FGD
WASTE WATER TREATMENT

HOT TOPIC HOUR McILVAINE PRESENTATION

INFILCO DEGREMONT
HIGH-EFFICIENCY
FGD WASTEWATER TREATMENT

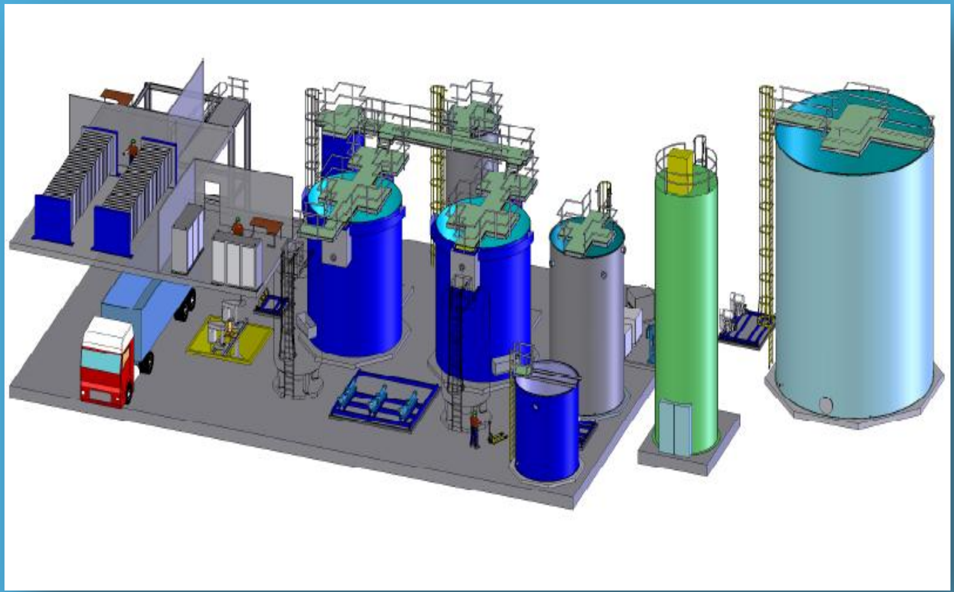
JUNE 16, 2011

Hot Topic Objectives

- ❖Who is Infilco Degremont (IDI)
- ❖Source of FGD Waste Water
- ❖Factors affecting the flow & the characteristics of FGD Waste Stream
- ❖FGD WW typical Characteristics
- ❖The Challenges
- ❖Treatment Design
  - Physical / Chemical
  - IX
  - Biological
- ❖Future of FGD WWTP

Who is Infilco Degremont Inc.

Infilco Degermont is one of the leading water and wastewater treatment plant in the world and part of the $45 billion Suez Group.



- **Over 100 years of US experience**
- **Over 500 US industrial lants**
- **45 FGD WWT Plants**
- **2,500 municipal wastewater plants**
- **3,000 drinking water plants**
- **"Infilcare" services capability**

117 Years of Service to US Industry and Municipalities

1894 — International Filter Co. started in Chicago, IL

1942 — International Filter Co. becomes Infilco Inc. (Relocated to Tucson)

1960 — GATX purchases Infilco Inc.

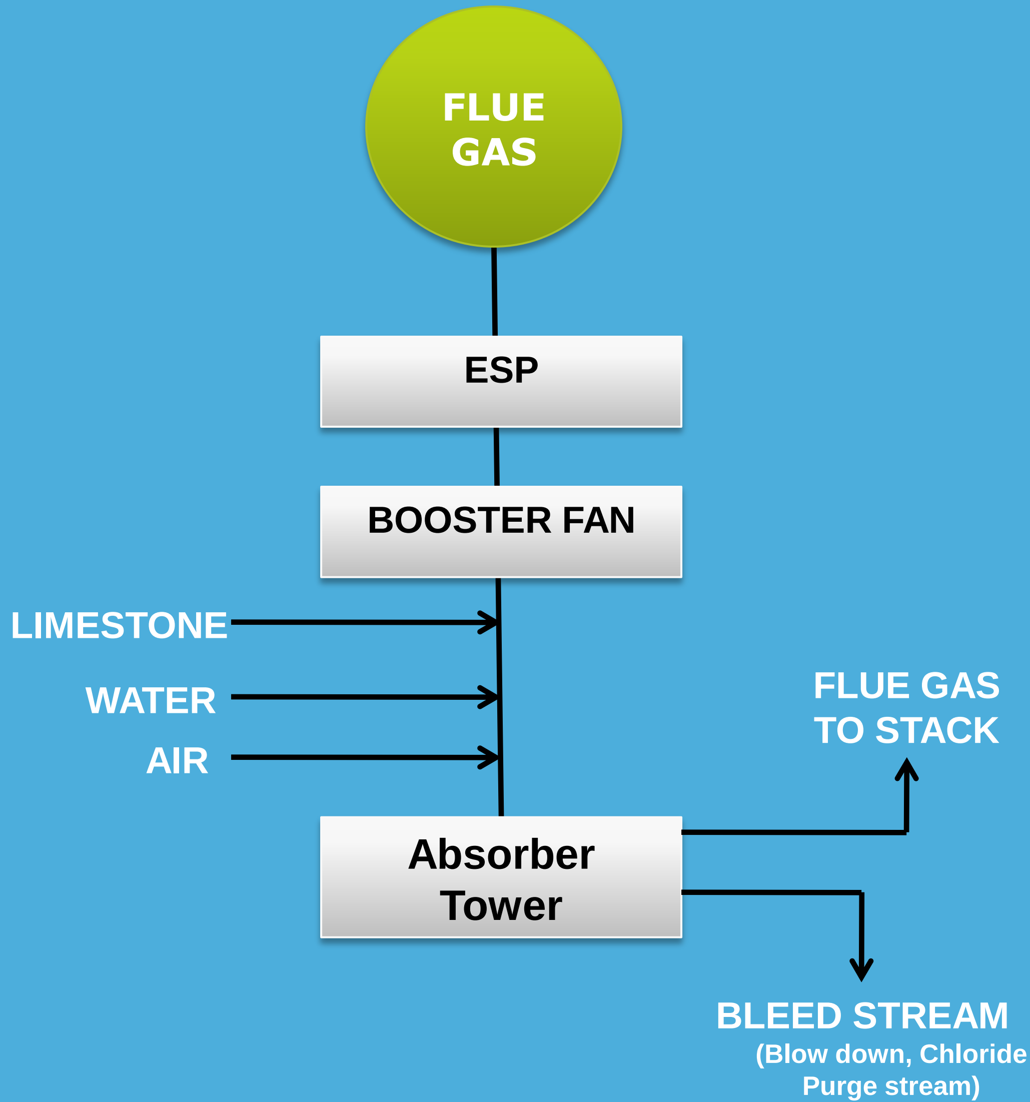
1970 — Westinghouse purchases Infilco Inc. (Relocate to Richmond)

1974 — Degremont acquires Infilco to form Infilco Degremont Inc

2007 — Degremont Technologies formed to consolidate North American Operations

2011 — Present leader in water and wastewater technologies

Source of FGD Waste Stream
FGD Block Diagram



Factors Affecting the FGD Waste Stream

- ❖Rate Capacity of the Absorber and the number of units
- ❖Design Chloride Characteristics of the Absorber Cycle Loop
- ❖Efficiency of Fly Ash Removal by the ESP (Electrostatic Precipitation)
- ❖Operational practices of the scrubber
- ❖Efficiency and type of the first & the secondary hydroclones
- ❖Type of FGD Process (Limestone, lime, caustic soda….)
- ❖Chemical Composition of Coal, Limestone, and Make-up Water

FGD Waste Water Characteristics

Design Impact Considerations

Parameters	Units	Typical Influent Dissolved Parameters (Range)	Typical Effluent Parameters
Total Suspended Solids (TSS)	mg/L	500 – 20,000	<10
Total Dissolved Solids (TDS)	mg/L	15,000 – 45,000	N/A
pH	Standard Units	4 – 6	6-9
COD	mg/L	200 – 500	N/A
Chloride (Cl)	mg/L	10,000 – 30,000	N/A
Ammonia (N-NH_4)	mg/L	20 – 60	3.0
Nitrate (N-NO_3)	mg/L	30 – 200	N/A
Sulfate (SO_4)	mg/L	3,000 – 5,000	N/A
Fluoride (F)	mg/L	10 – 50	10.0
Aluminum (Al)	mg/L	10 – 20	0.1
Arsenic (As)	mg/L	0.08 – 1	0.1
Boron (B)	mg/L	20 – 300	10
Cadmium (Cd)	mg/L	0.05 – 0.1	0.1
Calcium (Ca)	mg/L	300 – 10,000	N/A

* Filters are required

-Factor affecting equipment sizing

-Biological/IX treatment required

FGD Waste Water Characteristics

Design Impact Considerations

Parameters	Units	Typical Influent Dissolved Parameters (Range)	Typical Effluent Parameters
Chromium (Cr)	mg/L	1-3	0.1
Cobalt (Co)	mg/L	0.1-0.3	0.1
Copper (Cu)	Standard Units	4 – 6	6-9
Iron (Fe)	mg/L	2-5	0.5
Lead (Pb)	mg/L	2	0.5
Magnesium (Mg)	mg/L	200 – 4000	NA
Manganese (Mn)	mg/L	30 – 200	50
Mercury (Hg)	mg/L	1-3	0.001*
Nickel (Ni)	mg/L	1-2	0.2
Selenium (Se)	mg/L	0.08 – 0.8	0.1
Vanadium (V)	mg/L	1 – 3	3.0
Zinc (Zn)	mg/L	5-10	0.1
Sio_2	mg/L	50 – 300	N/A

* Filters are required

-Factor affecting equipment sizing

-Biological/IX/Evaporation treatment required

FGD Waste Water Characteristics

Design Impact Considerations for Dewatering

Parameter	Design Range
Flow (GPM)	75 – 400
Temperature ^{o}F	110 – 130
pH	5.5 – 6.5
TSS (mg/L)	<20,000
Chlorides (mg/L)	<30,000

TSS Make-up	Design Range
$CaSO_4$	40 – 60
$CaCO_3$	5 – 15
Flyash	5 – 15
Inerts	20 – 30
$Mg(OH)_2$, $MgCO_3$	0 – 10

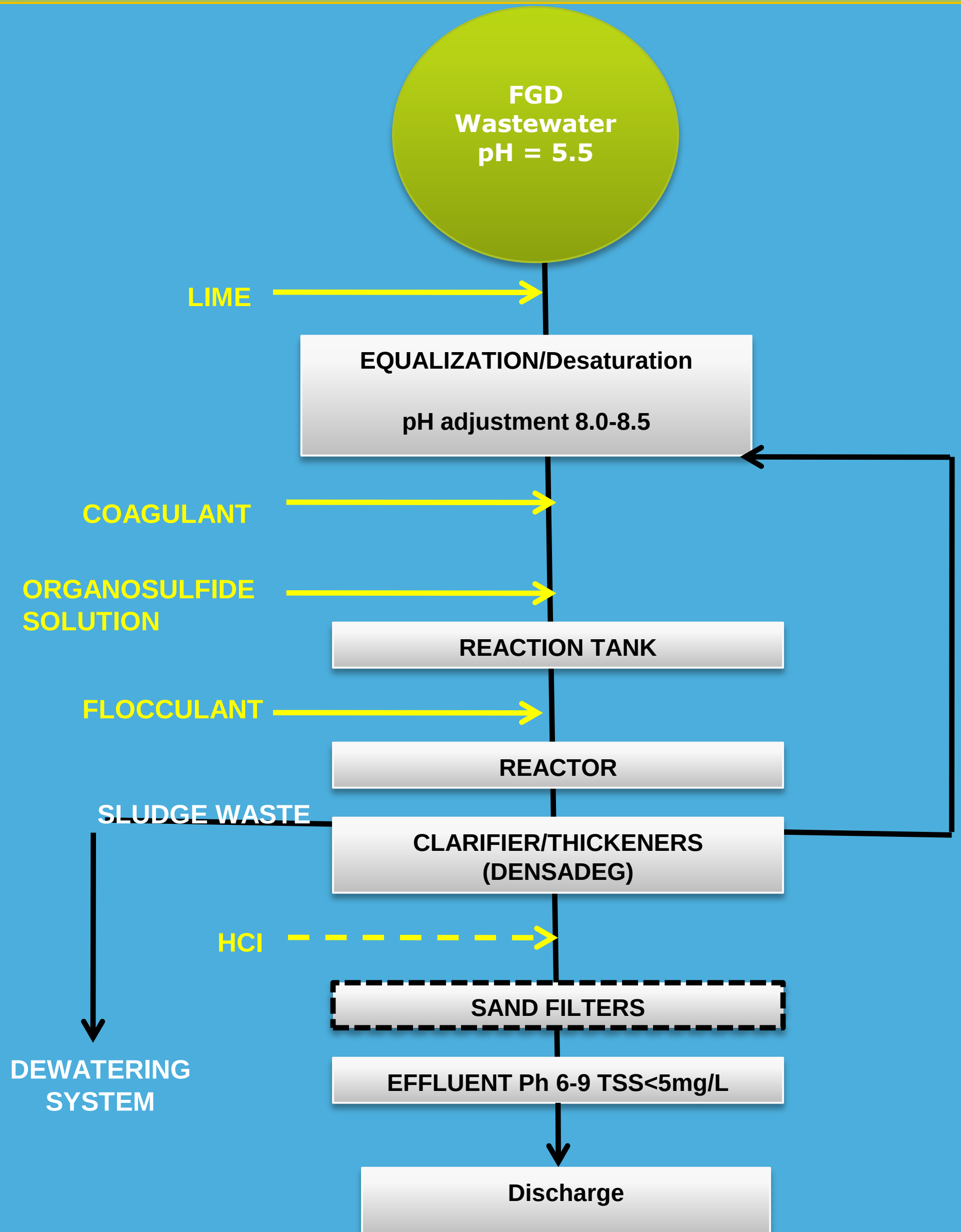
The Challenges

- ❖FGD wastewater treatment plants must be initially designed using assumed theoretical wastewater analyses.

- ❖Coal and limestone sources will change over time, and sometimes on the same day.

- ❖The design must incorporate high flexibility to accommodate the actual differing supply and operating conditions of the absorbers.

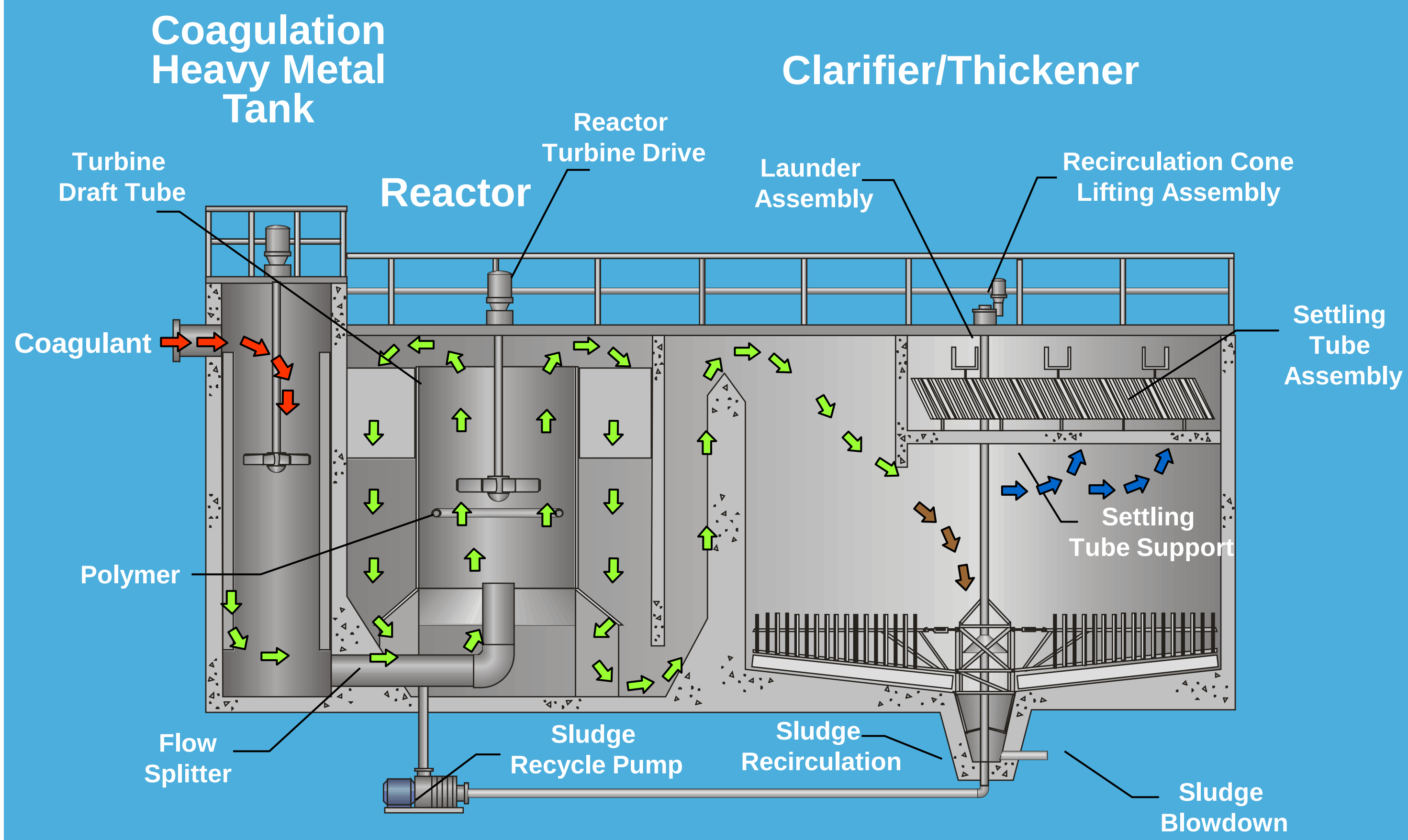
Typical FGD WWTP Block Diagram



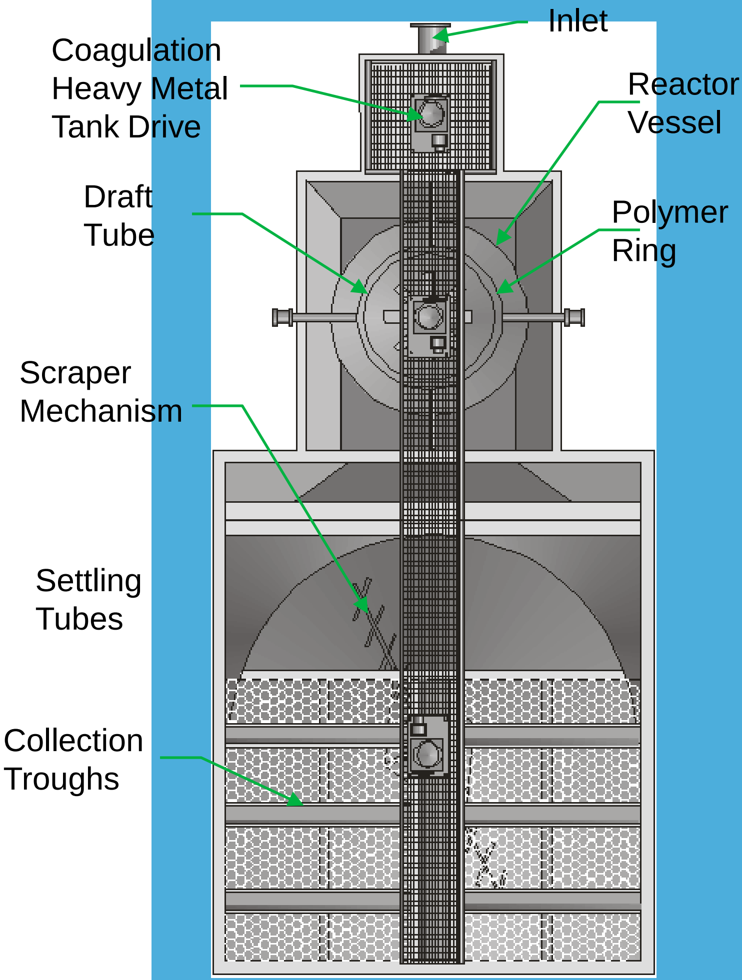
FGD Process Units

- Equalization
- Desaturation
- pH adjustment
- Coagulation
- Heavy Metal reaction tank
- Flocculation
- Clarification/Thickening
- Polishing
  - IX (Ion Exchange)
  - Biological
- Dewatering

Physical/Chemical Treament
Clarification/Thickening in One Tank
The "Heart" of IDI's Design

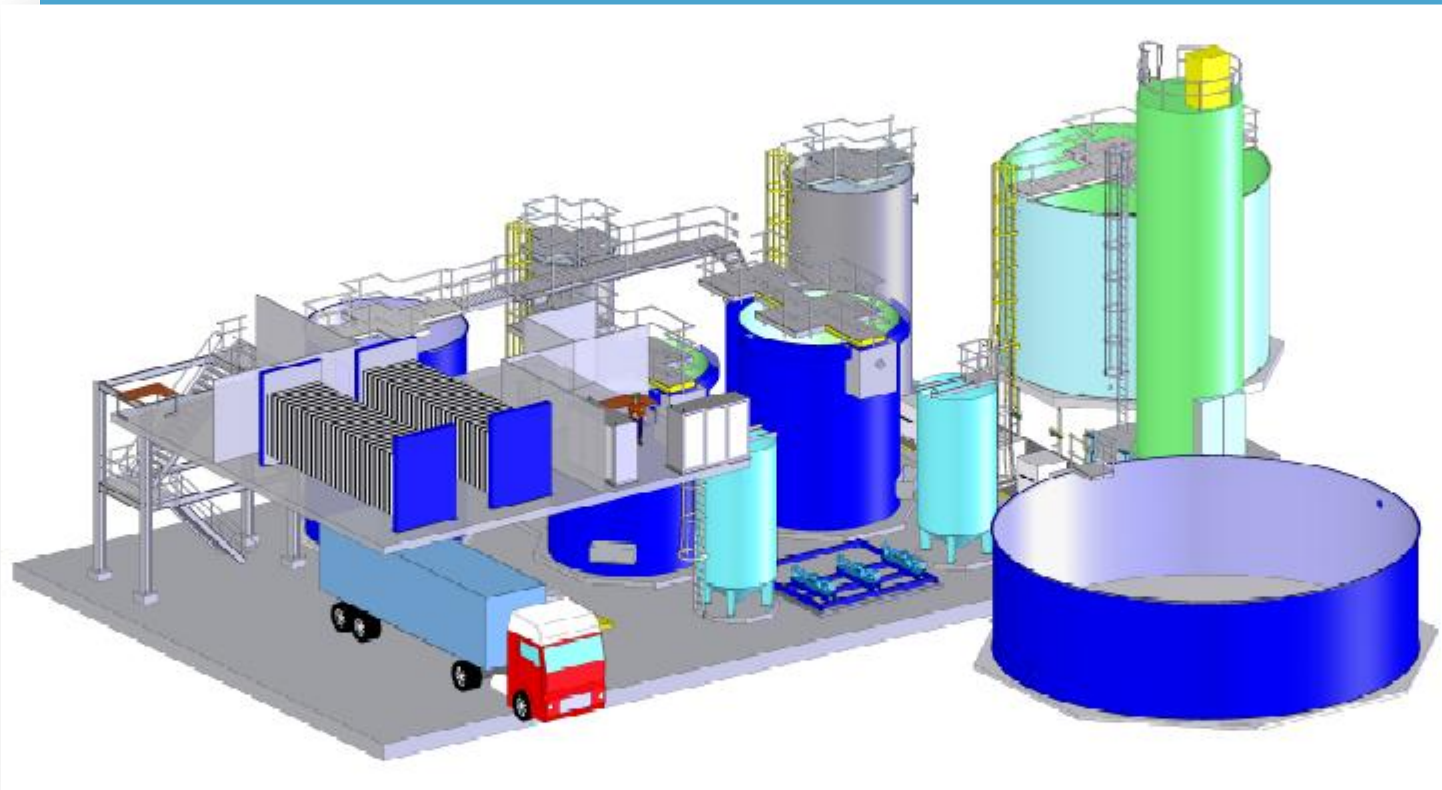


Design Principles of the DensaDeg



- **Rapid mix of coagulant and metal scavenger**
- **Polymer addition via a draft ring which increases efficiency of the flocculation**
- **Internal solids recirculation within reactor**
- **External sludge recycle back to reactor/or Desaturation tank**
- **Dense solids/clarified water separation up flow through tube settlers**

Typical WWTP 3D with Sand Filtration



Polishing with IX
Boron Removal from FGD Waste Stream

Boron can be removed from FGD Wastewater via two main processes

1. **Chemical Precipitation**

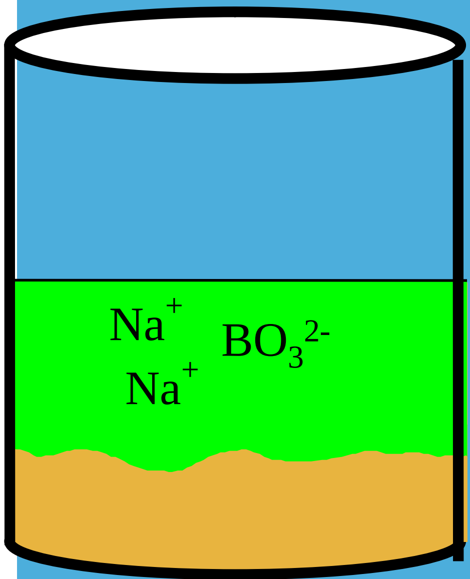
2. **Ion Exchange Concentration with final removal via:**

   a. **Crystallizer**

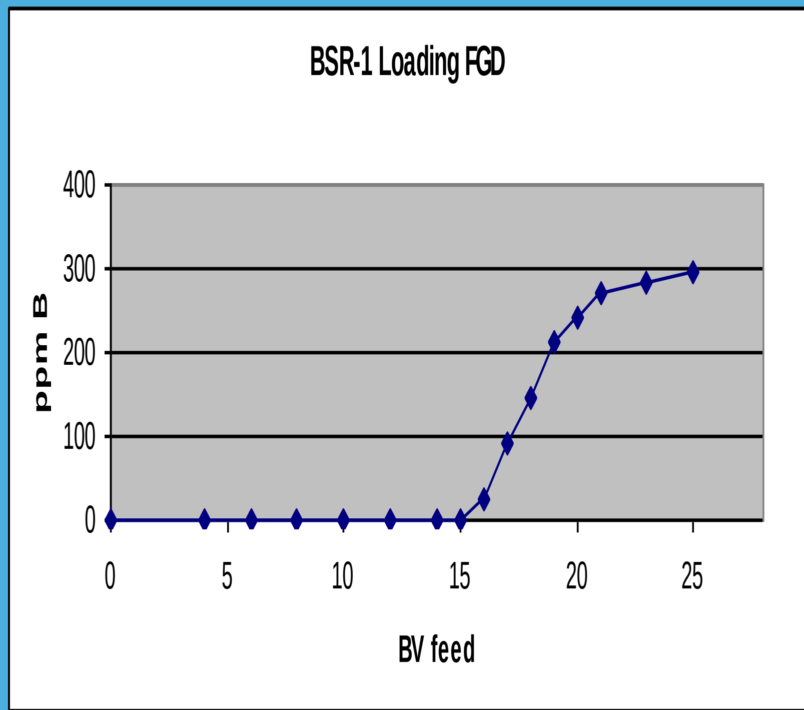
   b. **Chemical Precipitation**

iX™ Boron Removal Standard Steps in IX Operation Loading – Single Unit

Selective IX Resin removes Boron to <5 ppm in FGD Wastewater



FGD Wastewater



Boron Removal

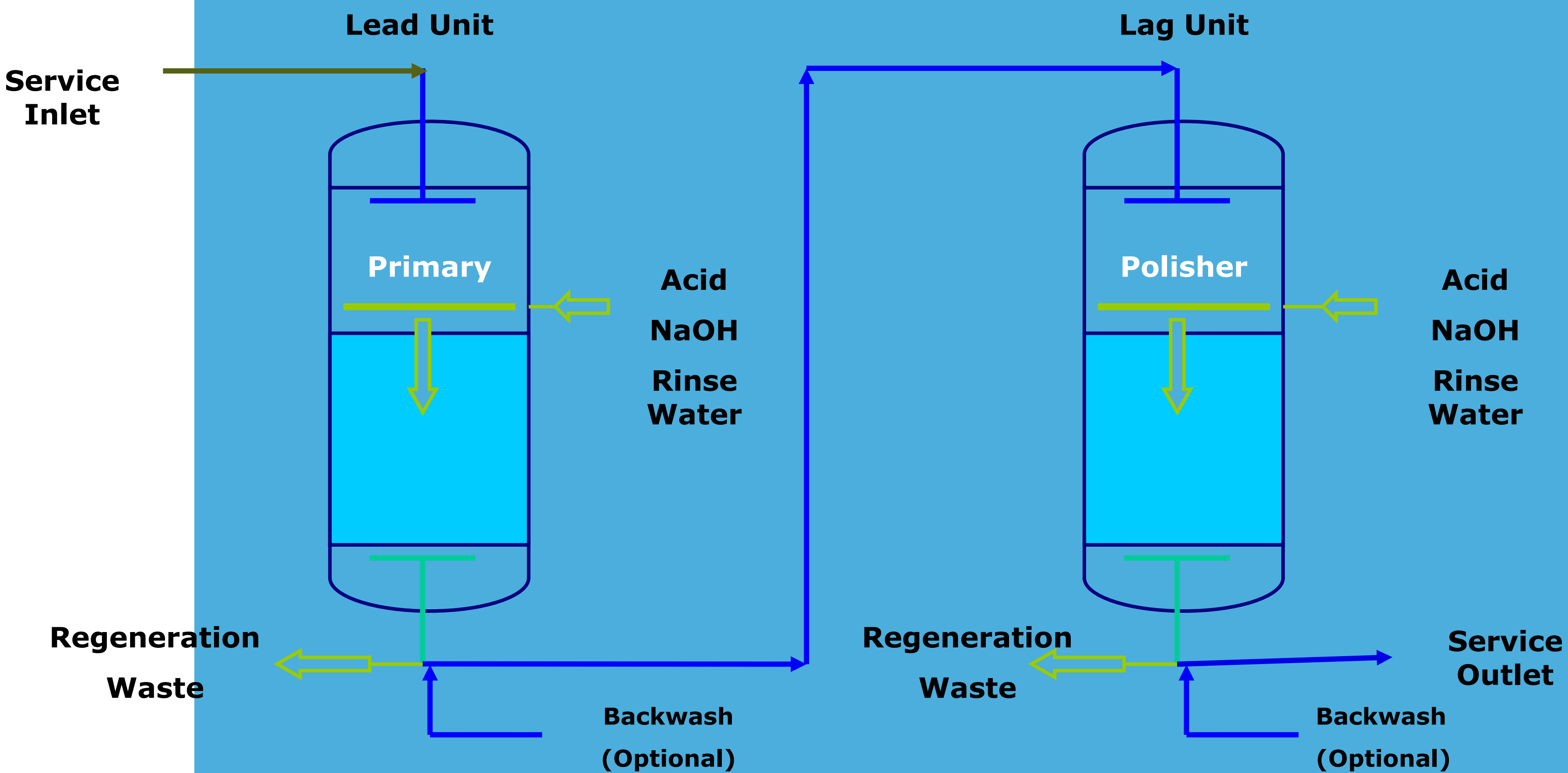
iX^{TM} System is based on a Selective IX Resin that is effective in the removal of borate from FGD Wastewater.

The process relies on the selective removal of Brate from the FGD wastewater, which results in a concentrated waste stream that can be more easily treated.

The IX process has the following advantages:

1. Concentrated waste stream
2. Small waste volume
3. Lower operating cost
4. Able to handle swings in Borate concentration in the wastewater very easily.
5. Operation cost directly correlates to Borate concentration

iX™ Boron Removal Process
Standard Steps in IX Operation Lead -Lag Concept



Boron Elution

- Sulfuric Acid (H_2SO_4) is used to elute the Borate off IX Resin

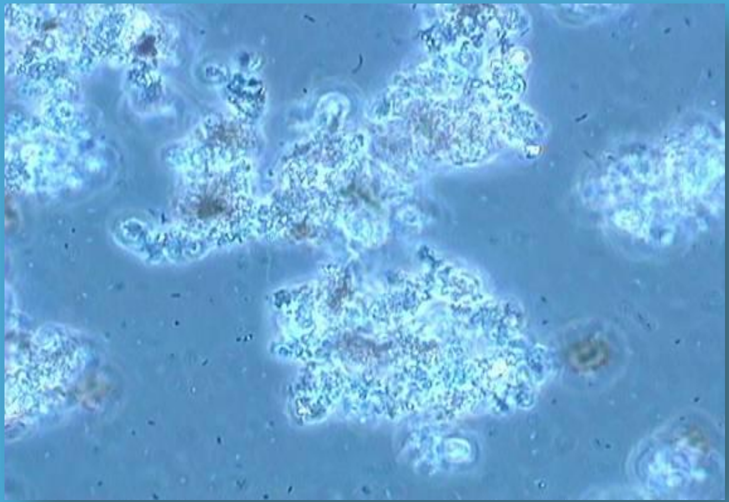
- The concentrated Boron recovery step takes normally 1.33 Bed Volumes of 5% H_2SO_4 solution.

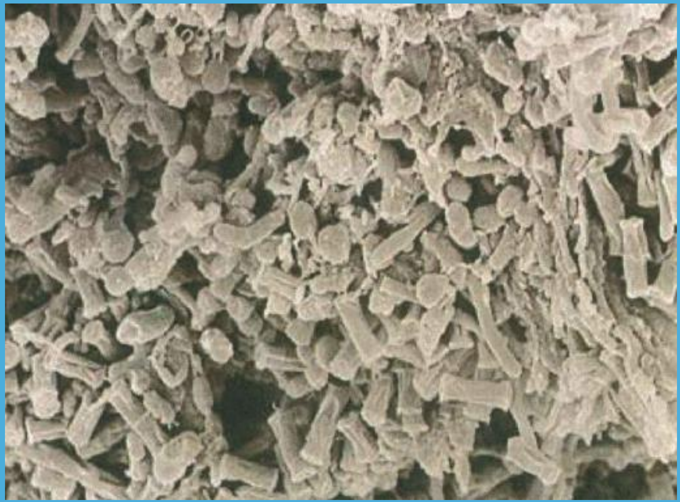
- Boron elution precedes and overlaps with H^+ elution

- The concentrate acid regenerate stream normally contains between 4,000 to 8,000 ppm of Boron

Biological Treatment
Selenium Removal Treatment iBio

The removal of oxy-anions of Selenium (Selenate and Selenite) are based on the biological reduction of selenium, via Sulfate Reducing Bacteria (SRB)and Denitrification Bacteria, to non-toxic elemental Selenium.





Reactor Configuration

iBIO®

- Suspended growth activated sludge system
- Continuous Stirred Tank Reactor
- Allows for minimum impact of wastewater transients (e.g., influent TSS).
- Decouples the two stages of bacterial activity and allows for independent optimization of the "denitrification" and "selenium reduction" steps.

iBIO® Microbial Activity

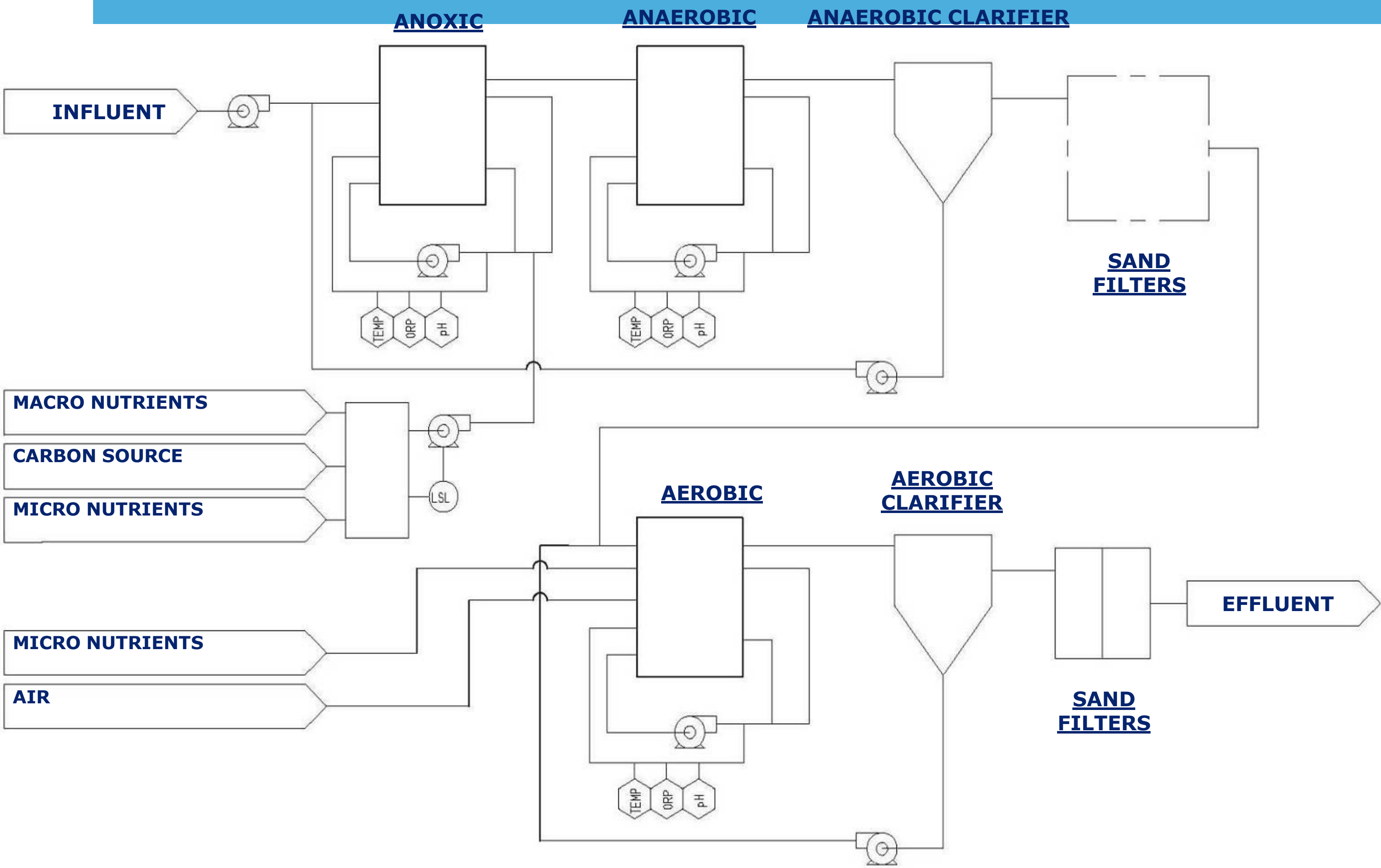
Denitrification

- Conversion of nitrates (NO_3) to nitrogen gas (N_2)
- Nitrates (NO_3) + Organics + Heterotrophic Bacteria = Nitrogen Gas + Oxygen + Alkalinity

Selenium Reduction Process

- Selenates/Selenites + Organics + Sulfur Reducing Bacteria = Reduced Elemental Selenium

iBIO® Process Schematic



Conemaugh Generating Station

Future of FGD Treatment Plants

- Coal fired plants provide – 50% of USA electricity and they remain a mainstay for electricity throughout the world

- 150 FGD projects had been scheduled in the USA within 2008 – 2010

- Some are retrofits others are new

- Approximately 80% of new scrubbers will use wet – limestone technology

- Reliability and abundance of limestone

suez environnement Degrémont

THANK YOU!

Questions

and

Comments

are Welcome