St. Lawrence TECHNOLOGIES

ABSTRACT

Given the presence of sulfite and various other variables that must be taken into account, the optimal design of a biological treatment process may be difficult for an integrated newsprint mill using the BCTMP process.

For this reason, a pilot unit for an activated sludge treatment was in operation for eight months at the Gaspésia Pulp and Paper mill in Chandler. Results show the value of an aerated activated sludge process in the treatment of this type of effluent, as well as the advantage of a plug-flow process over a completely mixed basin.

This test allowed the design and optimization of the treatment process that will be implemented at the Chandler mill to meet the new federal and provincial standards.

Saint-Laurent Vision 2000

INDUSTRIAL WASTEWATER

DETOXIFICATION OF THE EFFLUENTS OF A NEWSPRINT MILL THROUGH COMBINED ACTIVATED SLUDGE-OZONATION

MAIN FEATURES

- **Technology**
  - Treatability of effluents containing sulfite with the help of an aerated activated sludge process.
  - Advantage of a plug-flow process over a completely mixed flow.
  - Effectiveness of ozonation in the reduction of effluent toxicity.
- **Environment**
  - Removal of acute toxicity from the treated effluent.
  - Important reduction of BOD_5 (more than 95%).
  - Application for pulp and paper mills using the BCTMP process.
- **Cost**
  - Facilities and operation costs minimized with the optimization of design criteria.

Environment Canada
Québec Region

Environnement Canada
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PAPRICAN

GASPESIA

PROJECT OBJECTIVES

1. Assess the effectiveness of an aerated activated sludge process (BOD_5 and toxicity) to treat the effluents containing sulfite at the Chandler mill.
2. Assess the effects of the type of flow (plug-flow vs completely mixed) of the aeration basin on the effectiveness of an activated sludge process.
3. Determine the effectiveness of ozonation combined with an activated sludge treatment.
4. Determine the design criteria of the Chandler mill's future treatment system.

BACKGROUND

The pulp and paper industry will be submitted to new federal and provincial regulations imposing the reduction of BOD_5 and SS, as well as the removal of acute toxicity in effluents. In order to meet these new standards, several mills must be equipped with a secondary system for the treatment of their effluents.

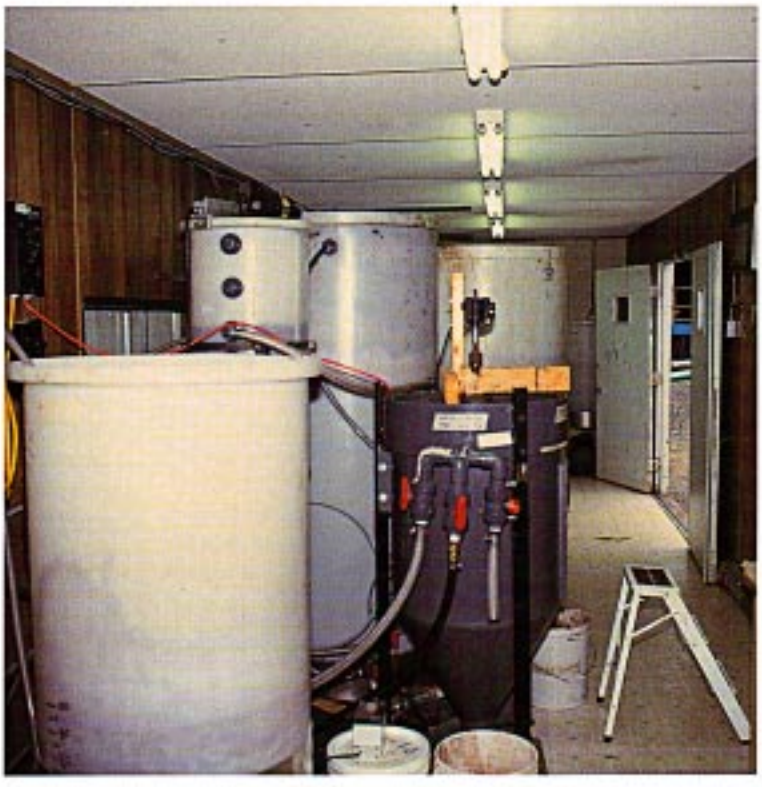
The presence of toxic substances in the effluents, particularly sulfites (SO_3^{-2}), can greatly impede the treatment of liquid discharged from a mill using the BCTMP process. In addition, toxicity removal is, in many cases, the limiting factor of the process. The use of an ozonation unit serving mainly to reduce toxicity or to eliminate residual toxicity therefore appeared as an interesting option and presented the additional advantage of reducing the investments required. Another point of interest was the type of hydraulic flow of the aeration basin, given that it may have a significant effect on the overall effectiveness of the biotreatment.

In light of this, a pilot project was carried out at the newsprint mill of the Gaspésia Pulp and Paper Company in Chandler.

TECHNOLOGY

The first unit included a series of three aerated tanks, while the second contained only one. The two systems were fed by a common mixing tank holding the different wastewaters produced by the mill. A first testing phase allowed to compare the effects of the type of flow (completely mixed vs plug-flow). The two systems were then modified to make them identical (two tanks in series) and ozonation tests were conducted. During the second phase, the load was increased to optimize the design criteria.

Contrary to what could have been expected, the presence of sulfites in average concentrations of 350 mg/L did not cause any operational problems during the pilot tests in Chandler.



RESULTS

• **Type of flow**

The two systems were operated at the same load for a stable period (equalized) of four weeks. The treated effluent was non-toxic and afforded a reduction in BOD_5 of more than 95% in both cases. The only significant difference observed was the quality of the sludge. The volume index of the sludge in the case of the mixed system was 36% higher when compared to the sludge resulting from the plug-flow system.

Sludge flotation problems were also encountered with the completely mixed process. Losses in SS were higher at the discharge of the mixed process than the losses observed in the case of the plug-flow system.

Since the level of sludge settleability is a very important parameter in an activated sludge treatment, the plug-flow process is clearly preferable.

• **Ozonation**

Tests measuring the effects of ozonation on toxicity were conducted on the treated and non-treated effluents of the Chandler mill. These tests allowed to confirm the effectiveness of ozonation since it significantly reduced the toxicity of effluents. However, this toxicity removal had little effect on the BOD_5. At the Chandler mill, the limiting factor of the activated sludge process was the removal of BOD_5. A treatment such as ozonation, which aims essentially the reduction of toxicity, is therefore unnecessary in this particular case.

• **Optimization**

Tests conducted with different loads allowed a BOD_5 reduction of more than 90% and acute toxicity removal. However, in the case of higher loads, the level of sludge settleability was significantly reduced, which is unacceptable for such a system.

This test therefore allowed not only to eliminate any uncertainties regarding the treatability of effluents, determine the best type of flow, and establish the optimal design criteria, it also included, with the help of PAPRICAN, ozonation and process control testing, as well as tests aiming the reduction of the volume of sludge produced.

RESULTS OF PILOT TESTS IN CHANDLER

Parameters		Period*					
		I		II		III	
		System 1	System 2	System 1	System 2	System 1	System 2
Type of flow		plug-flow	mixed plug-flow	plug-flow	plug-flow	plug-flow	plug-flow
Hydraulic retention time (h)		24	24	18	18	12	12
Sludge age (days)		10,0	10,0	10,0	10,0	4,2	4,2
F/M (g/g)		0,23	0,24	0,28	0,28	0,59	0,58
MLSS (mg/L)		4400	4060	4530	4620	3790	3870
Sludge produced (g/g BOD_5)		0,35	0,22	0,46	0,76	0,40	0,40
BOD_5 (mg/L)	feed	909	909	859	859	1031	1031
	discharge	40	45	31	25	96	93
	% removal	96	95	98	97	91	94
COD (mg/L)	feed	2930	2930	2930	2930	3567	3567
	discharge	1056	1124	1068	1007	1513	1738
	% removal	64	63	60	60	52	49
SS (mg/L)	feed	140	140	155	155	209	209
	discharge	56	117	117	38	203	119
	% removal	60	16	25	75	0	43
RFA (mg/L)	feed	8,9	8,9	12,4	12,4	–	–
	discharge	N.D.	N.D.	0,02	0,19	–	–
Toxicity (Trout) CL_{50} 96 h (%)	feed	8,7	8,7	12	12	8,7	8,7
	discharge	>100	>100	>100	>100	>100	>100
Toxicity (Daphnia) CL_{50} 48 h (%)	feed	7,1	7,1	9,3	9,3	8,3	8,3
	discharge	>100	>100	>100	>100	>100	>100
Sulfite (mg/L)	feed	216	216	288	288	353	353
	discharge	0	0	0	0	0	0
Specific sludge volume (mL/g)		125	163	200	180	220	210

* Average on a period of one month of operation: periods I and II refer to Phase I of the pilot testing (type of flow) and period III refers to Phase 2 of the testing (ozonation). N.D. Non detectable

POTENTIAL AND LIMITATIONS

Potential

This test demonstrated the capacity of an aerated activated sludge process to treat effluents containing sulfites. It also demonstrated the positive effects of a plug-flow system on the operation of a secondary sludge treatment plant (better quality of sludge when compared to the completely mixed process).

Ozonation allows an important level of toxicity removal in effluents but has little influence on the effluent BOD_5 removal of the BCTMP process at the Chandler mill. However, it can prove to be very interesting for other types of effluents.

Limits

Treatment through activated sludge remains very effective for high-level loads, but the quality of the sludges is reduced in such conditions, and losses in SS are significantly increased. There are therefore no advantages in overloading these treatment systems.

INFORMATION

This fact sheet is based on the results of a technological demonstration and development project carried out by Gaspésia Pulp and Paper Company Ltd. and the Pulp and Paper Research Institute of Canada (PAPRICAN) with the technical and financial collaboration of Environment Canada.

For more information, contact:

Ronald Zaloum, P. Eng., Ph.D.
Pierre Sylvestre, P. Eng., M.Sc.A.
Technology Development Section
Environmental Protection Branch, Environment Canada, Québec Region
Tel.: (514) 283-4252
Tel.: (514) 496-2657

Joseph Dorica
Group Leader
Environmental Technologies Group
PAPRICAN
Tel.: (514) 630-4100

Jean Guérard
Environment and Energy Superintendant
Gaspésia Pulp and Paper Company Ltd.
Tel.: (418) 689-5294

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Technology Development Section
Environment Canada
685 Cathcart, 8th floor
Montréal, Québec H3B 1M6
Tel.: (514) 283-9274

Production:
Sylvie Gautron, M.Sc.A.

Writers:
Pierre Sylvestre, P. Eng., M.Sc.A.
Jean Guérard, Gaspésia

Layout:
Dianne Ouellet

Editor:
Le Marché de l'Écriture

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Cette fiche est également disponible en français sous le titre :

Détoxication des effluents d'une usine de papier journal par une combinaison boues activées-ozonation.

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