BTG
RAISING YOUR PRODUCTIVITY

Application note

Optimization of dissolved air flotation in a waste water treatment process of a paper mill

- **Cost savings through optimized chemical dosage**
- **Reliable and stable operation of dissolved air flotation**
- **Quick lab results enable process improvements**

BACKGROUND

Paper machine effluents are typically clarified using a dissolved air flotation (DAF) system. Before reaching the DAF flotation tank, fibers and water are separated by dual chemical treatment where a coagulant followed by a flocculant are added. The coagulant serves to extract colloidal dissolved substances and to aggregate them into micro flocs. The subsequently dosed flocculant conglomerates the micro flocs into stable macro flocs. In the DAF tank, fine air bubbles introduced from the bottom attach to the flocs, thus forming a concentrated mass of floating flocs which can be removed from the surface. Finally, clarified water leaves the tank for further treatment.

CHALLENGE

A mill reported that the DAF unit was not running stable because a frequent and non-predictable release of fibers towards the following water treatment plant was observed. Both coagulant and flocculant were continually dosed in constant amounts. Poor flotation was counteracted by manually readjusting the flocculant dosage.

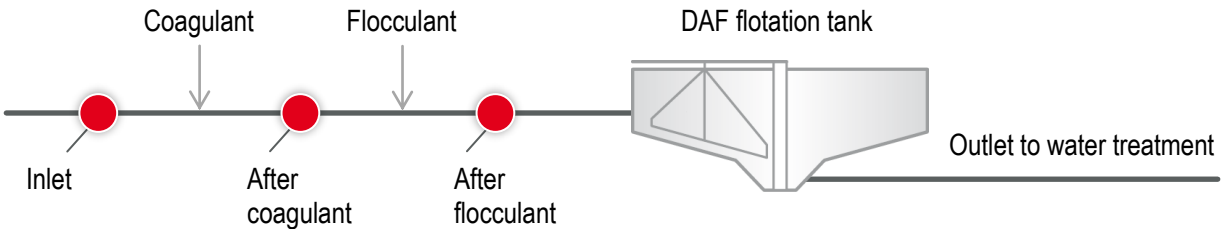


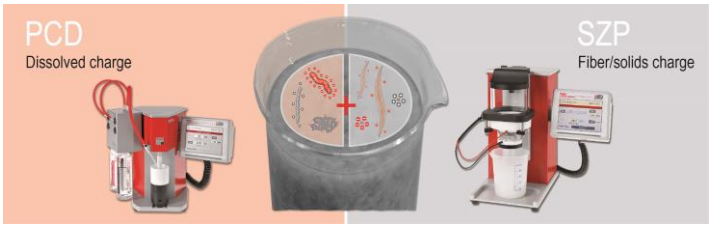
Figure 1: Simplified process diagram

SOLUTION

BTG suggested investigating the DAF unit in the laboratory. Samples for charge analysis were taken from the inlet, after coagulant dosage and after flocculant dosage. The colloidal dissolved charge of each sample was analyzed with a Particle Charge Detector (Mütek PCD-05) and the fiber charge was measured as zeta potential with a System Zeta Potential (Mütek SZP-10).

Objectives:

- Analyze charge household to evaluate each additive dosing point
- Check for charge variations
- Improve additive dosage strategy



Trial 1 – Charge household

The incoming effluent contains anionic fibers (-4.4mV) and a high dissolved charge (-135µeq/l). The introduced coagulant is supposed to neutralize substances carrying this dissolved charge - but this is obviously not the case. On the contrary, the dissolved charge increases to -177µeq/l after addition of the coagulant. What is more, the coagulant enters into unwanted reaction with the fibers and decreases the fiber charge to -3.5mV. It is the flocculant which eliminates the dissolved charge and reduces it to -26µeq/l, thus "cleaning" the filtrate and flocculating the fibers through a slightly cationic charge reversal to 1.3mV.

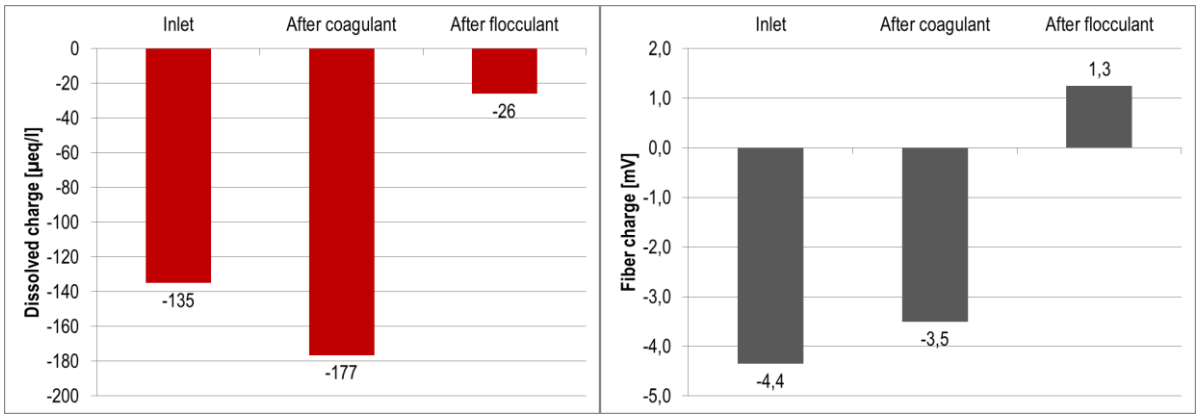


Figure 2: Charge household measured with PCD (red) and SZP (grey)

Trial 2 – Charge variations

The inlet to the DAF unit was sampled three times within three hours. While the fiber charge remained almost constant during the trial period (-4.4mV to -4.1mV), the dissolved charge showed a remarkable variation between -135µeq/l and -166µeq/l (and back) – which is around +/- 23%. This indicates that the system would have required an increased coagulant dosage at 10:21 to keep flotation stable. A stabilized dissolved charge would also result in a higher efficiency of subsequent flocculant application.

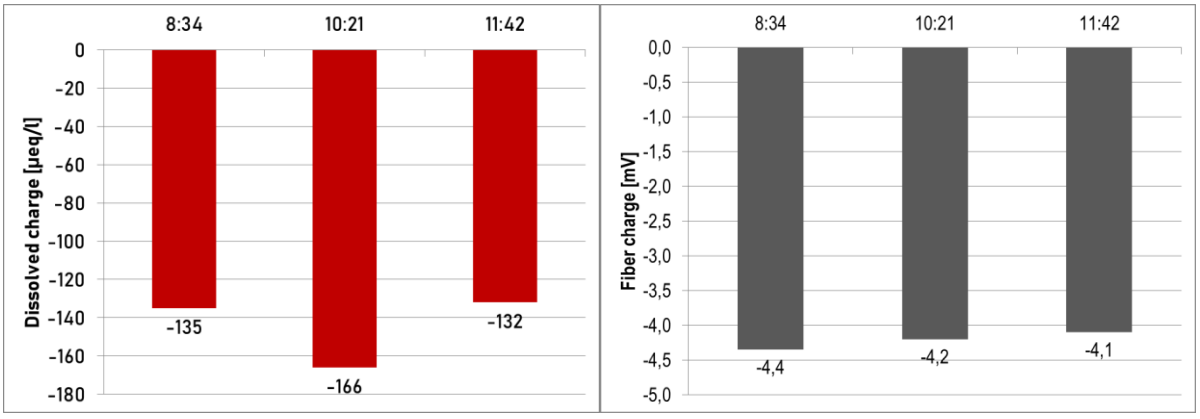


Figure 3: PCD and SZP data - variations in dissolved charge

Trial 3 – Optimum dosage strategy

As the coagulant seemed ineffective in Trial 1, a dosage strategy without coagulant was evaluated. Different amounts of flocculant were added to a sample taken from the inlet. In the absence of the coagulant, the flocculant performed significantly better. The standard flocculant dosage in the process now neutralizes the dissolved charge (to -15µeq/l). However, in view of a cationic value of 5.8 mV for the fiber charge, the flocculant was found to be overdosed. When – based on the current process dosage – the flocculant was reduced by 20%, a fiber charge of -0.5mV and a dissolved charge of -7µeq/l were measured. This reflects a nearly ideal situation for flocculation.

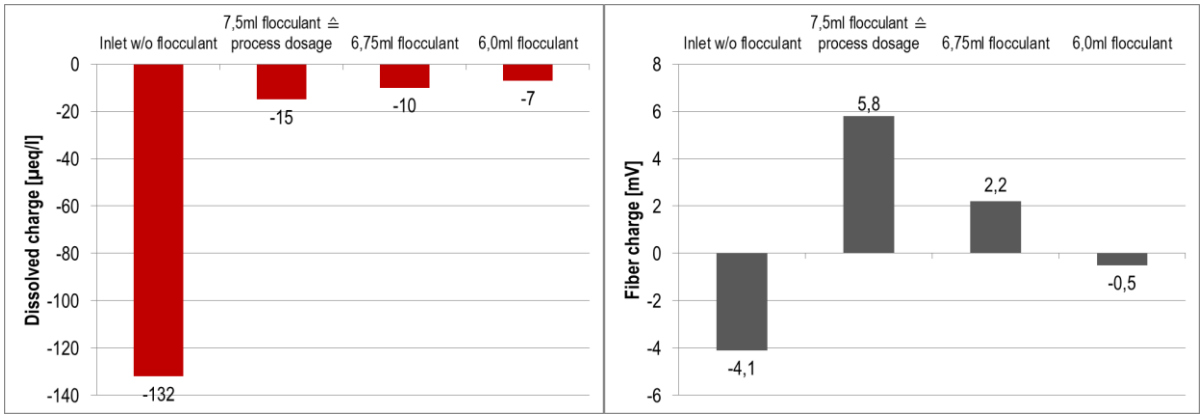


Figure 4: Charge results of flocculant dosage series

RESULTS

Three hours of lab charge measurements gave the following findings:

- The applied coagulant fails to neutralize the dissolved charge.
- Elimination of dissolved substances and flocculation of fibers is taken over by the flocculant
- The coagulant inhibits the performance of the flocculant; in absence of coagulant, the flocculant demand decreased by 20%.
- Dissolved charge fluctuations by +/- 23% within a 3-hour trial period revealed a varying chemical demand of the effluent.
- DAF performance can be optimized via charge measurement. By implementing online charge measurement (PCT-20 Charge Analyzer) further chemicals can be saved through demand-oriented dosage.

ⓘ For more information, please contact instuments@btg.com