Use of COD Analyzer Data for Improved Control of Aeration and Nutrient Usage in the Effluent System

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CANFOR

Effluent Treatment at Canfor Pulp Mills

- Kraft pulping and bleaching creates a waste effluent stream with high organic loading.
- Biochemical Oxygen Demand – the amount of oxygen required by aerobic organisms to break down organic material
- Aerated basins for biological effluent treatment
  - Using microbiology to eat the organics and treat the effluent
- Healthy microbial populations require
  - Nutrient – added to basins
  - Oxygen – added to basins
  - Food (in mill effluent)

Problems With Effluent Management

- BOD_5 is a permitted effluent quality parameter
- Problematic to rely on 5 day test (BOD_5) for effluent quality control
- Direction of effluent flows in upset conditions requires fast data
- Nutrient application and aeration is typically either “set & forget” or managed reactively

What Would Really Help?

- NEAR-REAL TIME BOD_5 RESULTS!
  - Would give warning of severity of process upsets and data could be used to direct flows
  - Would give near instant estimate of effluent quality across the treatment system
  - Would allow for day-to-day nutrient application or aeration changes.
- Need to find a strong correlation between BOD_5 and other effluent testing.

Chemical Oxygen Demand (COD)

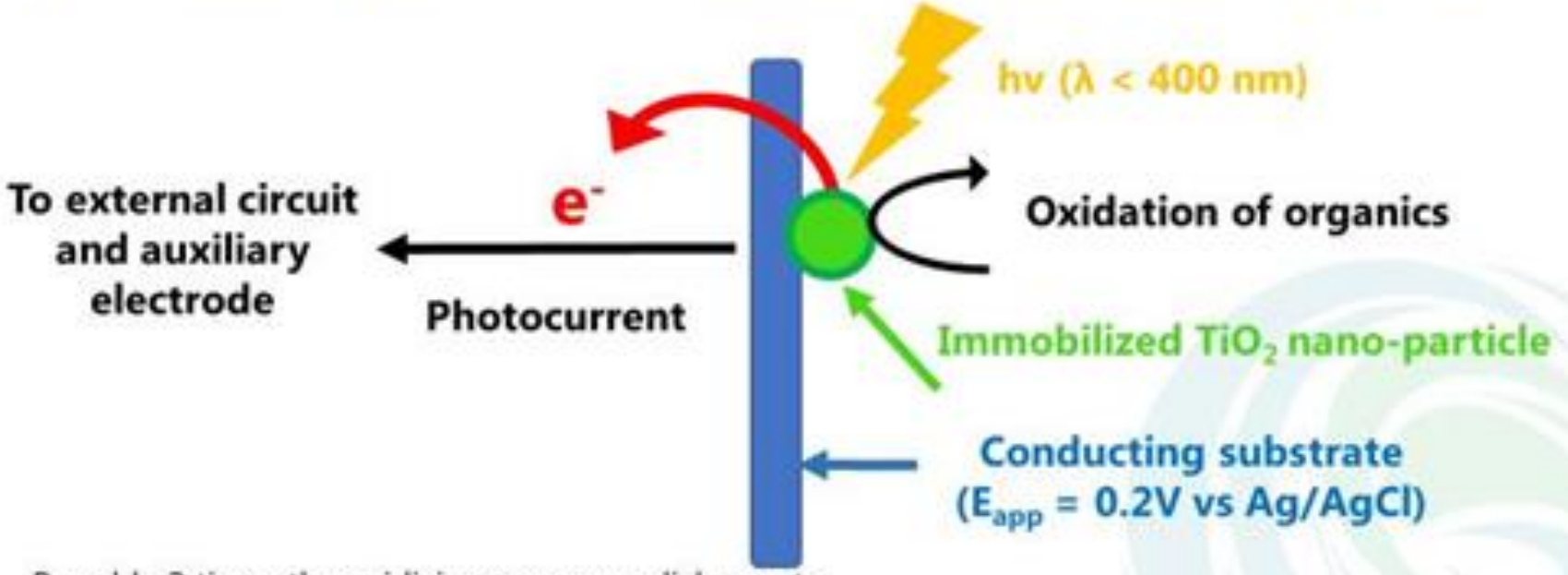
- Typically correlates well with BOD
  - Traditionally uses mercury dichromate
  - High health/environmental hazard
  - 3-4 hour turnaround time
  - Batch size limited by heat block capacity
  - Inefficient for managing rapid changes across an Effluent Treatment System

Photoelectric COD (PeCOD)

- New green COD technology offered by MANTECH
  - Uses a photoelectric effect across a titanium dioxide catalyst to create powerful oxidation of soluble chemicals.
  - Reagents are soluble, environmentally benign salt solutions.
  - Minimum health risk.
  - Results in 15 min/sample.
  - Measures soluble COD only.
- Purchased in early 2017.

PeCOD Technology

| PeCOD®| A Nanotechnology Based Approach



Roughly 2 times the oxidizing power vs. dichromate

- i.e. Benzene, 1.8 by COD_{Cr} and 2.6 by PeCOD®

PeCOD:COD correlation

- Mantech worked with FPInnovation to test correlations with dichromate COD in pulp mill effluents

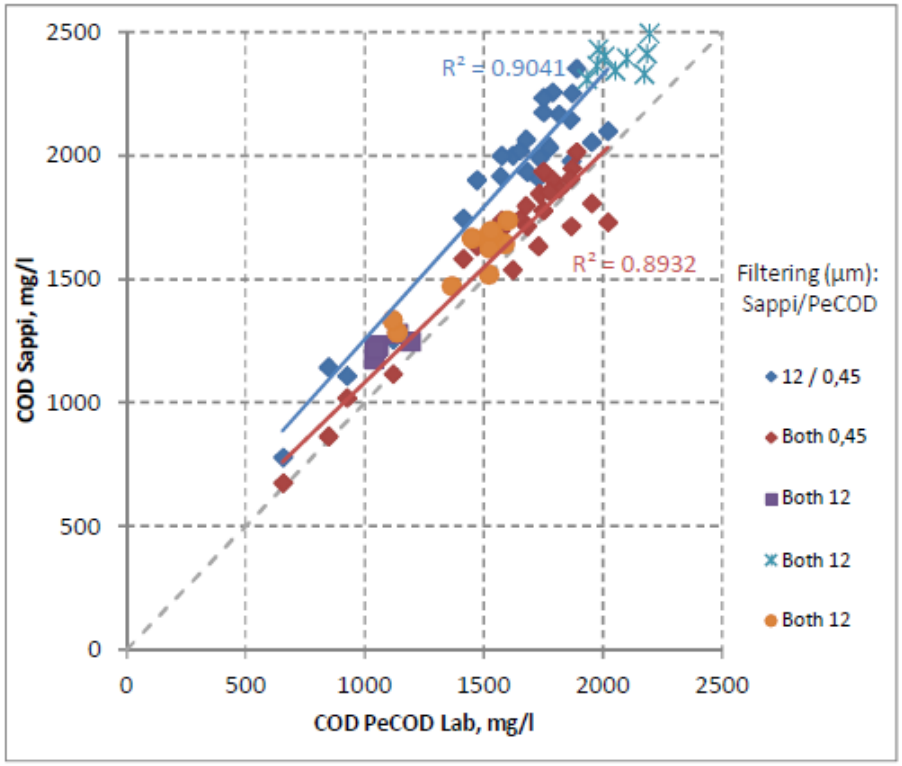
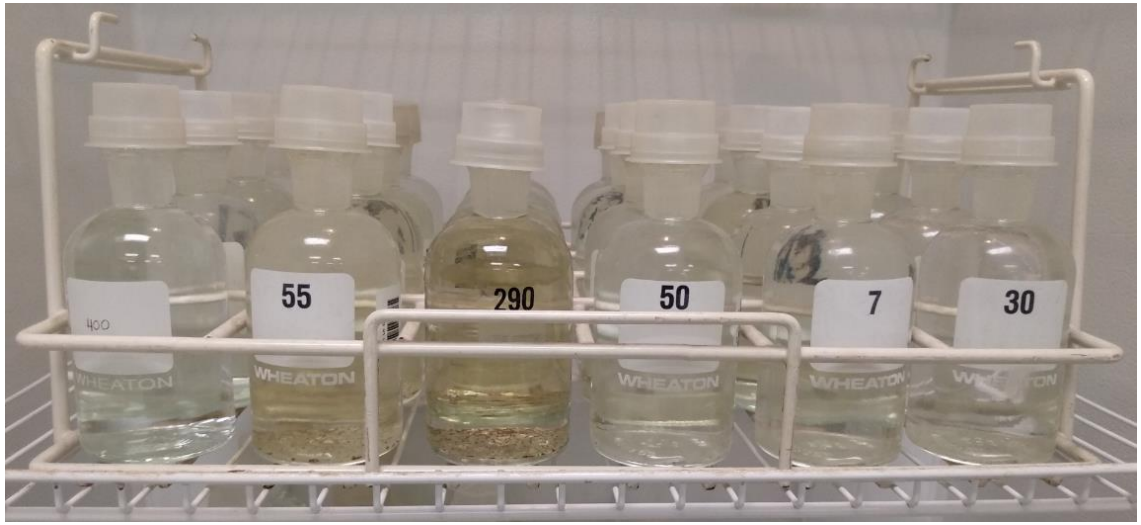


Figure 32. COD results measured with dichromate and peCOD technologies. Samples were filtered either with 12 µm or 0.45 µm filters before the analysis.

PeCOD:BOD correlations

- Little previous testing for BOD:PeCOD correlations in pulp mill effluent
- Because PeCOD is a measure of soluble COD, there should be a good correlation with BOD
- Selected sample locations across the spectrum of the ETS
- Samples were tested for both PeCOD and BOD



The PGI Effluent Treatment System

PeCOD Correlates With BOD5

- *R values X >0.8*
  - *CRT, Intercon Clarifier Overflow, PG Biobasin Inlet, PG BWW*

- R values 0.6<X<0.8
  - CCB, Intercon Bleach Plant Effluent, PG Clarifier Overflow, ASB Inlet

- R Values X<0.6
  - Intercon Biobasin Midpoint and Outlet, PG Biobasin Outlet, River Outfall

- *"In all instances the PeCOD slopes for the secondary treated effluents were greater than the slopes for the corresponding primary treated effluents. This could be due to the fact that the treated effluents contain higher levels of recalcitrant COD which the PeCOD measures more effectively than the dichromate method."* **FPInnovations Report (2016)**
  - Could explain correlations weakening further through the effluent system.

Fast BOD5 Prediction - Upset Conditions

- Monitoring of effluent system inlet BOD in near-real time.
  - One sample a day (at each location) under normal conditions
- During turnarounds/upset conditions
  - Multiple sample sets per shift
  - Enables quick response to effluent system load changes
- Can test U-drains and sumps as needed, results in 15 min, allowing for collection of spills in-mill
- Contaminated effluents can be directed to storage basins/tanks and an appropriate pump-back rate set based on data

PeCOD for Aeration control

- Intercon and PG biobasins provide biological effluent treatment
  - Each contains 10-11 60 HP surface aerators

- PG ASB provides further biological treatment of both mill effluents
  - Subsurface aeration grid runs off of 1, 2, or 3 800 HP blowers

With a cost to run the each blower at about $660 per day, or $240,000 per year, important to make the right decisions

- Prior to PeCOD, decisions were based on BOD results, resin acid loading, and knowledge of operating conditions.

- After PeCOD, decisions still take multiple factors into account but now include daily data on inlet loading

PeCOD for Nutrient Management

- PGPP and Intercon Bio Basin Nutrient Study
  - 4:1 Urea Ammonium Nitrate:Ammonium Polyphosphate
  - Set and forget application of nutrient leads to excess nutrients
  - Changing operational conditions require change in nutrient application
- Using PeCOD to adjust nutrient for an appropriate BOD:N:P ratio.
  - Regular checks on microbiology ensure nutrient deficiency is avoided

Aeration Control for Curtailment

- Regular PeCOD checks at basin inlets
- Used BOD:PeCOD correlation to calculate aeration requirements
- Shut down aerators as loading dropped off, keeping a minimum 2-3 running to ensure sufficient dissolved oxygen
- Ran ASB off one blower after reduction in incoming PeCOD
- Savings of $33,000 on electricity to run aeration over 4 weeks

Nutrient Control for Curtailment

- Regular checks of PeCOD at basin inlets
- Using PeCOD:BOD correlation to calculate amount of nutrient required based on BOD: N: P ratio
- Cut back nutrient addition over course of curtailment to minimum pumping levels (less than a quarter of standard usage at the time)
- Maintained basin health for startup
- Resultant savings of $46,000 over 4 weeks

Next Steps

- Expanding trial to manage aeration and nutrient loading better with a running mill
- Continue taking opportunities for savings during downtimes, and unbleached runs while maintaining treatment efficiency
- Looking at possibilities for online analysers in some locations
- Automating nutrient and aeration changes

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Questions