Product loss in pulp and paper mills

Manage Product Loss and Protect Profits in Pulp and Paper Manufacturing by Monitoring Nutrients and Solids

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Not only is product loss wasteful in the short term, it can also indicate a chronic underlying issue – such as a process inefficiency or mechanical breakdown – that could have staggering consequences in the long term. Plant managers can gain valuable insight into plant operations by tracking product loss over time, which can be done simply by collecting and tracking data in two key areas.

1. Nutrient Optimization
2. Solids Management



Biological treatment of wastewater

Nutrient Optimization

Secondary biological treatment of pulp and paper wastewater depends on healthy bacteria to remove biodegradeable organic matter and reduce toxicity, but nutrient dosing is a delicate balancing act.

Using an excess of nutrients is not only wasteful, but also leaves residual ammonia and orthophosphate in the effluent, which must be removed prior to discharge.

If nutrient levels are too low, however, treatment efficiency drops – even to the point of ineffectiveness – resulting in higher effluent total suspended solids (TSS) and biological oxygen demand (BOD). Indicators of nutrient-limited conditions include:

- Foaming and excess polysaccharide production
- Improper settling or dewatering
- Overgrowth of filamentous bacteria compared to floc-forming bacteria

Without adequate nitrogen and phosphorus, bacteria are unable to completely break down complex toxic organic molecules into simpler, less harmful compounds. Even a slight nutrient deficiency can mean that toxic substances are passing through untreated into the final effluent, resulting in higher production costs for post-treatment chemical dosing, or potential fines and downtime resulting from exceeding permit values.

Popular Nutrient Optimization Strategies

Control to Residual Targets

Most effluent treatment systems manage their nutrient feed by measuring nutrient residuals and then adjusting them based on residual control targets. This can be an acceptable management strategy, assuming that the propular residuals are measured in the proper location at a proper frequency (daily, at a minimum).

This strategy is reactive: operators react to residual levels by changing nutrient feed rates. If a residual is high, operators will decrease a feed rate; if residual is low, operators will increase a feed rate.

Pros: The risk of overfeeding or underfeeding is minimized because dosing is closely matched to nutrient requirements based on organic loading and aeration basin performance.

Cons: The potential for innacurate readings and slow response times is high, depending on where and when measurements are taken. For example, if residuals are measured at the end of large multi-day basins rather than at the completion of aerobic treatment, effluent residuals may be falsely elevated as a result of the nutrients released during the endogenous decay process.

Control to BOD:N:P Ratio

Nutrient feed may also be calculated as a ratio of biological oxygen demand to nitrogen to phosphorus in activated sludge. The recommended guideline is BOD:N:P of 100:5:1. Depending on the type of mill and treatment system, the proportion of nitrogen could range from 4.5 to 4.8, while the proportion of phosphorus could range from 0.5 to 0.8.

Pros: An established BOD:N:P enables nutrient feed that is closely matched to organic loading, resulting in nutrient cost savings and lower risk of nutrient deficiency.

Cons: Direct BOD testing has a 5-day lag time, therefore plants that employ this strategy must correctly corrolate BOD with COD, TOC or 1-day BOD measurements. Poor nutrient management will occur if good correlations have not been established.

Alternative Nutrient Optimization Strategies

Residual Feedback to BOD:N:P Feedforward

Online TOC or UVAS measurements can be used by a Hach RTC-DOS module to determine the optimal C/N/P ratio for carbon removal and automatically deliver the correct dose of phosphorus and nitrogen sources. The system continually detects phosphate and inorganic nitrogen and uses this feedback to further optimize the biological treatment process.

Pros: Nutrient dosing rates are continuously adjusted based on real-time organics load and residual nutrients, resulting in stabilized and compliant purification performance and sludge characteristics. “Off-the-shelf” system with simple set-up; little to no maintenance, training and staff oversight required.

Cons: Requires RTC-DOS module; may require additional instrumentation. *(Please refer to the Recommended Instrumentation section on page 4.)*

RTC-DOS features:

- Up to 4 different specific dosing rates N/BOD and P/BOD for different products
- Up to 4 TOC-UVAS/BOD relationships applicable
- Allows the operator to split the calculated nutrient dose rate into two dosing points
- Considers hydraulic retention time
- Option for load-based inflow distribution to selectors / aeration step
- F/M ratio calculation based on TSS (MLSS) and TOC inflow concentration
- Option for airflow monitoring to identify load peaks

Solids Management

Solids in pulp and paper wastewater refer to excess pulp fibers that have escaped the production process and are on their way to becoming waste instead of saleable product. Careful monitoring of solids can help:

1. **Optimize the save-all operation.** Maximize resource utilization by recovering more fibers on the paper machine water loop.
2. **Optimize the sludge dehydration process.** Maximize efficiency either by improving the BTUs of boiler fuel or by decreasing the cost of transportation and disposal.



Sludge belt press

Popular Solids Management Strategies

High-Pulp Consistency Meters

Most plants use high-pulp consistency meters to measure suspended solids and control their production. However, these meters are expensive, cannot measure low concentration and are bolted to the pipes without the option to perform maintenance during runtime.

Alternative Solids Management Strategies

Optical Probe

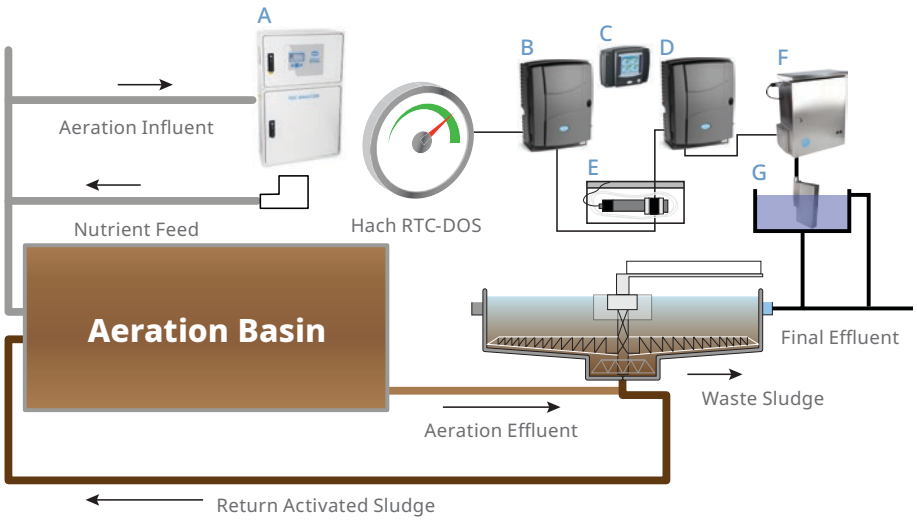
A versatile, low-cost suspended solid probe, such as the Hach TSSsc, enables plant operators to measure solids at more points throughout the production process without the financial or maintenance burden of a high-pulp consistency meter. *(See Recommended Instrumentation, page 4 and 5)*

Examples of applications of a suspended solids probe include:

- Measuring the solids at the effluent of each plant department for solids management, product loss optimization and troubleshooting.
- Improving the efficiency of the pulp thickeners.
- Monitoring and controlling of the kraft green (dregs) and white liquors (lime mud) clarifiers.
- Measuring the first pass retention on the paper machine with solids measurement at the headbox and wire pit.
- Measuring the efficiency of and controlling the save-all and coag/polymer dosage.
- Measuring the efficiency of the wastewater clarifiers and final effluent for regulation.
- Measuring WAS, RAS, MLSS and sludge retention time in the biological activated sludge reactor.
- Measuring sludge consistency and filtrate quality on the dehydration press for efficiency and coag/polymer dosage.

Recommended Instrumentation

Instrumentation for Nutrient Optimization with Hach RTC-DOS



The Hach RTC-DOS module system can be added alone if you have already the Hach online analytical instrumentation. It can also be used just with one control loop (Feed forward or Feedback).

The Hach RTC-DOS System

A. BioTector B7000i
B. Phosphax Orthophosphate Analyzer
C. SC1000 Controller
D. Amtax Nitrogen Ammonia Analyzer
E. Nitratax Nitrite/Nitrate UV Probe
F. Filtrax Filtration Control Unit
G. Filtrax Filtration Sample Pump

A. Hach BioTector B7000i for Total Organic Carbon

Hach's BioTector online TOC analyzer helps identify when water is safe to use or reuse by measuring carbon, commonly found in additives, bleaching compounds, and other chemicals. Its integrated modules identify nitrogen and phosphorus content to help optimize effluent water treatment decisions, while innovative self-cleaning oxidation technology easily handles difficult samples to help maximize uptime and reliability, while significantly reducing maintenance requirements common with older thermal and UV technologies. Where other technologies fail, BioTector's design allows greases, oils and soft particulate loads to be analyzed as part of the water sample, instead of being excluded or causing interference and damage to sensitive analyzers. Results from less-robust analyzers will drift as a result of contaminants and require additional maintenance to function properly, but BioTector's unique Two-Stage Advanced Oxidation (TSAO) technology delivers maximum chemical oxidation of the suspended and dissolved contamination to identify both inorganic and organic contamination levels in influent, process or effluent water.

B. Hach Phosphax sc for Orthophosphate

Prognosys Enabled

Hach's Phosphax sc is a digital on-site analyzer, ideal for the high-precision determination of orthophosphate concentration directly at the tank. The instrument offers a wide measurement range for a variety of wastewater and drinking water applications with detection limits as low as 0.05 mg/L and response time of less than five minutes including sample preparation. The phosphate analyzer also features minimum reagent consumption and easy handling with analysis accessible at all times.

D. Hach Amtax sc for Ammonium

Prognosys Enabled

Hach's Amtax sc digital on-site analyzer with a gas sensitive electrode is designed for the high precision determination of ammonium concentration directly at the tank. The analyzer offers a high degree of accuracy due to selective GSE instrumentation and needs only minimal supervision thanks to automatic cleaning and calibration and self-diagnosis.

E. Hach Nitratax sc for Nitrate and Nitrite Nitrogen

Prognosys Enabled

Hach's Nitratax sc family includes digital, optical probes for the high precision determination of nitrate concentration directly in the medium. Featuring a high degree of accuracy due to direct UV measurement, without cross sensitivities, Nitratax sc nitrate sensors are ideally suited to statutory, limit-value monitoring. The low maintenance, reagent-free optical probes offer a broad application spectrum thanks to turbidity compensation and self-cleaning, even for sludge applications.

Hach UVAS sc (Absorbance UV 254 nm)



Prognosys Enabled

Designed for the reagent-free determination of organic load via the spectral absorption coefficient (SAC) in the medium or in a bypass, this digital probe directly measures UV, instantly producing reliable values. The self-cleaning sensor with stainless steel housing is low maintenance and rugged enough to withstand difficult environmental conditions. Recommended for mills using mechanical wood pulp, which produces aromatic organic compounds that absorb UV light at 254 nm and produce good Abs/COD/BOD correlation.

Instrumentation for Solids Managment



Hach TSS sc Suspended Solids Probe

The TSS sc line of suspended solids probes provide high quality turbidity measurements in the most extreme conditions including high temperature, explosive and other harsh or hazardous environments.

With twelve instrument versions and thirty different mounting styles, including installations for in-pipe and immersion, Hach TSS sc probes can measure online suspended solids under a wide variety of conditions and in virtually all of the applications where this measurement is needed in a pulp and paper plant.

Its scratch-resistant stainless steel or titanium housing and sapphire window are easy to clean and resist fibers, chemicals, fillers, particles and biofilm.

The method of detection has a double optical system with two pulsated infrared LEDs and four receivers. As the transmitted light is scattered, the receivers pick up the incident light at 90- and 120-degree angles, effectively doubling the accuracy of the instrument. This eight-channel measurement system, with an integrated bubble and temperature compensating software, enables the instrument to have a wide measuring range that effectively covers most applications, from the darkest wastewater to ultrapure water with one instrument. The TSS sc probes have a measuring range between 0.001 and 500 g/L and between 0° and 90° C.

Hach Value-Adds



Hach Prognosys Predictive Diagnostics

Prognosys is a predictive diagnostic system that allows you to be proactive in your maintenance by alerting you to upcoming instrument issues. Prognosys allows pulp and paper mill managers to know with confidence whether changes in their measurements are due to changes in the instrument or changes in the water.

Prognosys displays two status indicators for every connected Prognosys Enabled instrument. These indicators give operators all the information they need to plan preventive maintenance and avoid unexpected emergencies. The measurement indicator monitors the instrument's components and uses that information to alert the user to upcoming instrument needs before measurements become questionable. The service indicator tracks the number of days until the instrument will require maintenance.

Hach Service

Service

Hach's comprehensive Service options include routine maintenance, timely repairs, and even remote support for all Hach equipment. A team of technical experts can proactively reach out with instrument health and performance alerts to maximise uptime and convenience without the need for coordinating onsite visits or instrument shipment to take your nutrients and solids management to the next level.

Conclusion

Measuring product loss is about more than plant performance: it can maximize yield and resource utilization, minimize operating expenses, and provide advance warning of costly process issues and mechanical breakdowns.

Even better, staying on top of these important concerns can be achieved with two simple measurements – and two solutions from Hach. RTC-DOS for nutrient optimization allows P&P managers to benefit from a continuous adjustment of dosing rates based on real-time organics load and residual nutrients. The TSS sc line of probes provides a low-cost, wide-ranging versatility for solids management. Used together with Prognosys, these solutions can help achieve more stable performance, more uptime and more confidence in meeting nutrient residual regulation levels.

Find complete water analysis solutions for the pulp and paper industry at www.hach.com/industries/pulp-and-paper