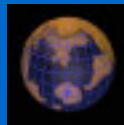# Optimization Study of Chemically Enhanced Primary Treatment

Riviera de Sao Lourenco, Brasil

Geo-CEPT

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What is CEPT?

- Chemically Enhanced Primary Treatment
  - Coagulant/flocculant usage prior to primary treatment
- Advantages
  - Reduction in cost and space
  - Increase in efficiency

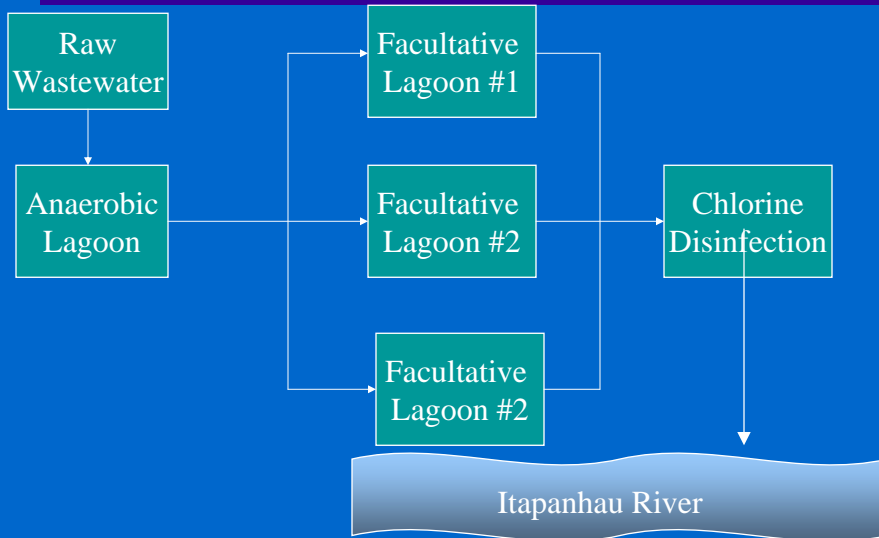| % Removal	CEPT	Conventional Primary
TSS	85	60
BOD5	65	30
N	30	30
P	85	30

Problem Statement

- Optimization of upgraded wastewater treatment system
- Focus on:
  - Bench-scale analysis
  - Full-scale analysis
  - Biosolids management
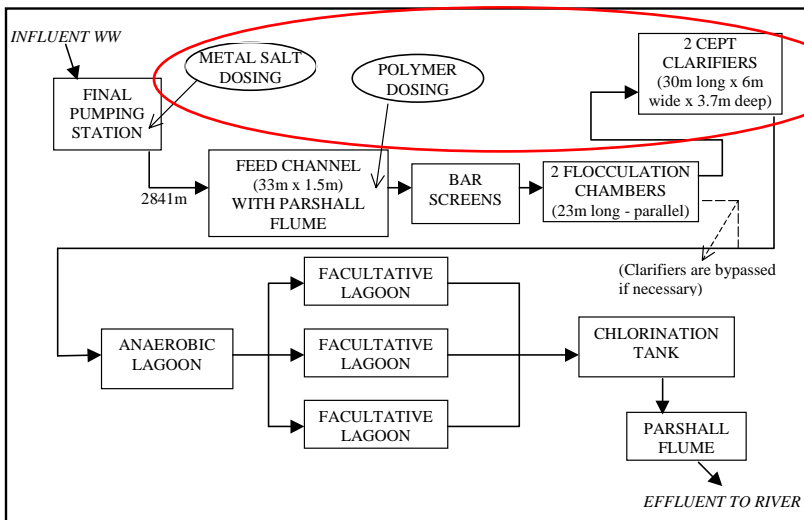 - Data management

Riviera de Sao Lourenco

- Beachfront resort along Atlantic Coast
- Large influx of people during summer
- Burdening of existing wastewater treatment system

Previous Train

Raw Wastewater → **Anaerobic Lagoon**

Facultative Lagoon #1

Facultative Lagoon #2

Facultative Lagoon #2

Chlorine Disinfection

Itapanhau River

CEPT Upgrade Schematic

INFLUENT WW

FINAL PUMPING STATION

METAL SALT DOSING

POLYMER DOSING

2 CEPT CLARIFIERS (30m long x 6m wide x 3.7m deep)

2841m

FEED CHANNEL (33m x 1.5m) WITH PARSHALL FLUME

BAR SCREENS

2 FLOCCULATION CHAMBERS (23m long - parallel)

(Clarifiers are bypassed if necessary)

ANAEROBIC LAGOON

FACULTATIVE LAGOON

FACULTATIVE LAGOON

FACULTATIVE LAGOON

CHLORINATION TANK

PARSHALL FLUME

EFFLUENT TO RIVER

Jar Tests

- Determine optimum operating conditions to improve removal efficiency
- Predicts functionality of a large-scale treatment operation
- Economical

Area of Focus

- Addition of different coagulants (ferric and ferrous salts, alum) or polymers (Nalco, GAC, Brazil)
- Variations in coagulant (0-50 mg/L) or polymer dosage (0-0.5 mg/L)
- Adjustments in mixing speeds and times
- Adjustments in settling times/overflow rates

Procedure

I. Mixing scheme

Step	Mixing Time (minutes)	Mixing Speed (rpm)
Coagulant Addition with Rapid Mixing	0.5	100
Polymer Addition with Rapid Mixing	0.5	100
Medium Mixing	2.5	70
Slow Mixing	2.5	30
Settling	5	0

II. Analysis of samples

A. COD Test

B. TSS Test

C. Visual Test

Optimal Combinations

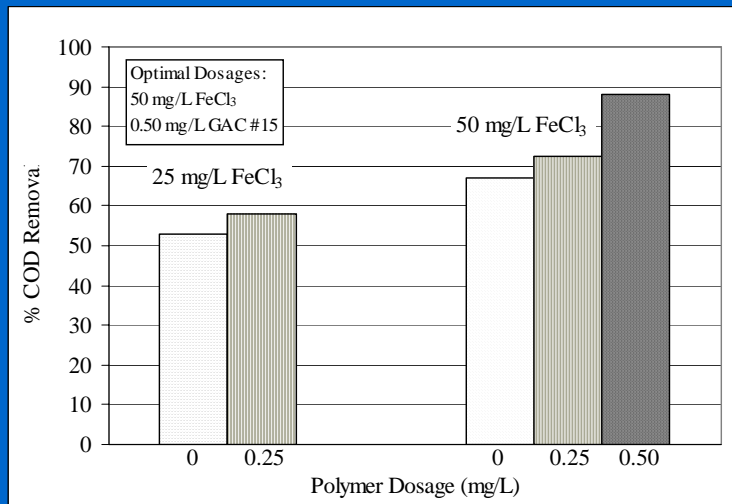| Plant	Optimal Coagulant	Polymer
Ipiranga	$FeCl_3$	Nalco #60540
Pinheiros	$FeClSO_4$	Nalco #2540
ETIG	$FeCl_3$	GAC #15
Riviera	$FeCl_3$	Nalco #4686
Tatui	$FeCl_3$	none

% COD Removal at ETIG
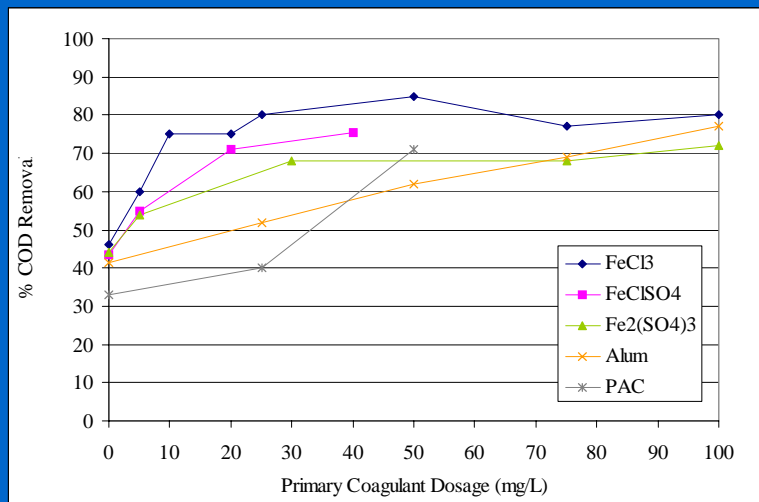
% TSS Removal at ETIG
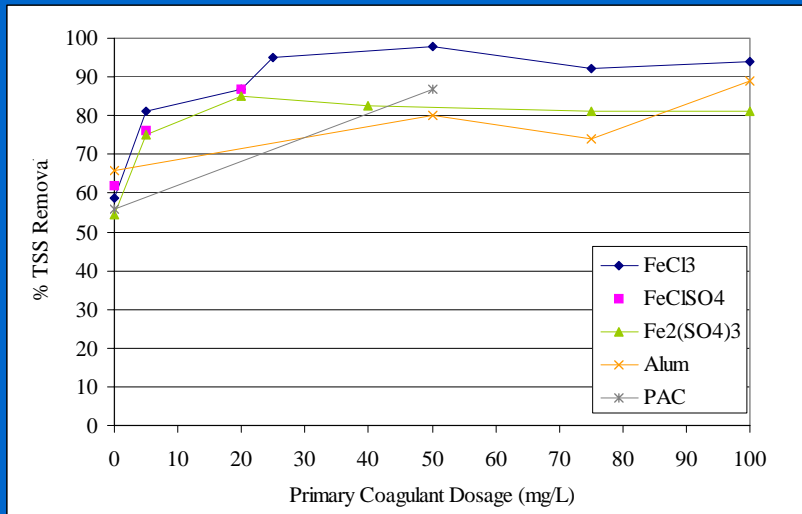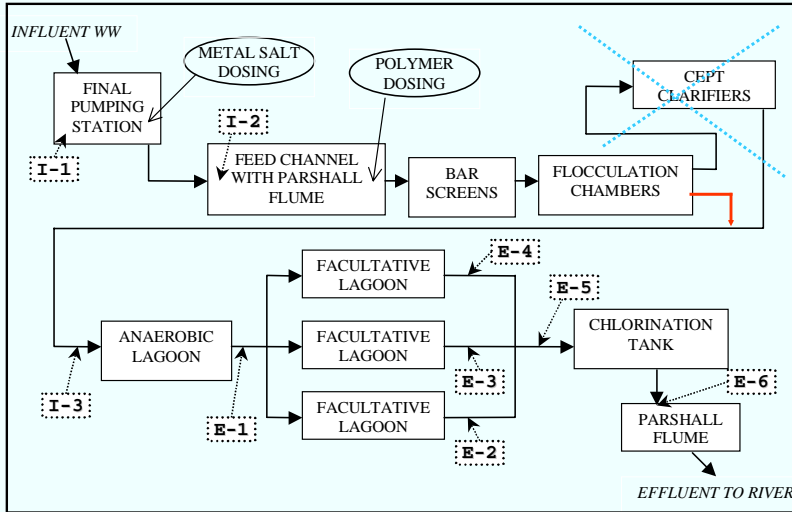

Polymer or No Polymer? (ETIG)

Full-Scale Testing

- Used to determine actual performance of CEPT system

- Why is it necessary to do full and bench-scale testing?

    - Numerous other factors in full System not in the lab (i.e. temp)

    - Cannot simulate a lagoon system (anaerobic) in the lab

    - Calibrate bench-scale testing with full-scale results

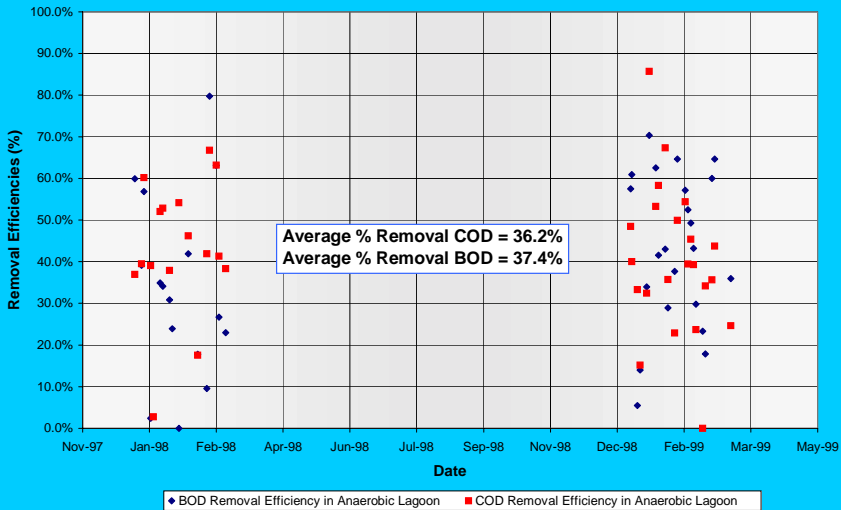   - Environmental compliance based upon full system results

System Design vs Real Life

- System design
    - Add two CEPT clarifier tanks prior to lagoons
    - Add metal salt (Ferric sulfate) at pump station
    - Add anionic polymer at Parshall flume

- Real life
    - Sludge scraper in the clarifier BROKE!
    - Diverted flow directly into lagoons, but still added chemicals
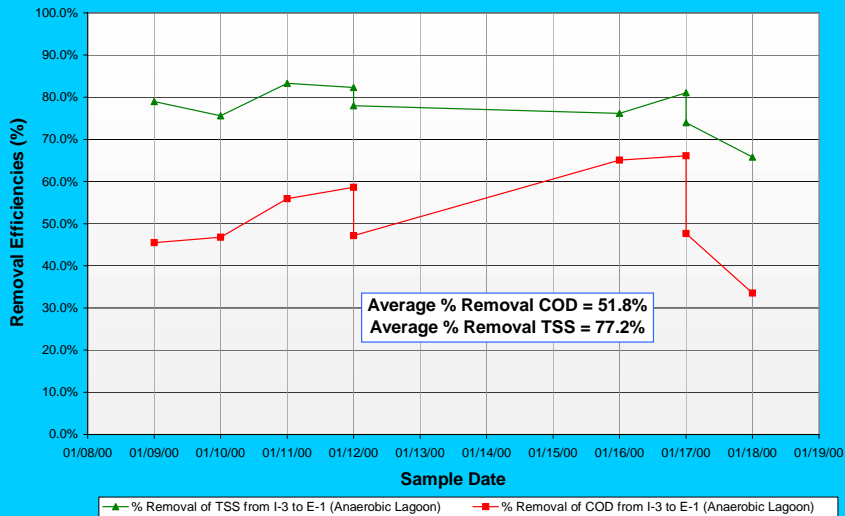   - Result: "In-Pond" CEPT (…at least for a while...)

Sampling and Testing

INFLUENT WW

METAL SALT DOSING

POLYMER DOSING

CEPT CLARIFIERS

FINAL PUMPING STATION

I-1

I-2

FEED CHANNEL WITH PARSHALL FLUME

BAR SCREENS

FLOCCULATION CHAMBERS

FACULTATIVE LAGOON

E-4

E-5

ANAEROBIC LAGOON

FACULTATIVE LAGOON

CHLORINATION TANK

I-3

E-1

FACULTATIVE LAGOON

E-3

E-6

E-2

PARSHALL FLUME

EFFLUENT TO RIVER

Anaerobic Lagoon Efficiencies Before CEPT in Summer Months

Average % Removal COD = 36.2%
Average % Removal BOD = 37.4%

Removal Efficiencies (%)

Date

◆ BOD Removal Efficiency in Anaerobic Lagoon   ■ COD Removal Efficiency in Anaerobic Lagoon

TSS and COD Removals in Anaerobic Lagoon During In-Pond CEPT

Average % Removal COD = 51.8%
Average % Removal TSS = 77.2%

Removal Efficiencies (%)

Sample Date

— % Removal of TSS from I-3 to E-1 (Anaerobic Lagoon) — % Removal of COD from I-3 to E-1 (Anaerobic Lagoon)

Full-Scale Summary

- COD efficiency increased from 36.2% to 51.8%
- TSS removal of 77.2%
  - Compare to 60% conventional primary and 85% for typical CEPT
- "In-Pond" CEPT is an even cheaper alternative that is currently being explored further
- CEPT has proven effective in other plants in Brasil, and around the world…so it is expected to be successful at Riviera as well!
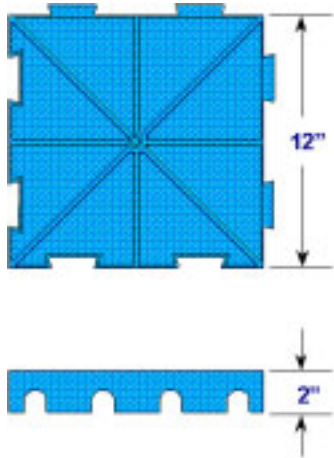
Sludge Handling at Riviera

➢ Purpose of the Study

➢ Brasil: Use of Sludge From Biological Treatment

Systems in Agricultural Areas

➢ Sludge Collection

- 2 sludge wells

- sludge pumps

- lime-dosing tank

- storage tank

Sludge Handling at Riviera (cont'd)

➢ Sludge Stabilization

- Lime Treatment
    - ✧ Bacteria Destruction
    - ✧ Odor Reduction

- USEPA Requirments to qualify for use for agricultural purposes
    - ✧ sufficient lime to raise pH of sludge > 12 after 2 hours of contact

Sludge Handling at Riviera (cont'd)

➤ low sludge production

➤ only operate for peak season

➤ **Sludge Dewatering**

　➤ Microwedge Dewatering Unit

　　• low capital and operating cost

　　• low/no energy cost

　　• ease of operation & maintenance

　　• ease of installation

Sludge Handling at Riviera (cont'd)

➤ Sludge Disposal/Reuse

• Temporary storage in the 2nd clarifier

• Next year: Construction of a sludge dewatering/drying lagoon using Microwedge

• To use the biosolids as fertilizer in a pilot study at Riviera

• Permit from the CETESB - the Brasilian environmental authority

Testing and Results

➢ 2 samples collected from the sludge wells

➢ pH

Change in pH of Lime-Stabilized Sludge
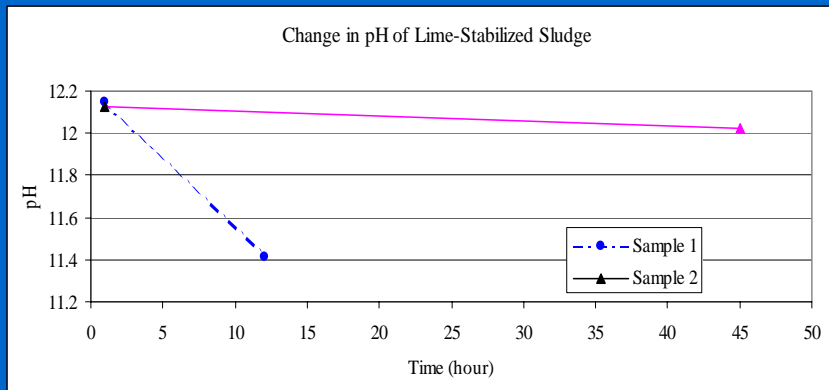
Testing and Results (cont'd)

➢ Dewatering

- Microwedge testing unit
- 10 L of CEPT sludge
- 2 hours after lime addition
- tested with cationic polymer

Testing and Results (cont'd)

➢ Solids content: 2% $\Rightarrow$ 10%

	No polymer	With polymer	1.5X Lime Dosage With polymer
Time required	87 hours	45 hours	24 hours

Testing and Results (cont'd)

➢ Coliform Analysis

- Multiple Tube Fermentation
- Raw Sludge
- Dewatered Sludge
- Amount of coliform decreases by 99%

Original Data Logging Scheme at Riviera