

Riocell SA's mill in Brazil has one of the most complete effluent treatment systems in the world.

ISSUE FOCUS: AIR/WATER QUALITY

ADVANCED WASTE TREATMENT SYSTEM REMOVES COLOR, SUSPENDED SOLIDS

Brazilian paper and market pulp mill installs high-efficiency waste treatment plant before starting bleaching operation

By **CELSE FOELKEL**

Riocell SA (formerly Industria Celulose Borregaard) is a 16-year-old pulp and paper company in Rio Grande do Sul, a city in southern Brazil. The mill was originally designed to produce 793 air-dry (a.d.) tpd of unbleached kraft pulp or 1,080 a.d. tpd of dissolving grade pulp.

The raw wood material used at the Riocell mill is 75% eucalyptus and 25% acacia. Formerly, the unbleached pulp was shipped to Norway for bleaching and subsequent marketing in European countries. The mill's

Mr. Foelkel is quality and R&D manager, Riocell SA, Brazil.

eucalyptus pulp was among the first introduced into specialized, sophisticated markets that demanded high quality.

When the ownership changed and the link with Norway weakened, management pushed to complete the mill. Now, Klabin, Iochpe, Votorantin (KIV) is the major owner, and BNDESPAR, a state bank, maintains an important share.

Currently, 716 a.d. tpd of bleached market pulp, 132 tpd of printing and writing paper, 176 a.d. tpd of unbleached market pulp, and 77 a.d. tpd of a semichemical filler pulp are produced. During dissolving grade runs, total production drops to 716 a.d. tpd, which is largely due to the intrinsic characteristics of the prehydrolysis kraft process.

ENVIRONMENTAL TROUBLES. The mill is located near Pôrto Alegre, a city of 1.2 million inhabitants on the right bank of the Guaiba River (a kind of ecological heritage of the so-called "gaucho" people living in the state).

The mill had problems with environmental authorities and the population before the bleaching project took place, and the company image was seriously damaged at that time. Thus, special attention was paid to environmental concerns and the production process, and today the mill is a well-known example of pollution control efforts.

Jaakko Pöyry Oy, which has provided engineering for the mill since its inception, handled engineering and construction management for the recent environmental projects and the new bleach plant. The environmental concept behind the mill is to keep final residues to a minimum and recover losses in the mill areas where they are generated.

To do this, a losses recovery system was installed in 1980. When the bleaching plant started up in 1983, the new wastewater treatment plant, which had begun operating in 1982, was ready to receive effluents. Effluents were treated at a tertiary level using the best available technology and then discharged, "free of pollution," into the Guaiba River.

TABLE 1: Efficiency of waste treatment system at Riocell SA mill in Brazil.

Overall efficiency	
BOD ₅ removal	98% to 99%
COD removal	91%
Suspended solids removal	97%
Color removal	90%
Treated effluent characteristics	
Specific organic load	
kg BOD ₅ /a.d./ton	0.2 to 0.3
kg COD/a.d./ton	5.0 to 5.5
Suspended solids specific load	
kg SS/a.d./ton	0.4 to 0.5
Color specific load	
kg PtCo/a.d./ton	19 to 20

TREATMENT SYSTEM. The effluent treatment system is illustrated in Figure 1. Effluents from various areas, except the bleaching plant, are collected in underground pipelines and conveyed to the treatment plant by gravity.

The general effluent initially passes through a grit chamber and a screening system, going finally to a neutralization tank, which also receives the bleaching effluents. Neutralized effluent is fed to settling units for suspended solids removal. It is then cooled to 37° or 38°C in heat exchangers.

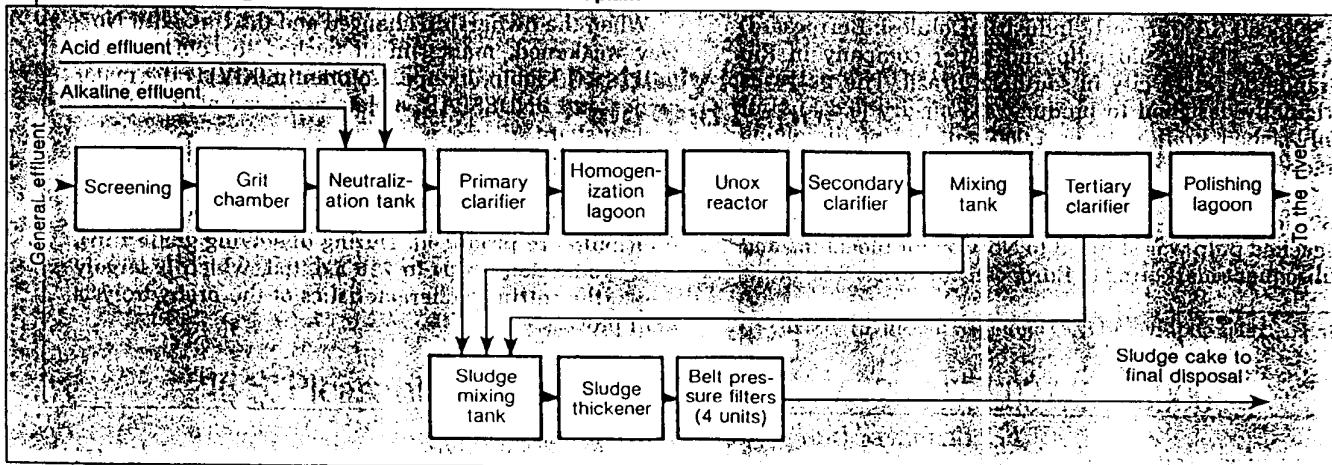
In the case that abnormal conditions occur, effluent is sent to an emergency lagoon and gradually put back into the system later. Effluent is then homogenized in a lagoon with surface aerators and finally pumped to the Unox reactor and secondary clarifiers. The Unox system is an activated sludge system that is largely based on the use of oxygen to promote the effective growth and action of microorganisms.

The biologically treated effluent is then sent for color removal, which is achieved by flocculation with aluminum sulphate addition, followed by sedimentation. Finally, effluent is neutralized with lime, put into a polishing lagoon, and discharged into the river through diffusers. Primary, secondary, and tertiary sludge is thickened and dewatered in belt pressure filters. The treatment system's overall efficiency is demonstrated in Table 1.

MILL INVESTMENT. Since the mill's early days, the company has invested \$45 million in environmental protection systems, 60% of which has gone toward wastewater treatment facilities. The effluent plant required a capital expenditure of \$20 million, and the operational cost is \$200/1,000 m³. The average flow is 35,000 m³/day.

An important research program aimed at converting sludge and other mill residues (grit, dregs, flyash, etc.) into organic fertilizer has already been started. The fertilizer generated by this process will supply part of the chemical nutrients to the 98,800 acres of forest owned by the company.

FIGURE 1: Flow diagram of Riocell SA effluent treatment plant



Advanced Waste Treatment System Removes Color, Suspended Solids

Brazilian paper and market pulp mill installs high-efficiency waste treatment plant before starting bleaching operation

By **CELSE FOELKEL**

Riocell SA (formerly Industria Celulose Borregaard) is a 16-year-old pulp and paper company in Rio Grande do Sul, a city in southern Brazil. The mill was originally designed to produce 793 air-dry (a.d.) tpd of unbleached kraft pulp or 1,080 a.d. tpd of dissolving grade pulp.

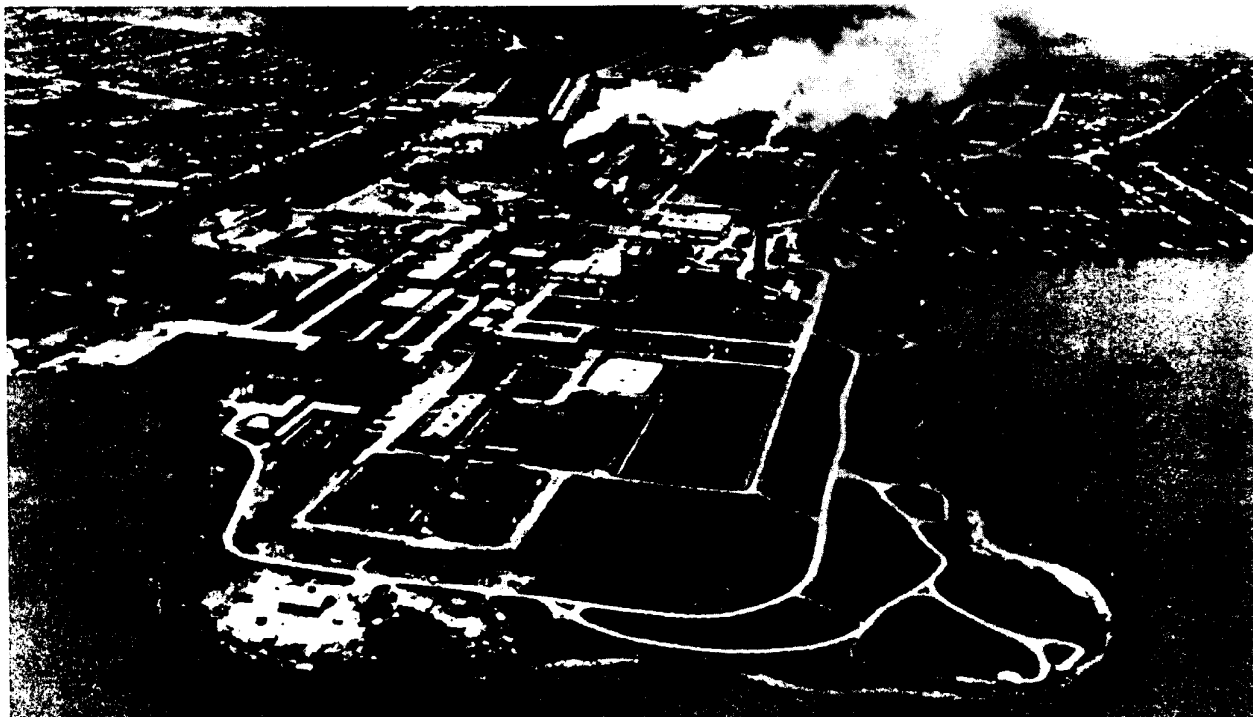
The raw wood material used at the Riocell mill is 75% eucalyptus and 25% acacia. Formerly, the unbleached pulp was shipped to Norway for bleaching and subsequent marketing in European countries. The mill's

eucalyptus pulp was among the first introduced into specialized, sophisticated markets that demanded high quality.

When the ownership changed and the link with Norway weakened, management pushed to complete the mill. Now, Klabin, Iochpe, Votorantin (KIV) is the major owner, and BNDESPAR, a state bank, maintains an important share.

Currently, 716 a.d. tpd of bleached market pulp, 132 tpd of printing and writing paper, 176 a.d. tpd of unbleached market pulp, and 77 a.d. tpd of a semichemical filler pulp are produced. During dissolving grade runs, total production drops to 716 a.d. tpd, which is largely due to the intrinsic characteristics of the prehydrolysis kraft process.

Mr. Foelkel is quality and R&D manager, Riocell SA, Brazil.



Riocell SA's mill in Brazil has one of the most complete effluent treatment systems in the world.

ENVIRONMENTAL TROUBLES. The mill is located near Pôrto Alegre, a city of 1.2 million inhabitants on the right bank of the Guaiba River (a kind of ecological heritage of the so-called "gaucho" people living in the state).

The mill had problems with environmental authorities and the population before the bleaching project took place, and the company image was seriously damaged at that time. Thus, special attention was paid to environmental concerns and the production process, and today the mill is a well-known example of pollution control efforts.

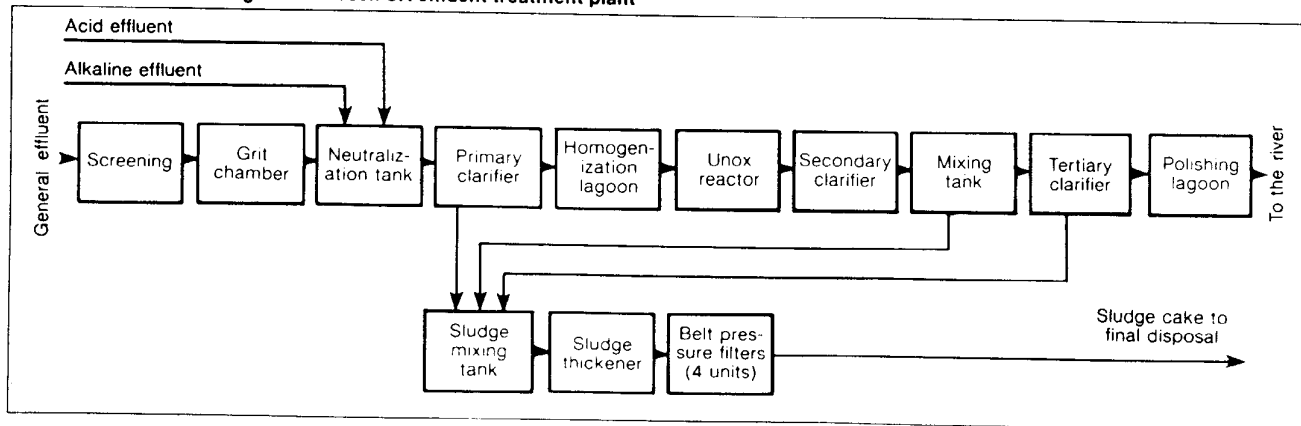
Jaakko Pöyry Oy, which has provided engineering for the mill since its inception, handled engineering and construction management for the recent environmental projects and the new bleach plant. The environmental concept behind the mill is to keep final residues to a minimum and recover losses in the mill areas where they are generated.

To do this, a losses recovery system was installed in 1980. When the bleaching plant started up in 1983, the new wastewater treatment plant, which had begun operating in 1982, was ready to receive effluents. Effluents were treated at a tertiary level using the best available technology and then discharged, "free of pollution," into the Guaiba River.

TABLE 1: Efficiency of waste treatment system at Riocell SA mill in Brazil.

Overall efficiency	
BOD ₅	98% to 99%
COD removal	91%
Suspended solids removal	97%
Color removal	90%
AOX	85%
Treated effluent characteristics	
Specific organic load	
kg BOD ₅ /a.d. ton	— 0.2 to 0.3
kg COD/a.d. ton	— 5.0 to 5.5
Suspended solids specific load	
kg SS/a.d. ton	— 0.4 to 0.5
Color specific load	
kg PtCo/a.d. ton	— 19 to 20
AOX	
kg/a.d. ton	— 0.15 to 0.20

FIGURE 1: Flow diagram of Riocell SA effluent treatment plant



TREATMENT SYSTEM. The effluent treatment system is illustrated in Figure 1. Effluents from various areas, except the bleaching plant, are collected in underground pipelines and conveyed to the treatment plant by gravity.

The general effluent initially passes through a grit chamber and a screening system, going finally to a neutralization tank, which also receives the bleaching effluents. Neutralized effluent is fed to settling units for suspended solids removal. It is then cooled to 37° or 38°C in heat exchangers.

In the case that abnormal conditions occur, effluent is sent to an emergency lagoon and gradually put back into the system later. Effluent is then homogenized in a lagoon with surface aerators and finally pumped to the Unox reactor and secondary clarifiers. The Unox system is an activated sludge system that is largely based on the use of oxygen to promote the effective growth and action of microorganisms.

The biologically treated effluent is then sent for color removal, which is achieved by flocculation with aluminum sulphate addition, followed by sedimentation. Finally, effluent is neutralized with lime, put into a polishing lagoon, and discharged into the river through diffusers. Primary, secondary, and tertiary sludge is thickened and dewatered in belt pressure filters. The treatment system's overall efficiency is demonstrated in Table 1.

MILL INVESTMENT. Since the mill's early days, the company has invested \$45 million in environmental protection systems, 60% of which has gone toward wastewater treatment facilities. The effluent plant required a capital expenditure of \$20 million, and the operational cost is \$200/1,000 m³. The average flow is 35,000 m³/day.

An important research program aimed at converting sludge and other mill residues (grit, dregs, flyash, etc.) into organic fertilizer has already been started. The fertilizer generated by this process will supply part of the chemical nutrients to the 98,800 acres of forest owned by the company. ■

CONTENTS

Foreword

vii

SECTION 1. Environmental Permitting and Planning

1. Greenfield Mill Site Permitting Can Take Years of Preparation	3
2. Tighter Environmental Regulations Will Alter Mill Process, Permits	8
3. Ten Tips for the Industry on How to Avoid Environmental Problems	16
4. Mills Considering New Deinking Line Must Answer Environmental Questions	18
5. Industry Must Address Emergency Chemical Spill Response Planning	23

SECTION 2. Advances in Effluent Technology

6. Industry's Effluent Problems Spawn New Engineering Technology, Design	29
7. Paper Industry on Right Track with Latest Effluent Control Strategies	36
8. End-of-Pipe Treatment Costs Can Be Minimized in Process Design Stage	39
9. Process Changes, Regulatory Knowledge Necessary to Meet Dioxin Challenge	42
10. Chlorinated Organics in Perspective: from Drinking Water to Mill Effluent	45
11. Dioxins and Furans: 0.013 Needles in About a Quadrillion Haystacks	48
12. Bleach Plant Modifications, Controls Help Industry Limit Dioxin Formation	51
13. Bleaching Alternatives Proliferate as Mills Meet Environmental Demands	58
14. H ₂ O ₂ -Enhanced Bleaching Strategy Cuts TOCl Levels in Mill Effluent	63
15. Bleach Plant Faces New Environmental Hurdle in Adsorbable Organic Halides	67
16. Tough Canadian Environmental Standards Being Met by Howe Sound	71
17. Process Modifications, End-of-Pipe Technologies Reduce Effluent Color	73
18. New Color Abatement Strategies Include End-of-Pipe Treatment	76
19. Mills Try New Bleaching, Washing Technology to Cut Effluent Color	80
20. Environmental Audit Can Help Mills Analyze Wastewater Treatment Needs	82
21. In-Plant Loss Control Holds Most Potential for Waste Treatment	86
22. Tighter Mill Effluent Regulations Make Anaerobic Option More Viable	90
23. Pope & Talbot's Halsey Mill Leads U.S. in Effluent Quality Improvement	93
24. Weyco Program Keeps Effluent Treatment System pH Under Control	96
25. Activated Sludge Treatment Gains Popularity for Improving Effluent	99
26. Advanced Waste Treatment System Removes Color, Suspended Solids	105
27. Floating Chains and Fine Bubbles Improve Lagoon Aeration Methods	107

28. Federal Maintains DO Compliance with Sidestream Oxygenation	109
29. Chinese Mill Reduces Sulfite Liquor Pollution with Spray Film Evaporator	112
30. Simpson Paper Switches to CO ₂ to Eliminate Deposits in Sewer Pipes	120
31. Storm Water Regulations Will Affect Mill Operating, Construction Plans	124
32. Anaerobic Treatment Allows Viable Handling of Bleached CTMP Effluent	126
33. PGW/CPGW Mills Report Low Effluent Loads, Reduced Steam Contamination	128

SECTION 3. Air Emission Control

34. New "Air Toxics" to be Next Emission Hurdle for North American Mills	135
35. Emissions Management Program Plays Major Role in Pollution Prevention	142
36. Tighter Sulfur Dioxide Regulations Spur Better Control Technologies	145
37. Tembec's Temiscaming Mill Invests \$14 Million to Limit SO ₂ Emissions	150
38. Equipment, Maintenance, Safety are Keys to Improved Odor Abatement	153
39. Electrostatic Precipitator Designs Evolve to Meet Tighter Regulations	156
40. Detector Tag Networks Can Identify Mill Site Sources of Hydrogen Sulfide	159
41. Scrubbing of Bleach Plant Gases Can Reduce Costs, Environmental Impact	162
42. Cleaning of Secondary Fiber Stickies May Necessitate Monitoring for VOCs	167

SECTION 4. Solid Waste Handling and Minimization

43. Proposed Regulations Could Change Mills' Solid Waste Disposal Plans	171
44. Mills Search for New Waste Disposal Methods as Landfill Policy Tightens	174
45. New Incineration Technologies Aid in Mills' Disposal of Solid Waste	177
46. New Technology Solves Permitting Problems for Landfill Expansion	180
47. Today's Competitive Mill Needs New Approaches to Sludge Management	186
48. Mill Cuts Sludge Drying Costs 25% with Low-Cost IR Moisture Analyzer	189
49. Ketchikan Pulp Reduces Transformer PCBs with Minimized Plant Downtime	191

Index	192
-------	-----

ENVIRONMENTAL SOLUTIONS

For the Pulp and Paper Industry

Edited by Kelly Ferguson

