St. Lawrence TECHNOLOGIES

ABSTRACT

Operators of secondary wastewater treatment using activated sludge techniques often encounter the problem of thickening of the sludge, which tends not to settle in the secondary sedimentation tank.

Pilot tests carried out using a Poseïdon flotation unit have shown that the dissolved-air flotation process can efficiently recover residual biomass from treated effluent and offers advantages over sedimentation.

These tests combined with previous results of biological treatment trials have permitted the conception and design of an industrial scale system and a technical and economic evaluation of the capital and operation costs of the two types of solid-liquid separation technologies.

INDUSTRIAL WASTEWATER

TECHNOLOGICAL ADAPTATION OF A DISSOLVED-AIR FLOTATION UNIT FOR CLARIFYING EFFLUENTS FROM DE-INKING PLANTS.

MAIN FEATURES

- **Technology**
  - Dissolved-air flotation process applicable to residual biomass from aerobic secondary treatment.
  - Compact unit.
  - Withstands variations in loads.
  - Requires the addition of flocculants.
  - May be installed in addition to an existing secondary sedimentation tank.
- **Environment**
  - Guarantees optimal efficiency of a wastewater treatment plant, even when the bioreactor is operating unevenly.
  - Recycles highly active residual biomass to the bioreactor, given the very short hydraulic retention time in the flotation unit.
  - Guarantees that the treated effluent will contain very few suspended solids (SS).
- **Cost**
  - Capital costs lower than for a secondary sedimentation tank, but higher annual operating costs.

Saint-Laurent Vision 2000

Environment Canada — Québec region

Environnement Canada — Région du Québec

Cascades Inc. · Poseïdon · Gouvernement du Québec, Ministère de l'Environnement et de la Faune · CQVB

PROJECT OBJECTIVES

The goal of the research carried out jointly as part of this project by the UQTR Pulp and Paper Research Centre, Cascades Inc., Désencrage C.M.D. Inc., Désencrage Cascades (1988) Inc. and Les Traitements des Eaux Poseidon Inc was to:

- evaluate the performance of a dissolved-air flotation unit for separating residual biomass under stable and unstable operating conditions of biological wastewater treatment equipment using activated sludge and aerated lagoon techniques at two Cascades Group plants;
- conduct a preliminary technical and economic evaluation of the application of this technology.

Pilot-scale trials were carried out at the sites of two deinking mills of Cascades Inc. One is the Désencrage C.M.D. Inc. located at Cap-de-la-Madeleine and the other is Désencrage Cascades (1988) Inc. located at Breakeyville. Each of these mills has a station for secondary treatment of their effluent. One with activated sludge, the other with aerated lagoon.

BACKGROUND

The solid-liquid separation of suspended biomass residue in treated effluent from a conventional biological treatment plant using the activated sludge method generally calls for conventional sedimentation technology with a secondary sedimentation tank. This residual biomass often causes difficulties with sedimentation, and the operating problems of the upstream aeration tank frequently add to these difficulties, to the point where the biomass tends to float or form a compact system of stagnant filamentous bacteria that inhibits decantation.

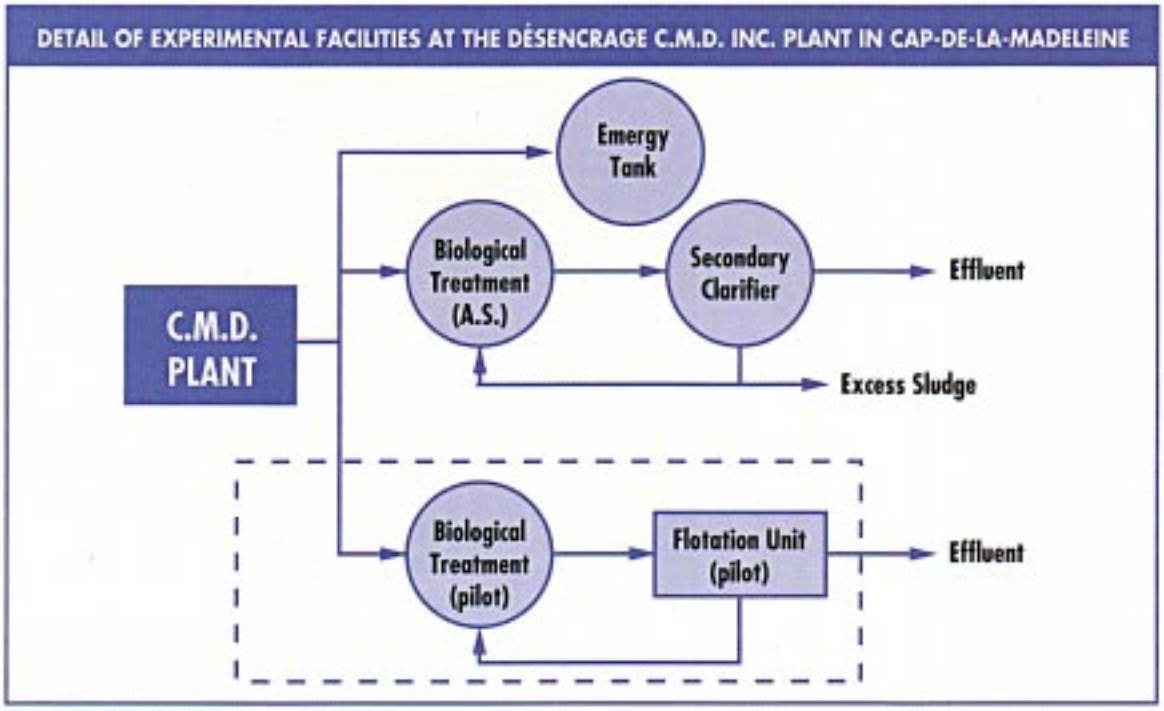
TRIALS

The experimental Poseïdon dissolved-air flotation unit, with a volume of approximately one cubic metre, was first installed at the Désencrage C.M.D. Inc. plant and fed with treated effluent from a pilot bioreactor (volume of 46 m^3) operating in activated sludge mode. As the diagram shows, a common waste stream was fed to the two reactors. First of all, the pilot reactor was operated under exactly the same conditions as the industrial reactor; the pilot reactor was then intentionally subjected to unfavourable operating conditions to generate filamentous bacteria. In both cases, the flotation unit was used to recover biomass from the treated effluent and to recirculate part of it to the reactor.

The optimal operating conditions for the flotation unit were evaluated on the basis of biological treatment parameters and by varying mainly the hydraulic retention time and the quantity of polymers added to the flotation unit.

For polishing an effluent fed from an aerated lagoon, the experimental flotation unit was fed directly from the output of the aeration tank at the Désencrage Cascades (1988) Inc. plant. The operating conditions of the flotation unit were varied to optimize the removal of the biosolids generated.

DETAIL OF EXPERIMENTAL FACILITIES AT THE DÉSENCRAGE C.M.D. INC. PLANT IN CAP-DE-LA-MADELEINE



Notes: A.S. (Activated Sludge)

RESULTS

The main results obtained show that the Poseïdon dissolved-air flotation unit removes over 98% of biosolids from a bioreactor using an activated sludge process under stable operating conditions; adding polymers improves this performance very slightly. Under unstable conditions or when the sludge thickens, a polymer must be added at concentrations of less than 10 mg/l; the removal efficiency then ranges from 95% to 97%. If the biosolids come from an aerated lagoon, ferric chloride must be added along with a polymer to attain efficiency of 97%.

A technical and economic evaluation was carried out to examine the replacement of an aerated lagoon by an activated sludge system and flotation unit. The study showed that such a unit costs less than a sedimentation tank, but is more expensive to operate because of the electric power needed to run the recirculation and air saturation pump.

PERFORMANCES OF THE POSEÏDON FLOTATION UNIT FOR THE REMOVAL OF BIOSOLIDS

Operating conditions					
Aerobic biological treatment			Flotation unit		
	Stable (mean values)	Unstable		Stable (mean values)	Unstable
Activated sludge (pilot)					
HRT (h)	50	5 - 35	HRT (min)	45	12
Sludge age (d)	14	4			
F/M	0,22	0,77			
Xva (mg/l)	1800	2600			
Aerated lagoon (industrial)					
HRT (d)	12	—	HRT (min)	11	—
Xva (mg/l)	1610	—			

Flotation unit performance			
Conditions	Effluent feed Xa (mg/l)	Polymer used	% MLSS removal
Activated sludge (pilot)			
Stable operation	2545	—	97,7
Stable operation	2807	Percol (2,5 mg/l)	98,5
Unstable operation	3063	Diafloc (9,8 mg/l)	95,2
Aerated lagoon (industrial)			
Stable operation	1680	Diafloc (6 mg/l) + $FeCl_3$ (144 mg/l)	97,0
Stable operation	1750	Diafloc (21 mg/l)	87,0

SUMMARY COMPARISON OF ANNUAL OPERATING COSTS

Equipements	Activated sludge with secondary clarifier	Activated sludge with flotation unit
Chemicals	$ 4 000,00	$ 1 000,00
Electricity	$ 1 000,00	$ 9 000,00
TOTAL	$ 5000,00	$ 10 000,00

POTENTIAL AND LIMITATIONS

Given its good performance under pilot trials, there are great advantages to using a dissolved-air flotation unit in place of a secondary sedimentation tank at a wastewater treatment plant operating in activated sludge mode or for removing biosolids from an aerated lagoon. In activated sludge mode, the flotation unit can completely or partially replace decantation. The main benefits are the control of problems caused by filamentous bacteria, the return of highly active secondary sludge to the bioreactor because of the short residence time in the flotation unit in comparison with the time necessary in a sedimentation tank, the very high efficiency of biomass removal by the unit, more compact facilities where limited space is available, and resulting residual biomass up to 2 g/l. Based on these advantages, the Désencrage Cascades (1988) Inc. plant in Breakeyville decided to convert its effluent treatment system from the aerated lagoon technique to a bioreactor in activated sludge mode using a Poseïdon flotation unit for the management of residual biomass.

INFORMATION

This data sheet is based on the results of a technology demonstration project conducted jointly by the UQTR Pulp and Paper Research Centre, Cascades Inc., Désencrage C.M.D. Inc., Désencrage Cascades (1988) Inc. and Les Traitements des Eaux Poseïdon Inc.

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