

A Novel Filter Aid for Improved Efficiency of Pressure Filters

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Abstract

Filtration is one of the dewatering unit operations used in iron ore beneficiation plants. It is used for dewatering of both concentrate and tailing. In present study filtration of iron ore concentrate was investigated by using a novel filter aid FAM-110 developed by *M/s: Innocule Materials and Additives Private Limited*. The studies were conducted in laboratory scale vacuum leaf and pilot pressure filters. Subsequently, the product was also tried in a plant pressure filtration unit. Plant scale filtration trial showed that addition of FAM-110 was able to reduce the moisture of filter cake from 10.25% to 8.72%, with same operating parameters. Reduction of surface tension and enhancement of contact angle are responsible for improved dewatering. The degree of moisture reduction depends on the particle size, reagent dosage, conditioning, and other process variables. It was found that addition of FAM 110 enables the plant to achieve an additional moisture reduction of around 1.5% without affecting the filtration rate, which is substantial.

Keywords: Iron ore concentrate; Filter Aid; Filter cakes; Dewatering; Pressure filtration.

Introduction

Dewatering of iron ore concentrate is essential before further processing or utilization. Generally in dewatering process, the mineral concentrate slurry is subjected to different unit operations like sedimentation, decantation, filtration, etc. to facilitate the removal of water. Water removal not only reduces the energy requirement for subsequent processes like evaporation, roasting, reduction, etc. but also decreases the weight of concentrate and helps in saving transportation cost.

Filtration is one of the dewatering operations used, in iron ore pelletization plants, for removal of the water from the concentrated slurry. The problems occurred mainly when the mineral concentrates are more fine and clayish in nature. The moisture content of 9-10% is desirable for iron ore palletisation plants to achieve required green pellets. Moreover, higher moisture also gives rise to handling issue because cake becomes sticky if the ore contains clay particles. The filter cake that forms from the filtration of slurry with clay content is often substantially impermeable in nature. Filtration of such materials can

be effected only at extremely slow rates or under extremely high pressures. For dewatering of such slurry with fine particles and high clay content, it is advantageous to add dewatering aid. Proper addition of dewatering aid reduces the residual moisture content of the cake, improves filter cake handling capacity and reduces binding of the filter medium.

There are various types of filter aids such as surfactant filter aid and flocculant filter aid. The addition of these aids improves filtration efficiency either by increasing effective particle size or modifying surface chemistry or both (Meenan (1988), Wang et al. (1978)).

The objective of the present work is to develop a new filter aid, which could be able to reduce the moisture content of filter cake by 1-2% without hindering the production throughput, in an economical way.

Materials and methods

Iron ore concentrate

The industrial iron ore concentrate used in this investigation was obtained from the pelletization plant of M/s: Brahmani Rivers Pellets Limited, Kalinganagar, Jajapur, Odisha. The chemical analysis of the concentrate was found as follows:

Contents	Assay (%)
Fe	60
SiO ₂	2.1
Al ₂ O ₃	7.8
LOI	4.8

Dewatering aid

The dewatering aid, FAM 110, developed by *Innocule materials and Additives Pvt. Ltd.* was used for the study.

Procedure for filtration study

All laboratory and pilot filtration studies were conducted at CSIR-IMMT, Bhubaneswar. Filtration studies were conducted in the laboratory vacuum filtration and pilot pressure filtration unit. The following are the general procedure carried out for both the vacuum and pressure filtration tests.

- The slurry was thoroughly mixed before the filtration test.

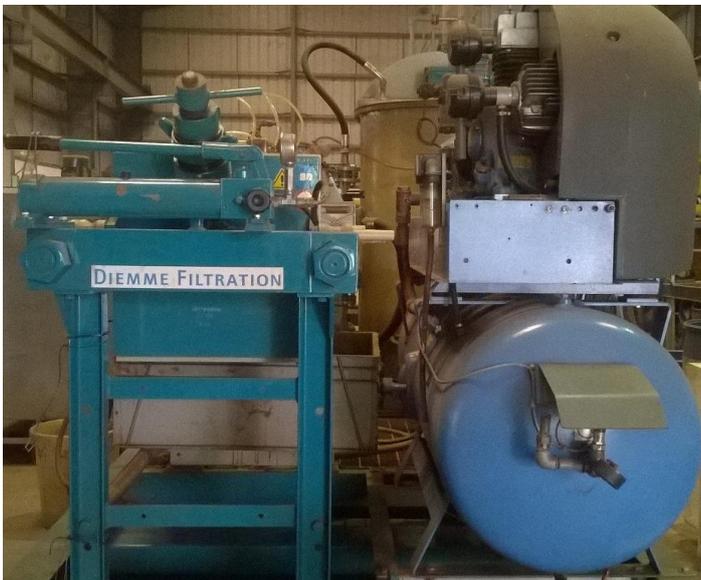
- The required solid concentration of slurry was maintained.
- Then the slurry was subjected to filtration. After the filtration cake was taken out and the moisture content was noted down.

Vacuum for the filtration was generated by a pump. The vacuum was maintained at 25 in Hg for all the experiments. The pilot pressure filtration tests were conducted by Diemme Filtration unit. During filtration, cake formation time, flushing time, initial pressure drop, pressure drop during drainage period, and drying cycle time were recorded.

Finally, plant scale trials were carried out at pelletization plant of M/s: Brahmani Rivers Pellets Limited, Jajpur to check the efficiency of the chemical in a continuous plant. Following operating parameters were maintained during the commercial trial. At the starting of the trial, blank trial run (without chemical) was conducted and subsequently, trial was conducted with FAM 110.

Table - 1: Operating parameters at BRPL Plant

Slurry Density (Gram/ml)	1.97		
Filling time (in Sec.)	90	Filing Pressure (Bar)	1.5
Filtration time (in Sec.)	250	Filtration Pressure (Bar)	7.2
Pressing time (in Sec.)	290	Pressing Pressure (Bar)	10.3
Air drying time (in Sec.)	420	Air Drying Pressure (Bar)	8.5



(a)



(b)

Figure 1 : Pressure filtration unit (a) pilot pressure filter (b) Laboratory pressure filter at IMMT

Results

Results of Vacuum Pressure Filtration

The results performed by vacuum pressure filtration unit was shown in Table-2. Without addition of any chemical, moisture content of the filter cake was achieved 15.31% whereas addition of FAM-110 reduced moisture content to 13.84%. There was around 1.4% of moisture reduction occurred by addition of this novel chemical dewatering aid. Total time taken for the production of cake was 13 minute and vacuum pressure was maintained at 25 in Hg.

Table - 2 : Vacuum filtration by adding FAM 110

Additives	Dosage (g/MT)	Thickness (cm)	Moisture (%)
NO	0	0.8	15.31
FAM-110	50	0.8	14.02
FAM-110	100	0.8	13.84

Results of Pilot Pressure Filtration

The results obtained by the pilot pressure filtration unit are shown in Table-3. Total time taken for the filtration was 16 minutes with feeding pressure at 5 bar, flushing at 5.5 bar, squeezing pressure at 12.5 bar.

It was observed that blank trial (without using filter aid) delivered filter cake with moisture content of 11.6 % whereas addition of FAM 110 reduced moisture content of filter cake to 9.8%. A minimum 1-2% reduction in moisture content was seen on addition of FAM 110.

Table - 3 : Pressure filtration by adding FAM 110

EXPT NO	Additives	Dosage (g/MT)	Thickness (cm)	Moisture (%)
1	Blank	0	2.8	11.6
2	FAM 110	50	2.8	10.80
3	FAM 110	100	2.8	9.8

Results of Pressure Filtration trial at M/s: Brahmani River Pellets Limited (BRPL)

The results of plant scale trial done at BRPL are shown in Table-4. It was observed that moisture content of filter cake in absence of FAM-110 was 10.25 % whereas addition of FAM 110 at a dosage of 45 g/MT reduced moisture to 8.72%. Around 1.5% reduction in moisture content was seen on addition of FAM 110.

Table - 4 : Results of filtration at BRPL Plant

	Filter Aid Dosage	Throughput	Cake Moisture	Reduction in Moisture content
	gram/MT	MT	%	%
Blank	0	28.5	10.25	Reference
Test-1	35	28	9.59	0.66
Test-2	45	29	9.37	0.88
Test-3	55	28	8.72	1.53

The optimum results of the effect of FAM 110 on the both vacuum and pressure filtration unit is summarized in Table 5. It was observed that the reagent addition significantly reduces the moisture content compared to blank test (without chemical). It was also observed that results in the plant scale are similar to the pilot scale tests. It was also observed that vacuum filtration is not effective in achieving the desired moisture content for preparation of iron ore pellets.

Table - 5 : Comparison of all the results

	Filter Aid Dosage	Cake moisture	Reduction in Moisture content
	gram/MT	%	%
Plant Scale trial at M/s: BRPL			
Blank	0	10.25	
FAM 110	45	8.72	1.53
Pilot Pressure filter			
Blank	0	11.6	
FAM 110	100	9.8	1.8
Vacuum Pressure filter			
Blank	0	15.31	
FAM 110	100	13.84	1.47

Conclusion

The experimental studies conducted on iron ore concentrate showed that FAM 110 could reduce 1.5% of the moisture content of the filter cake when compared with reference tests. Commercial plant scale trial showed that moisture content of filter cake can be reduced from 10.25% to 8.72%, by adding FAM 110 at the dosage of 45g/MT, without hampering production rate of pressure filter. The investigation showed that FAM 110 can also be used as a low-cost dewatering aid and can improve the throughput of pressure filter unit.

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