flocculent dose, more numbers of amide and hydroxyl groups are available to be adsorbed on the particles and to make bridges with them [11]. The above effect is also manifested when the pulp density is 15% (Fig.2) and 20% (Fig..3).

(Fig..4) shows the effect of various type of synthesized and commercial flocculants on the settling rates of iron ore slimes at 10 ppm flocculants does and

10% pulp density. It is apparent from (Fig..4) that the performance of AP-g-PAM, CMC-g-PAM and SAM-II was better than other commercial flocculants. However, when the flocculants is increased to 30 ppm, the settling rate with magnafloc 1011 is higher than that using AP-g-PAM and SAM-II (Fig..5). The maximum settling rate with AP-g-PAM at 10% PD and 30 ppm flocculants dose is 107 mm /min which is marginally lower than that achieved with mangfloc 1011 (122 mm/min) (Table.2).

Effect of pulp density on initial settling rate at 30 ppm flocculants dosage is shown in (Fig..6). It is apparent form this figure that the initial settling rates decreases with increasing pulp density. Under the hindered settling condition, there happens to be several forces which affect the settling rate of particles. A decreasing rate in settling is generally observed at higher pulp density due to a greater buoyancy forces as well as lesser ease of liquid trickling through the particles(12).

(Fig..7) shows the variation of settling velocity with flocculants dose. The maximum settling rate increases sharply when the flocculant dose changes from 20 ppm to 30 ppm at 10% PD incase of AP-g-PAM, CMC-g-PAM and magnafloc (1011) in case of SAG-II and SAM-II increase in the initial settling velocity is not that high when the flocculants dose changes form 20ppm to 30 ppm

It is understandable since certain amount of polymer is required for adsorption followed by bridging of the particles. The larger adsorbed amount of polymer enhances the stability by steric stabilization. In such cases as the particles approach sufficiently close to each other, the interpenetration of the chains takes place. Since the polymer chains are hydrated, overlap of the layers would cause some dehydration. Hence, an increase in free energy and repulsion between two particles takes place, which ultimately results in the stabilization of the colloidal system [13].

Table 2

Flocculant	Flocculant dose	PH	Pulp density	Settling Velocity
Ap-g-PAM	30 ppm	Normal	10%	107 mm/min
SAM-II	30 ppm	Normal	10%	51 mm/min
SAM-II	20 ppm	Normal	10%	45 mm/min
SAM-II	10 ppm	Normal	10%	41 mm/min
Magnafloc	30 ppm	Normal	10%	112 mm/min
SAG-II	30 ppm	Normal	10%	37 mm/min
Magnafloc	30 ppm	Normal	15%	42 mm/min
Magnafloc	30 ppm	Normal	20%	22 mm/min
Ap-g-PAM	20 ppm	Normal	10%	32 mm/min
Magnafloc	10 ppm	Normal	10%	20.6 mm/min
Magnafloc	20 ppm	Normal	10%	23 mm/min
Ap-g-PAM	10 ppm	Normal	10%	28 mm/min
SAG-II	20 ppm	Normal	10%	30 mm/min

SAG-II	10 ppm	Normal	10%	27 mm/min
CMC-g-PAM	30 ppm	Normal	10%	112 mm/min
CMC-g-PAM	10 ppm	Normal	10%	33 mm/min
CMC-g-PAM	20 ppm	Normal	10%	40 mm/min

Filtration test

Like settling, filtration is also influenced by solid concentration type, amount of flocculants and pH etc. However, the flocculant dose giving optimum result in case of settling may not give same result in case of filtration as the requirement for settling and filtration are different. (Fig..8) clearly shows that the increase in volume of filtrate as the flocculant dose is increase. This is due to better flocculation at higher concentration of the flocculant. The effectiveness of SAM-II[12] is compared with SAG-II and magnafloc (1011) at normal pH which is shown in (Fig..9). It is clearly indicated that the performance of SAM-II is much better than SAG-II and magnafloc (1011) at normal pH. It is observed that filtration rate increases sharply with the higher flocculant doses. This is because of the increase in bed porosity (loosely packed bed as a result of better flocculation)[11]. The increase in the filtration rate with increasing amount of the flocculant in the suspension is due to the fact that with increasing the flocculant dose, a large number of functional groups are available to the adsorbed on the particles and form bridges with them.

CONCLUSIONS

- The settling rate decreases with increasing pulp density. A varialtion in the flocculant dose has more pronounced effect on the settling rate at 10% pulp density compared to higher pulp densities. The settling rate with graft copolymer is higher than that with magnafloc 1011 at lower flocculants dose; where as it is marginally lower with graft copolymer at higher flocculent dose.
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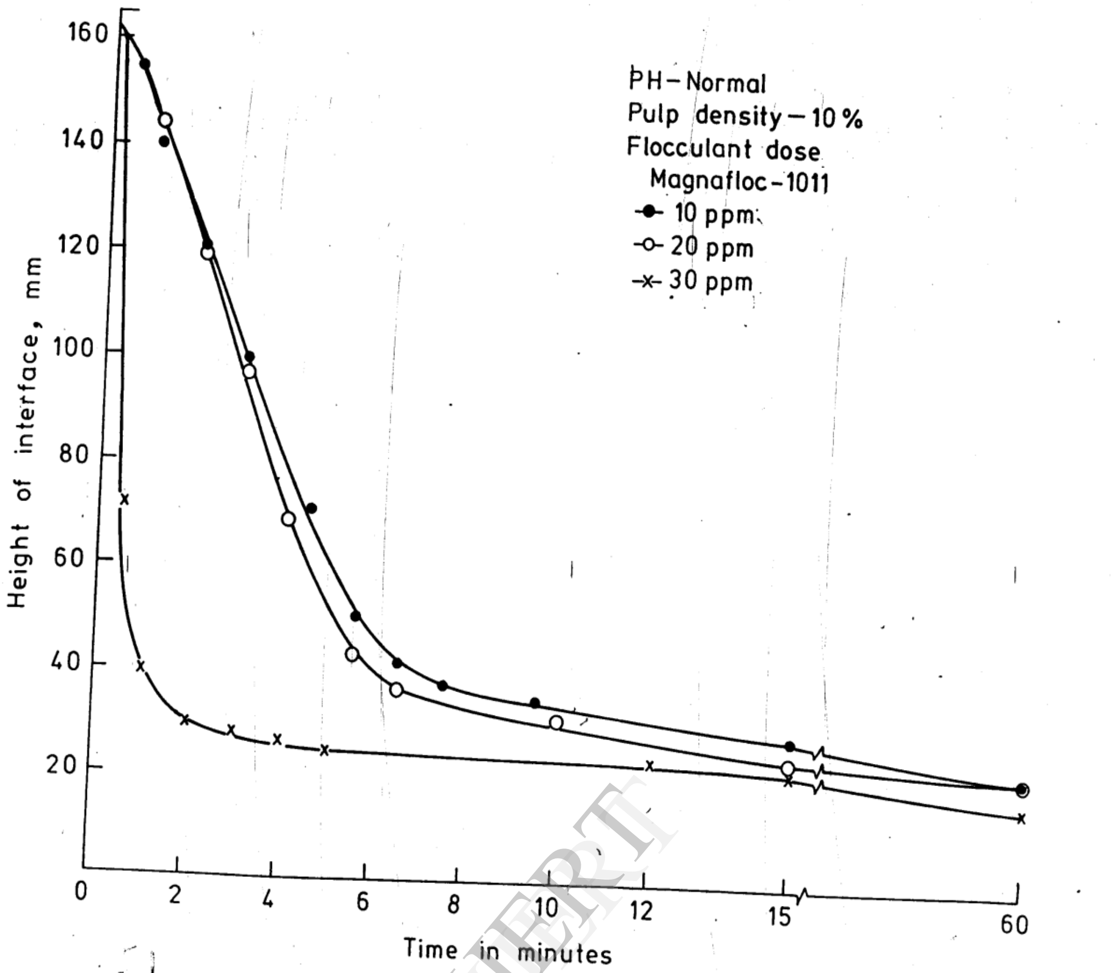

Fig. 5.1 Variation of height of interface with time.

Fig..1

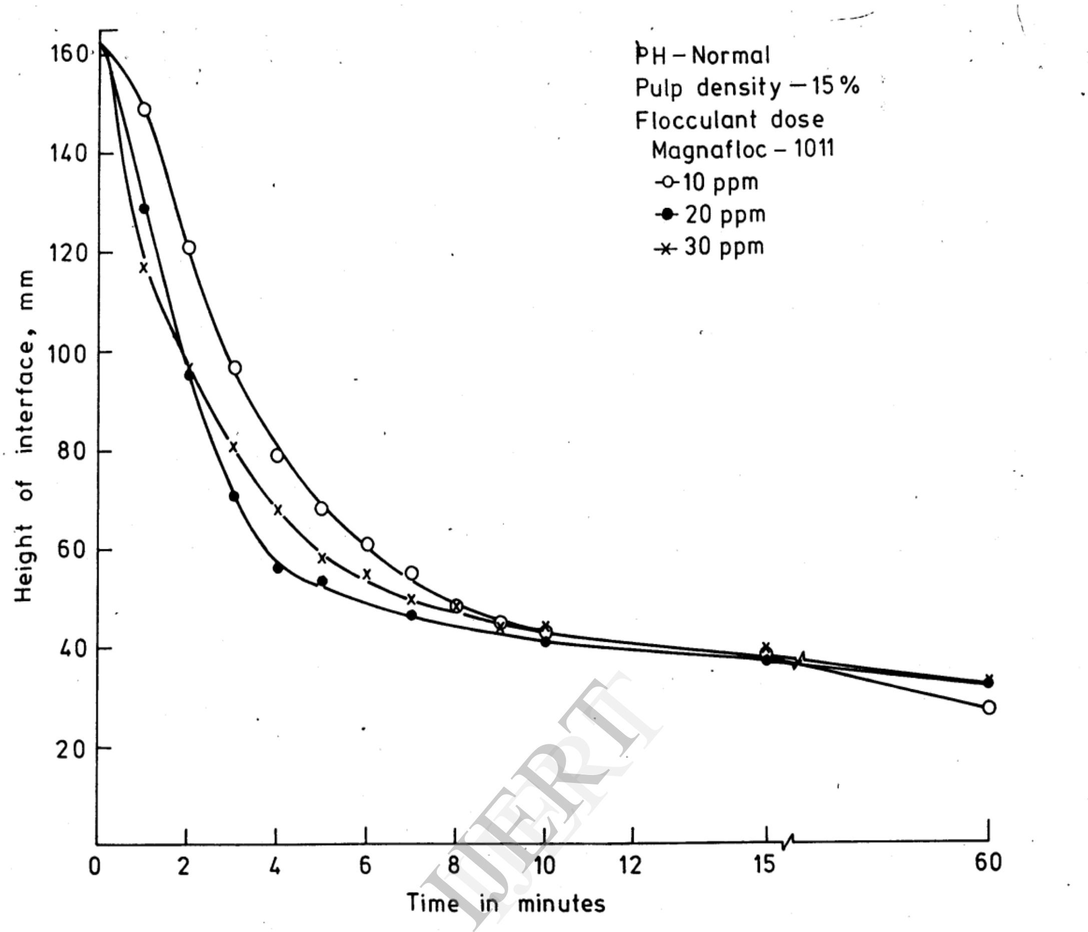
PH – Normal
Pulp density – 15 %
Flocculant dose
Magnafloc – 1011
10 ppm
20 ppm
30 ppm
Height of interface, mm
Time in minutes
160
140
120
100
80
60
40
20
0
2
4
6
8
10
12
15
60

Fig..2

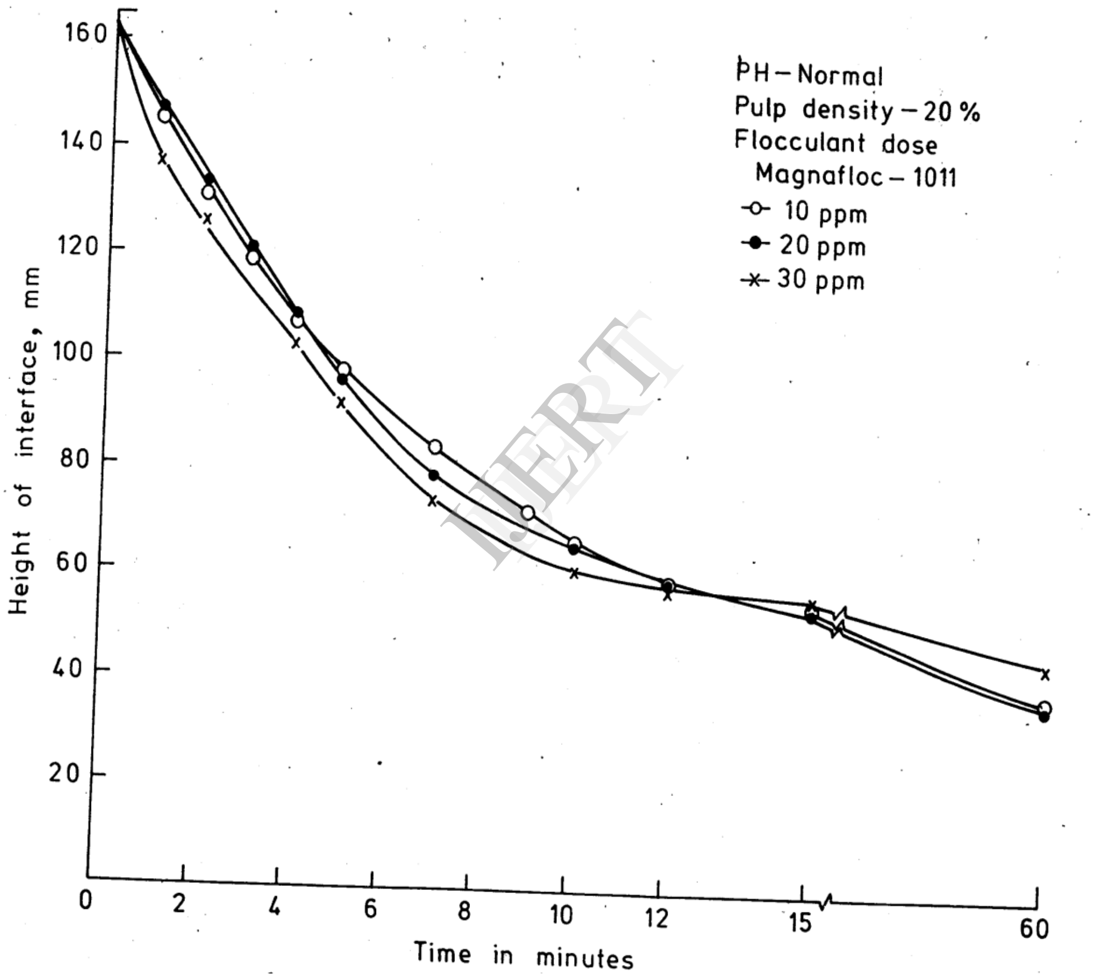
PH – Normal
Pulp density – 20 %
Flocculant dose
Magnafloc – 1011
10 ppm
20 ppm
30 ppm
Height of interface, mm
Time in minutes
160
140
120
100
80
60
40
20
0
2
4
6
8
10
12
15
60

Fig..3

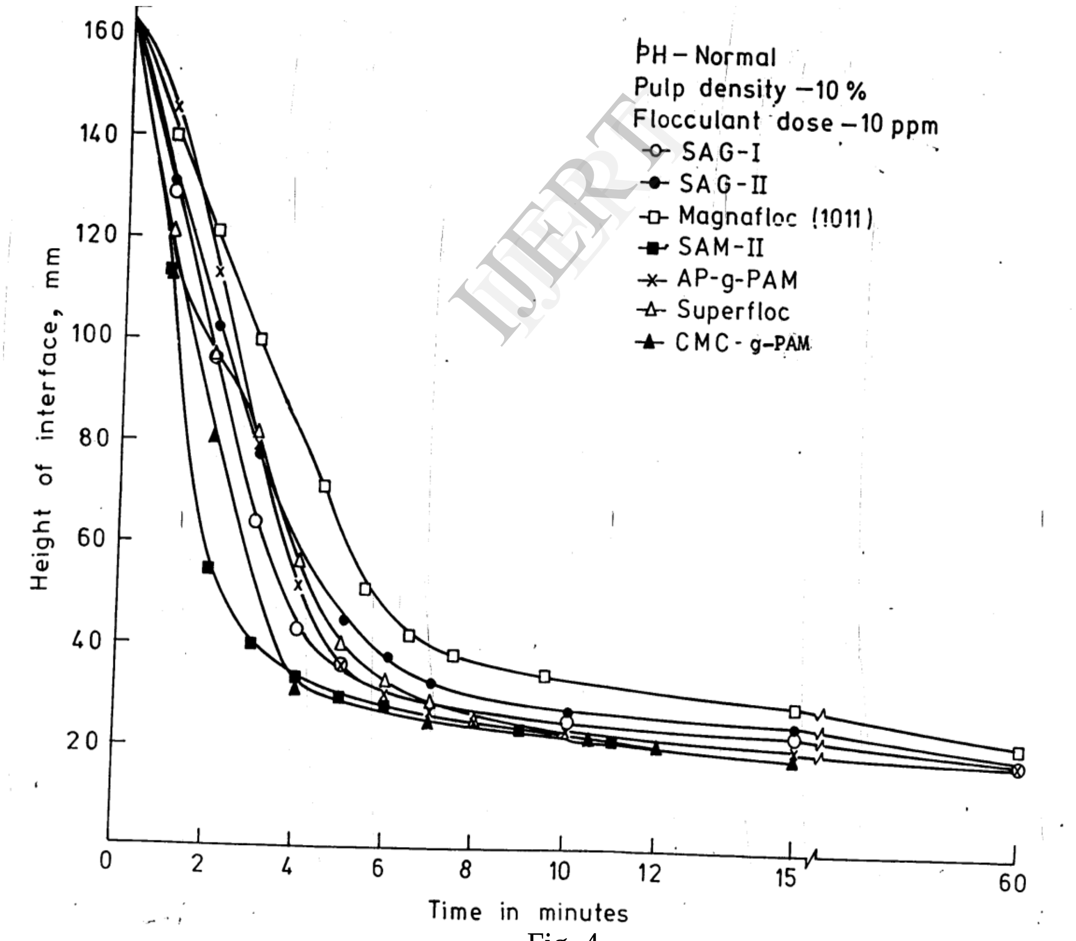
PH – Normal
Pulp density – 10 %
Flocculant dose – 10 ppm
SAG-I
SAG-II
Magnafloc (1011)
SAM-II
AP-g-PAM
Superfloc
CMC-g-PAM
Height of interface, mm
160
140
120
100
80
60
40
20
0
2
4
6
8
10
12
15
60
Time in minutes

Fig..4

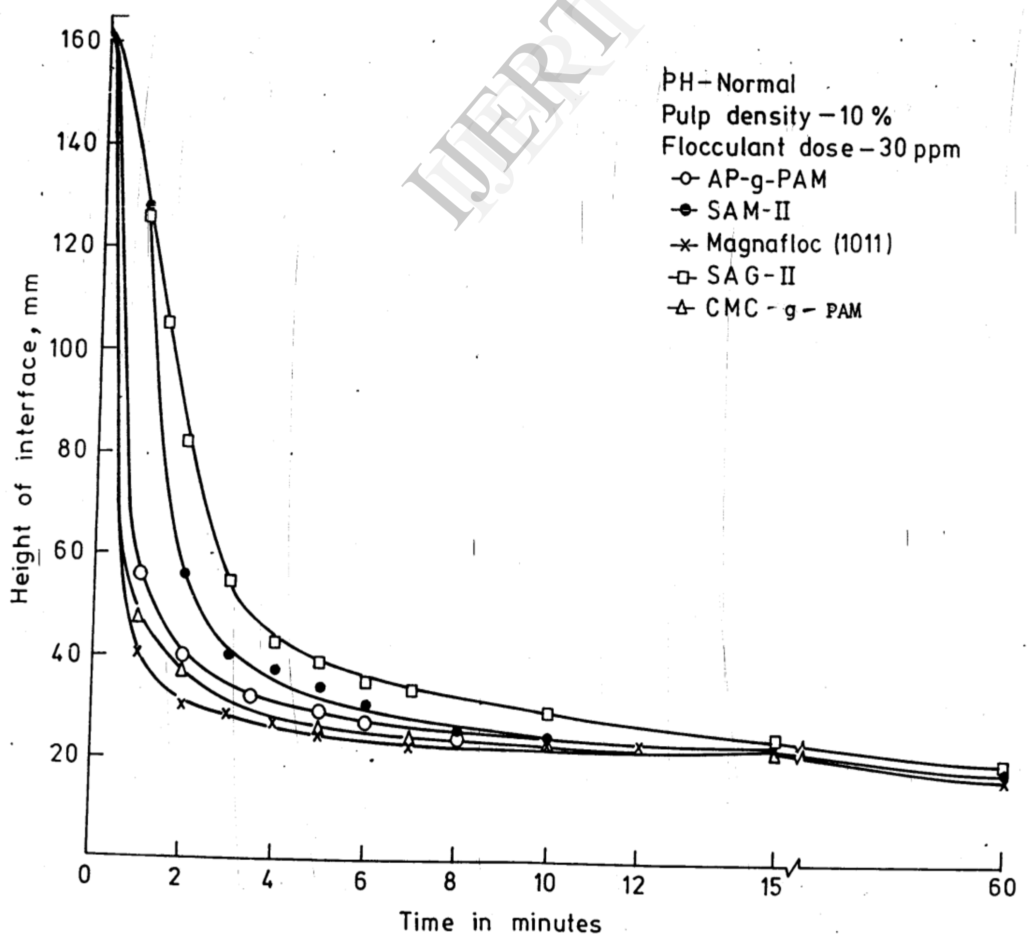
PH – Normal
Pulp density – 10 %
Flocculant dose – 30 ppm
AP-g-PAM
SAM-II
Magnafloc (1011)
SAG-II
CMC - g - PAM
Height of interface, mm
Time in minutes
160
140
120
100
80
60
40
20
0
2
4
6
8
10
12
15
60

Fig.5

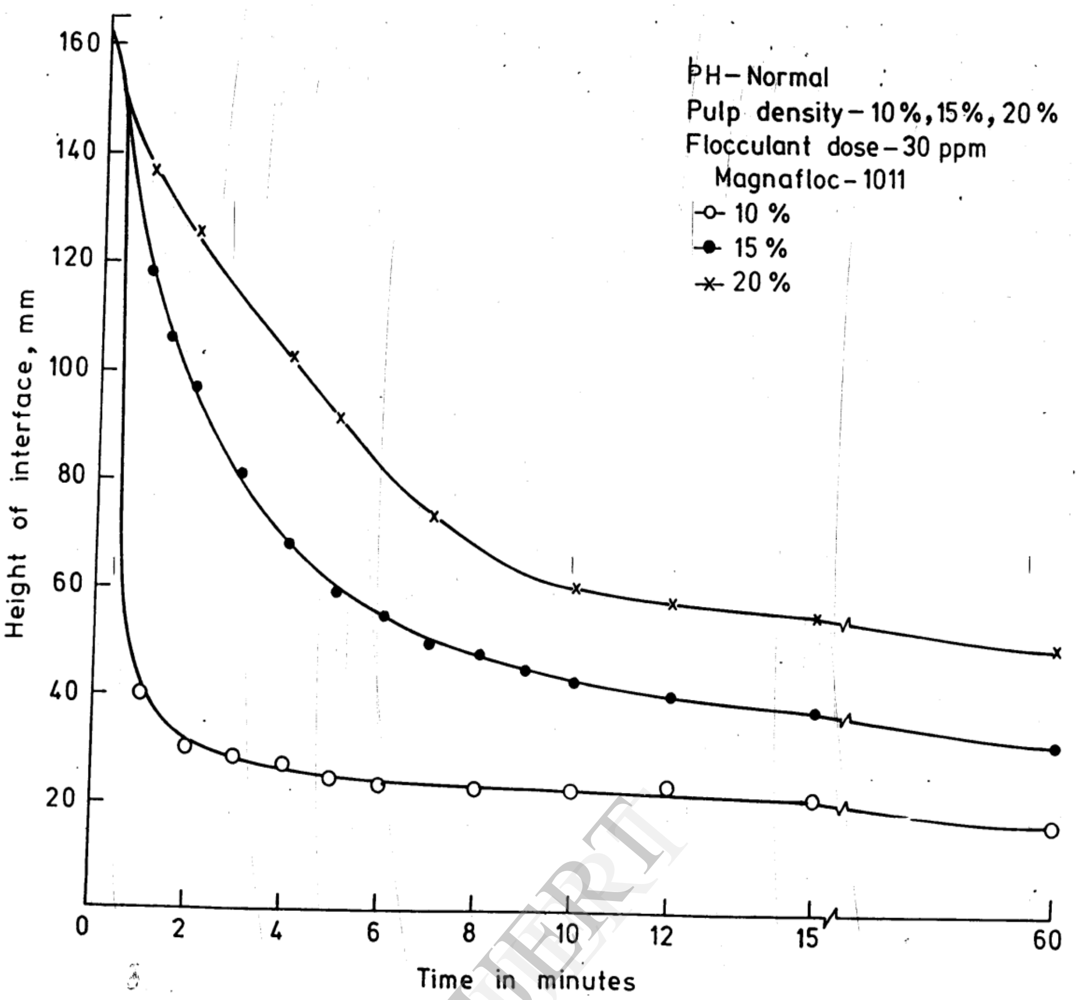
PH – Normal
Pulp density – 10 %, 15 %, 20 %
Flocculant dose – 30 ppm
Magnafloc – 1011
10 %
15 %
20 %
Height of interface, mm
160
140
120
100
80
60
40
20
0
2
4
6
8
10
12
15
60
Time in minutes

Fig..6

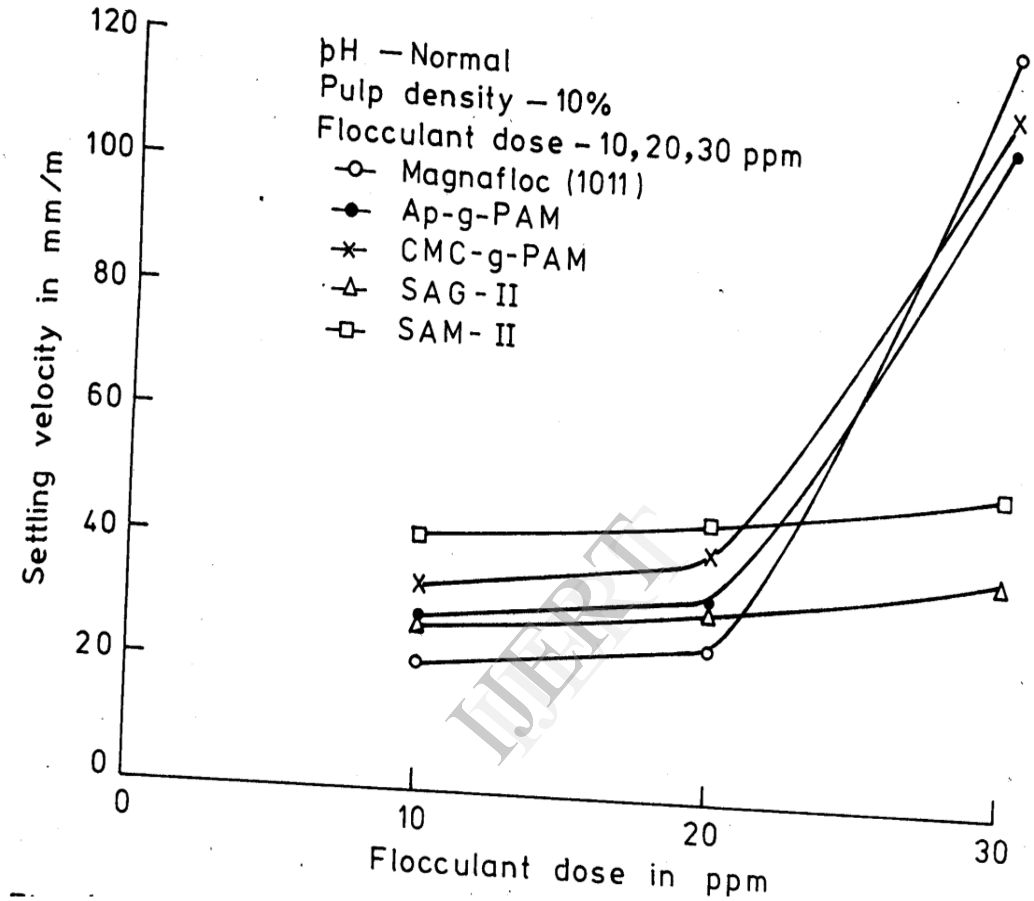
pH – Normal
Pulp density – 10%
Flocculant dose – 10,20,30 ppm
Magnafloc (1011)
Ap-g-PAM
CMC-g-PAM
SAG-II
SAM-II
Settling velocity in mm/m
Flocculant dose in ppm
0
20
40
60
80
100
120
0
10
20
30

Fig..7

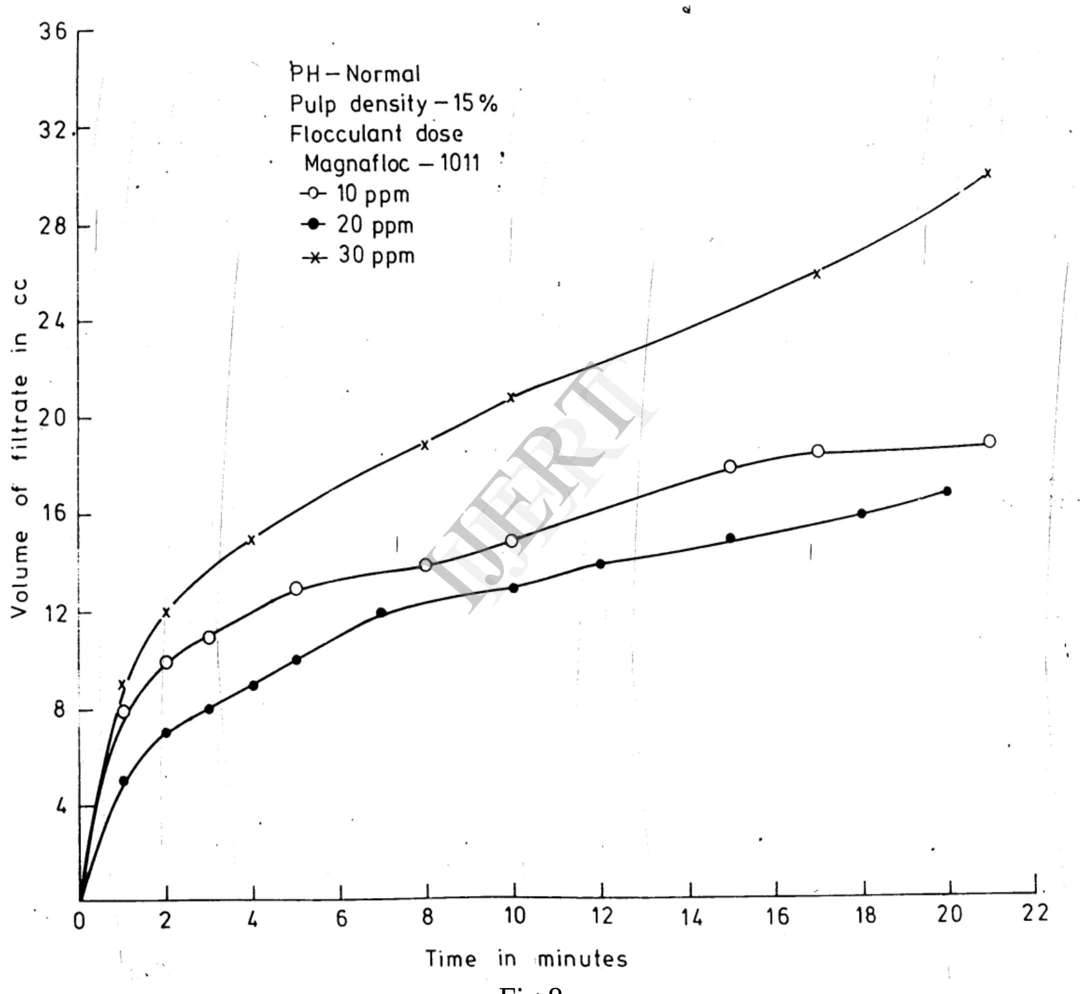
PH – Normal
Pulp density – 15 %
Flocculant dose
Magnafloc – 1011
10 ppm
20 ppm
30 ppm
Volume of filtrate in cc
Time in minutes
36
32
28
24
20
16
12
8
4
0
2
4
6
8
10
12
14
16
18
20
22

Fig.8

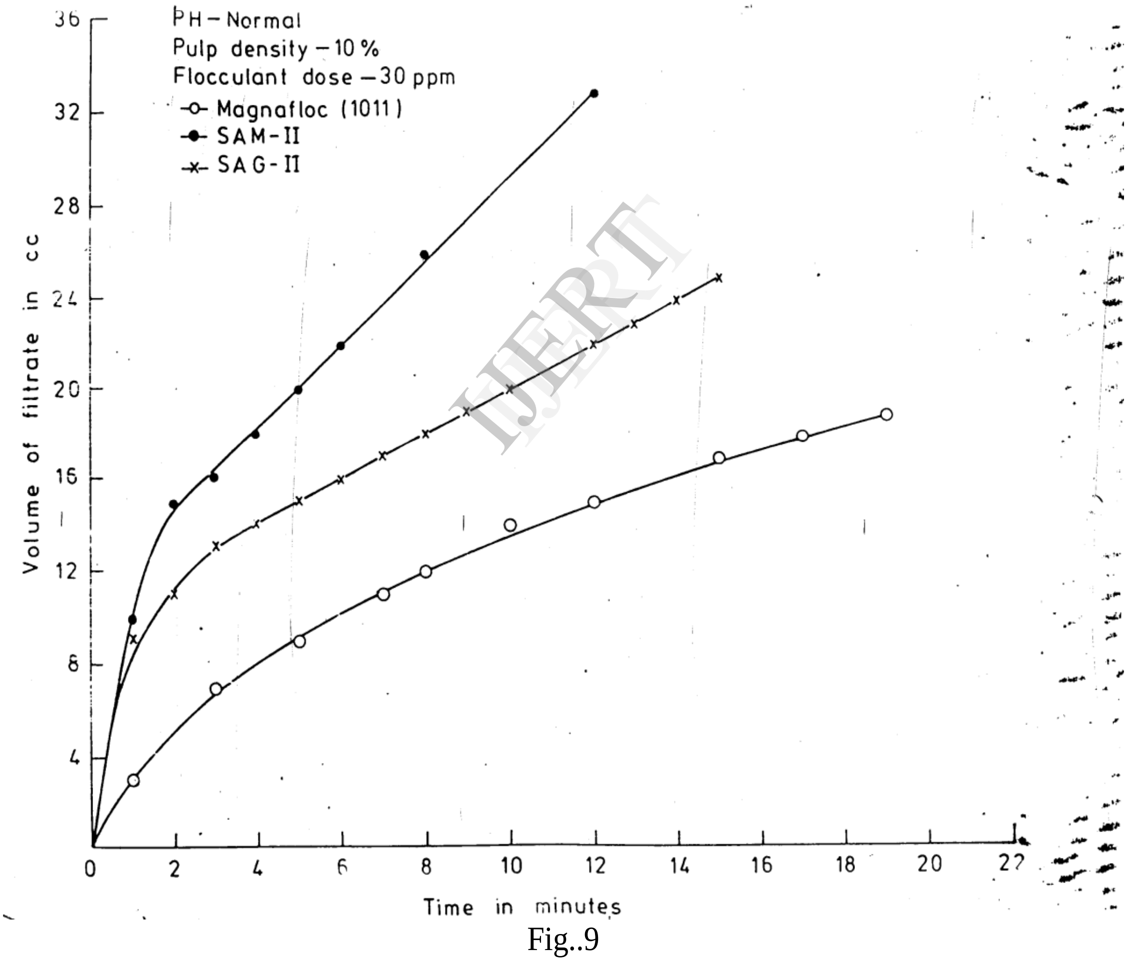
PH – Normal
Pulp density – 10 %
Flocculant dose – 30 ppm
Magnafloc (1011)
SAM-II
SAG-II
Volume of filtrate in cc
Time in minutes
0
2
4
6
8
10
12
14
16
18
20
22
4
8
12
16
20
24
28
32
36

Fig..9

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