APPLICATION OF FLOCCULANTS TO FACILITATE DEWATERING

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ABSTRACT.

Sedimentation in cone tanks and retention on Hatschek machines are not well understood. In most of the machines where flocculants are used, the flocculants do not show their expected effect, i.e. the flocculants are wasted. The flocculants are not specified and tuned to the actual cement chemistry; soluble alkali, C3A, water circuit etc. The effect in sedimentation in cone tanks and the retention in the vat (pickup ratio) is not systematically determined and the dosage of flocculants adjusted as necessary.In many factories, the flocculants are not dosed correctly on a dry basis or they may be added at the wrong place in order to control sedimentation and retention.

This has the following consequences:

- Generally lower and less constant quality
- Thickening of slurry opposite feeding
- Large sludge accumulation and raw material losses
- Poorer dewatering process
- More effort and labour for machine cleaning
- Delamination and pick up troubles

The paper will identify main issues of flocculants use in industrial fibre cement application.

KEYWORDS:
Sedimentation, retention, flocculants evaluation, optimum retention, Bending strength.

INTRODUCTION

In many fibre cement factories, chemical aids (e.g. polymer, flocculants) are used to facilitate the dewatering process. Flocculants can both assist cement retention and sedimentation of solids in the process. To maximize the benefit of the flocculants, it is essential to choose a suitable flocculant and correctly apply it in the process. First, we need to evaluate flocculants to find the type which matches best with the chemistry of the cement used and the specific process conditions in the plant. In many plants, flocculants are chosen by economic considerations (price) rather than by technical criteria which typically does not yield the expected results. In this paper, we will show a simple pragmatic way how to evaluate and find the optimal flocculant for the specific cement used and production process.

FLOCCULANT SPECIFICATIONS

The most important parameter for flocculants is the anionic charge density. For most of the wide array of Portland cements used in the fibre-cement production flocculants in the ionic charges range between 5 – 40 % are necessary. The molecular weight and chain length influence also the retention and sedimentation.

The C3A content, the soluble alkali in the cement and the degree of water circuit closure determine which ionic charge must be chosen to achieve an optimal result in retention and sedimentation. This means, that a comprehensive evaluation of flocculants can only be done directly on a machine in operation.

EVALUATION, FLOCCULANT EFFICIENCY TEST

As we cannot simulate the real situation in a laboratory environment, we perform a simple and pragmatic test employing effluent water samples from a machine in service. For an efficiency test a minimum of 5 flocculants types (e.g.10, 20, 30, 40, 50 % anionic charge density) should be available. All should have the same molecular weight.

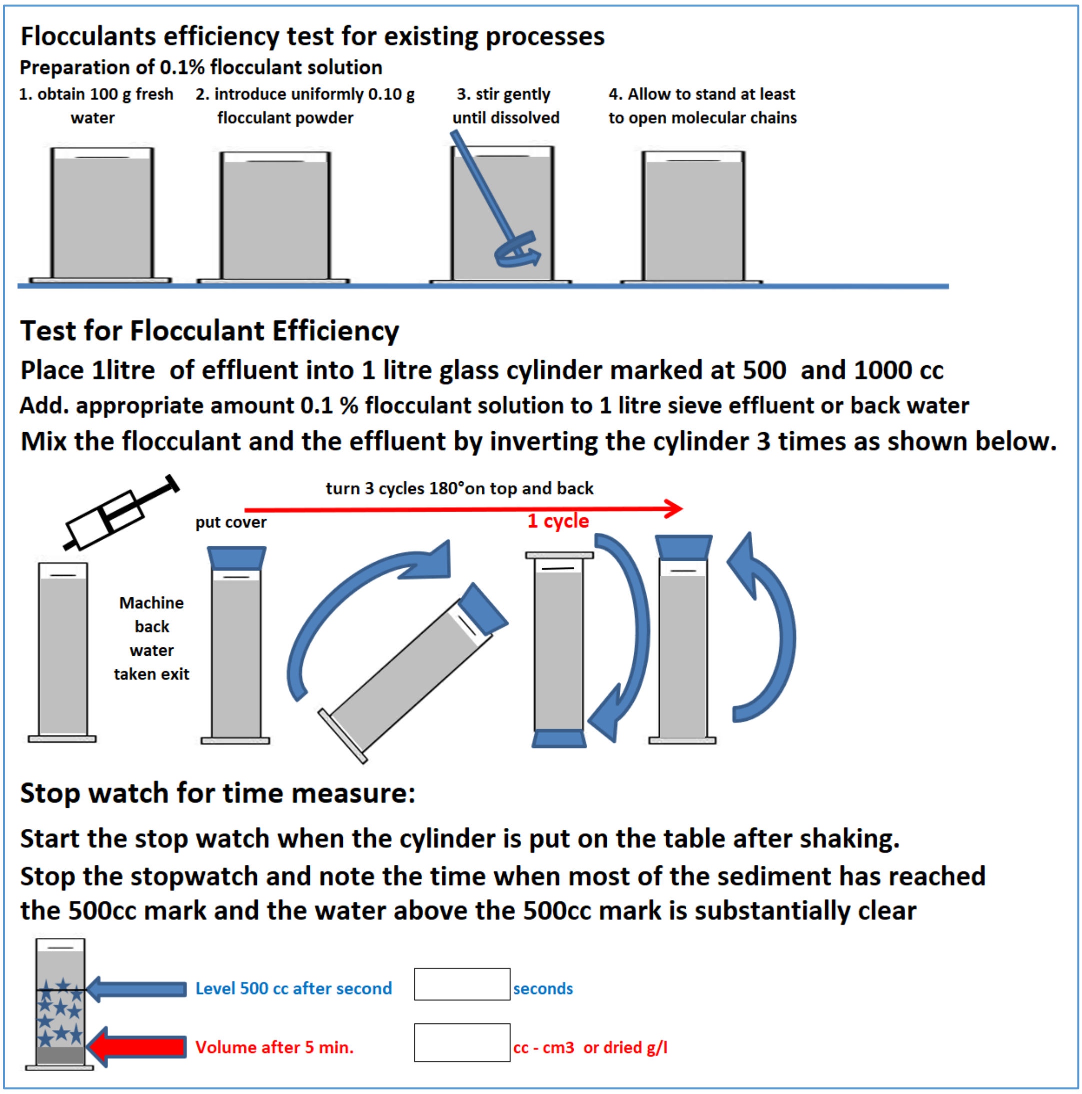

Fig. 1: Test procedure

1. Dissolve flocculants in clean potable water at a concentration of 0.1 % (m/m) or less according to the supplier instruction or application sheet see **Fig. 1.**
2. Obtain 1 litre of effluent water from Hatschek machine vat underflow, when the machine is in equilibrium (i.e. after at least 1 hour running in constant conditions)
3. Determine the dry quantity of solids per litre of effluent water by filtration on a suitable filter paper
4. Place in a graduated 1 Litre glass cylinder (cc)
5. inject approximately 100 ppm flocculant (based on the estimated dry quantity of sediment /litre determined above)
6. Shake 3 times according to instructions given in Fig. 1.
7. Put the cylinder on a table and start timer
8. Stop timer, when most of the flocks passed the 500-cc line and the water above the 500-cc line is clean (see example below and Fig, 3) and record the timing

Important.
All indication in ppm must be calculated on the dry basis; sediment, flocculants, feed stuff etc.

SEDIMENTATION TEST, EXAMPLE

In this example 90 ppm flocculant were used in the regular production, therefore all tests were done with 90 ppm. Two flocculants were evaluated as the following figures illustrate.

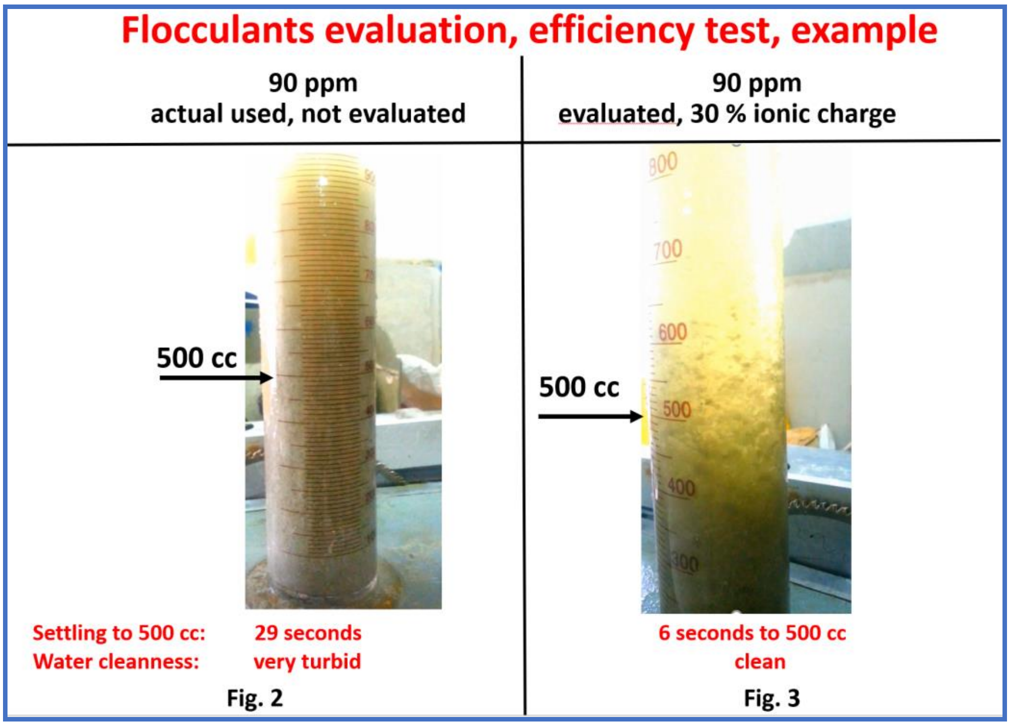

Fig. 2 Fig. 3

The sedimentation test in Fig. 2 shows a typical case, where the flocculant was only evaluated on cost. This flocculant shows no reaction at all.

By contrast the sedimentation test in Fig. 3 with the best flocculant in the series with 30 % ionic charge, shows an optimal result, i.e. settling in 6 seconds to the 500 cc line and very clean water.

An additional test without flocculants showed the same result as in Fig. 2, i.e. 30 second settling time and very turbid water above the main sediment. with not evaluated flocculants. Therefore, one can conclude, that in this case the flocculants were wasted.

Sedimentation in cone tank

For sedimentation in cone (adding flocculants into the machine channel before the backwater pump or preferably inject in the outlet of backwater pump). Flocculants with sedimentation times of 6 seconds to 500 cc level in test in Fig. 3 (and clean water) is suitable to start. The sedimentation speed in cone tank down will be higher than the upward speed of the cleaned water removed from the cone tank. If the overflow water from cone 1 to 2 and the wash water for felt and sieve is clean, the flocculants can be reduced to below 90 ppm. The amount of flocculant for sedimentation in the cone tank does not influence the bending strength significantly. The settling time should be monitored and reported regularly. If necessary, the flocculant dosage must be adjusted to get the desired and defined settling result in cone. If the cement and or process has changed then re-evaluation of flocculants must be done.

For retention in vat (added flocculants in pre-mixer)

With flocculants of the type found in example of Fig 3 one can start with 90 ppm added to the pre-mixer. The retention rate with a working flocculant at 90-100 ppm, for most cements and machines will be between 65-80 %. The resulting retention rate e.g. 75 % must be kept constant while continuing production, monitoring and reporting the sediment and bending strength to do further correlation. Monitoring of retention rate is done indirectly using Imhoff cones, by measuring the amount of sediment settling in 5 minutes. Fig. 4. Due the conic geometry, the read out is very fast and accurate. The sedimentation in cc in Imhoff cone correlates with the consistency or g/litre. This allows us to calculate the retention rate by comparing the sediment in the mix compared to the sedimentation in the backwater. Fig. 5.

Fig. 4

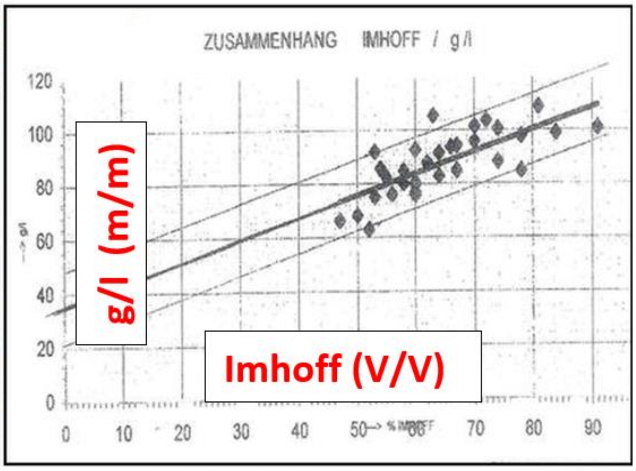

Fig. 5

Important
No optimum retention ratio can be defined and the optimum retention ratio must be found on the running machine, by correlating the results in bending strength with the sediment. Depending on fibre types, mix and machine construction etc., the highest strength can be obtained in some cases with a very low retention!
Generally mixes including long synthetic fibres need a lower retention rate since the dispersion of synthetic fibres is better with lower retention rates (less fibres concentration in the vat). Most of Hatschek machines produce the highest strength at 60-70 % retention depending on mix and vat. With 2–hour-trials varying the sediment must be found based on correlations the optimum retention rate to get maximum strength.

Example
Optimizing program bending strength based on sediment variation on a special cascade Hatschek machine.

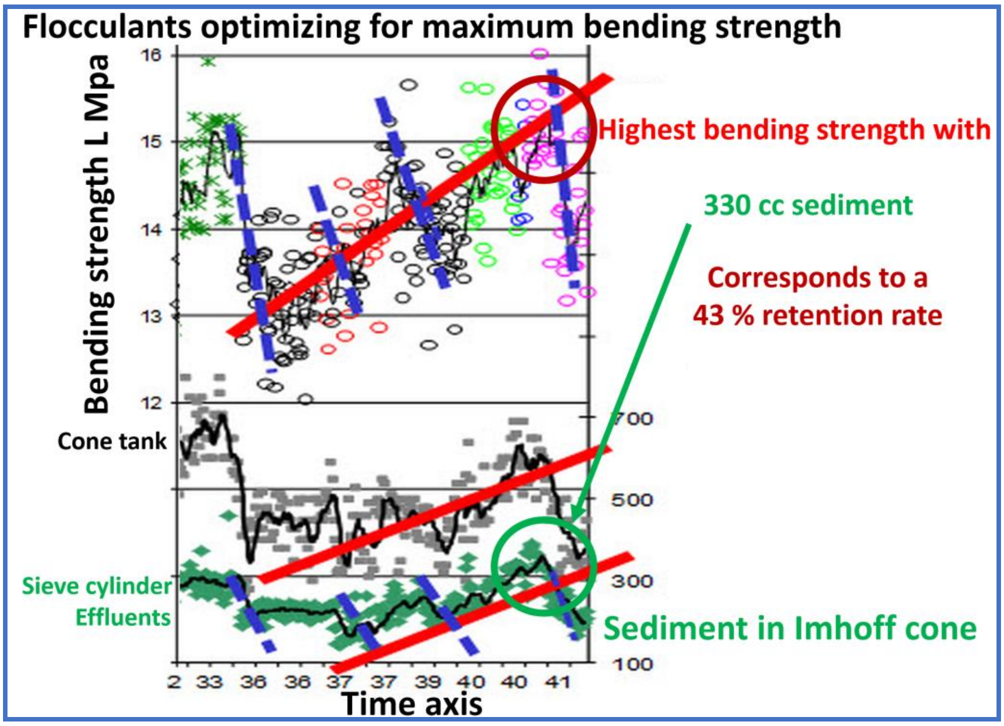

Fig. 6

On this machine, the 4 trials show, that highest Bending strength was reached with 330 cc sediment Imhoff, corresponds a retention ratio of 43 %.

CONCLUSION

To get optimal retention for maximum bending strengths 2 steps are needed

1.Evaluate and find a suitable flocculant which matches the cement used and the process condition

2.Vary the flocculant dosage and correlate the retention calculated from the Imhoff Cones with the bending strength. The optimum retention rate can then be determined