

Process analysis for stock and water loops – a well-proven process optimization and development tool



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The experienced specialist teams at Voith Process Solutions cover the entire spectrum of technical, technological and engineering services for the paper industry.

Paper production problems often arise at many levels. The only way to solve them satisfactorily is by thorough process analysis in order to diagnose and eliminate the causes. The following objectives can be involved:

- Product quality enhancement
- Higher production
- Better runnability
- Reduced operating consumables.

Cost saving goals can also be met by process analysis and optimization to reduce the expensive emission of for example effluent, residues, polluted air, heat and additives.

As with analyses of the wet end, process analysis for stock and water loops is largely standardized and independent of the end product and system configuration. Experience from more than fifty process analyses clearly shows that this systematic procedure can also handle problem areas not originally identified as such. The amount of analysis work involved on site and in the laboratory depends on the specific problems and objectives involved.

To work out a detailed problem-solving strategy for process analysis, various tools are required:

- Operating data records
- Stock sample data
- Laboratory examination of stock and paper samples
- Inspection of all key machines and components
- Balancing and process modelling (simulation)
- Checking of machine sizes
- Trials in Voith's Technical Centre.

Voith process analysis incorporates all the latest know-how from our R&D programmes together with new multi-platform machine and process developments as well as control and automation expertise.

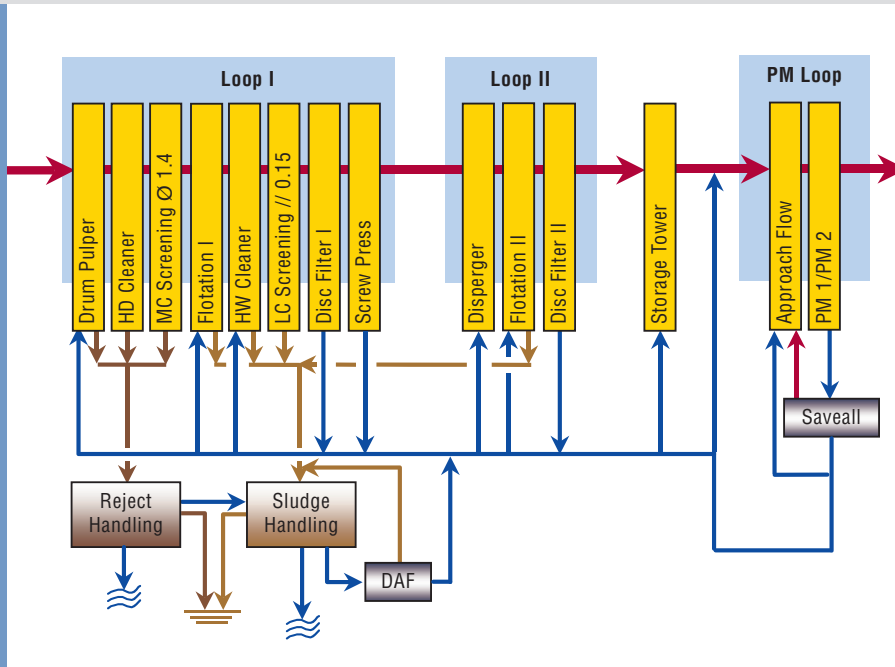
The WEP analysis described in the previous article should provide back-up interest when analyzing the approach flow system and paper machine loops and their effects on paper quality.

The following practical examples from mill operation illustrate the systematic procedure used for process analysis.



Fig. 1: System configuration of a newsprint production plant.

Fig. 2: COD values as an indication of how far the counterflow principle is followed.



Sample point for clear filtrate	Before optimization (measurement)	Before optimization (balancing)	After optimization (balancing)
	COD Chemical oxygen demand [mg/l]		
1st water loop	> 4000	4682	1678
2nd water loop	941	1104	231
PM water loop	235	288	60

Case study

After seven years of production and growing competition on the Asian market, a newsprint mill using 100% recovered paper needed to take fundamental steps to strengthen its market position. The entire paper production process was analyzed to show the best ways of enhancing product quality and increasing productivity.

Results from analyzing the stock preparation and approach flow

The stock preparation line is a classical system with two water loops (Fig. 1) and intermittently operating final stages in

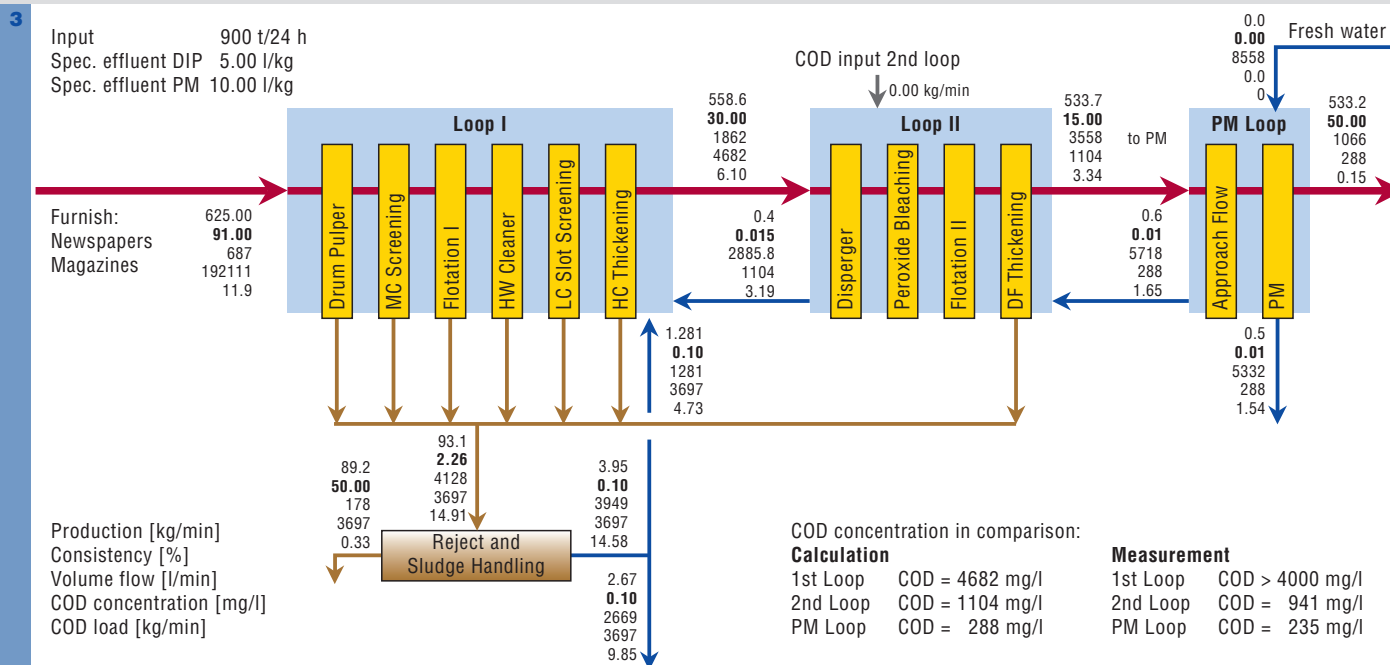
hole and fine slot screening and in the cleaning system.

The stock sample analysis results showed an extremely high stickies content in the final stages of these subsystems. Due to badly adjusted intermittent operation of each final stage, large quantities of stickies were washed into the accepts and re-entered the previous stage. This led to stickies concentration in each of these final stages. A large proportion of these stickies was broken down by this recirculation and they then found their way into the downstream subsystems. Some of them reached the paper machine as microstickies, clearly causing problems such as deposits on the felts as well

as dust and flocks on the drying cylinders.

Since intermittently operating final stages demand exceptionally sensitive adjustment of the operating and wash cycles, simple rebuild measures were recommended in both cases. The result was user-friendly continuously operating final stages with a high removal efficiency.

During the WEP analysis a higher than normal gas content was detected in the headbox, causing unstable operation of the paper machine. To reduce this gas content, the mill added increasing amounts of defoamer despite the adequately dimensioned deaeration system.



Inspection of the vacuum system revealed a defect in the vacuum pump plant, which restricted the deaeration capacity. This was then repaired.

Analysis of chemical interactions in the stock and water loops

While inspecting all the main machines and components, excessive foaming in the flotation cells with extremely stable foam and poor removal efficiency was found. Due to the low content of magazine papers in the furnish and the resultant low ash content, only tensides were used to aid flotation.

Apart from optimizing the spray nozzles to break down the foam more efficiently, a combination of tensides and soap was recommended to aid flotation.

By using less tensides, foam formation has been reduced and the use of soap has improved the removal efficiency of the cells.

Heavy deposits were found ahead of the machine chest and in the headbox. Chemical-physical analysis in the laboratory revealed aluminium sulphate as the main component of deposits at the machine chest as well as a silicate mixture in the headbox. Analysis of the additives and quantities identified the following situation:

- The aluminium sulphate dosing method was inadequate, resulting in excessive local dosages and formation of deposits just after the dosing point.
- The Composit (PAC and anionic silicate) dual retention system was correctly operated. Interaction with the relatively high concentration of aluminium sulphate led however to deposits in the headbox and these were very difficult to remove.

Balancing results and process model analysis with the focus on water management

While the analysis work was being undertaken, about twice as much process wa-

4	Stock buffer	Water buffer	Before optimization	After optimization	
	Dump chest	1000 m ³	Buffer DIP	–	1000 m ³ (new)
	Total stock buffer DIP	1000 m ³	Total water buffer DIP	–	1000 m ³
	Storage tower 1 DIP	800 m ³	Clear filtrate buffer 1	1500 m ³	1500 m ³
	Storage tower 2 DIP	1000 m ³	Clear filtrate buffer 2	–	2000 m ³ (existing)
	Dry broke	800 m ³			
	Wet broke	800 m ³			
	Total stock buffer PM	3600 m ³	Total water buffer PM	1500 m ³	3500 m ³

Fig. 3: Simulated COD balance for conditions before optimization. The simulated balance indicated significant COD and disturbing substance improvements following implementation of the counterflow principle (see also Fig. 2).

Fig. 4: Lack of dynamic water buffer capacities leads to uncontrolled overflows.

ter was flowing from the paper machine loop into the biological effluent treatment plant compared with process water from the first stock preparation water loop. This indicated that the counterflow principle had not been properly implemented in the mill's water management programme.

With the counterflow principle, process water flows in the opposite direction to the stock flow. In other words, overflow from the paper machine water loop with a relatively low dissolved solids content is re-utilized in the stock preparation water loops before passing with a high dissolved solids content to effluent treatment.

The COD value (chemical oxygen demand) serves as a measure of colloidal and dissolved solids content (disturbing substances) in the various process water flows. In this mill case the COD test results clearly confirmed the balancing results (Fig. 3).

In particular, the first water loop in the stock preparation line showed an unnecessarily high level of colloidal and dissolved solids due to the restricted operating mode (Fig. 2).

Using a simulation model of the entire papermaking process, a proposal was worked out for a systematically optimized water management based on the counter-

flow principle. The relationship of dynamic stock and water buffer levels was also checked out and optimized (Fig. 4).

Process analysis conclusions

About one year after presenting the process analysis results, the success of all optimization measures taken so far has been confirmed. Some smaller, less spectacular measures still have to be taken. The process analysis has led to close teamwork between the mill and Voith Process Solutions, so that all objectives are being reached in an economically sensible way.