

BIOTEQ

ENVIRONMENTAL TECHNOLOGIES INC.

Case Studies of Sustainable Water Treatment Solutions for Acid Rock Drainage



Award for Excellence
in Sustainable
Development



2009 WINNER
CANADA EXPORT
ACHIEVEMENT
AWARDS

Canada Export
Achievement Award



MACLEAN'S

Canada's Top 50 Most
Socially Responsible
Corporations

PDAC2009
PROGRESS & DEVELOPMENT ASSOCIATION OF CANADA

Environmental and
Social Responsibility
Award

CHINA MINING
中国国际矿业大会

Environmental
Protection Award



THE GLOBE AND MAIL

Environmental
Excellence Award



Presentation Outline



- Background about Bioteq
- Water treatment technologies
 - Metal recovery
 - Sulphate removal
- Case studies
 - Water quality
 - Life cycle costs
 - Profits from waste



BioteQ Environmental Technologies



- BioteQ specializes in wastewater treatment to remove or recover dissolved metals and/or sulphate in mining, power generation, and oil & gas operations
- We convert wastewater into a useful resource, producing saleable by-products and clean water for re-use or recycle
- We reduce or eliminate sludge, and the associated environmental liability
- We have been in commercial production since 2001



Established Customers



We work with the world's leading resource companies, utility operators, and regulators:

Xstrata
Barrick
Vale Inco
Cameco
Newalta

Jiangxi Copper
Freeport-McMoRan
Capstone Mining
Teck Corp.
EPCOR

Aditya Birla
Koza Gold
Breakwater
EcoMetales
US EPA

Strategic alliances:

Newalta

Lanxess

EcoMetales



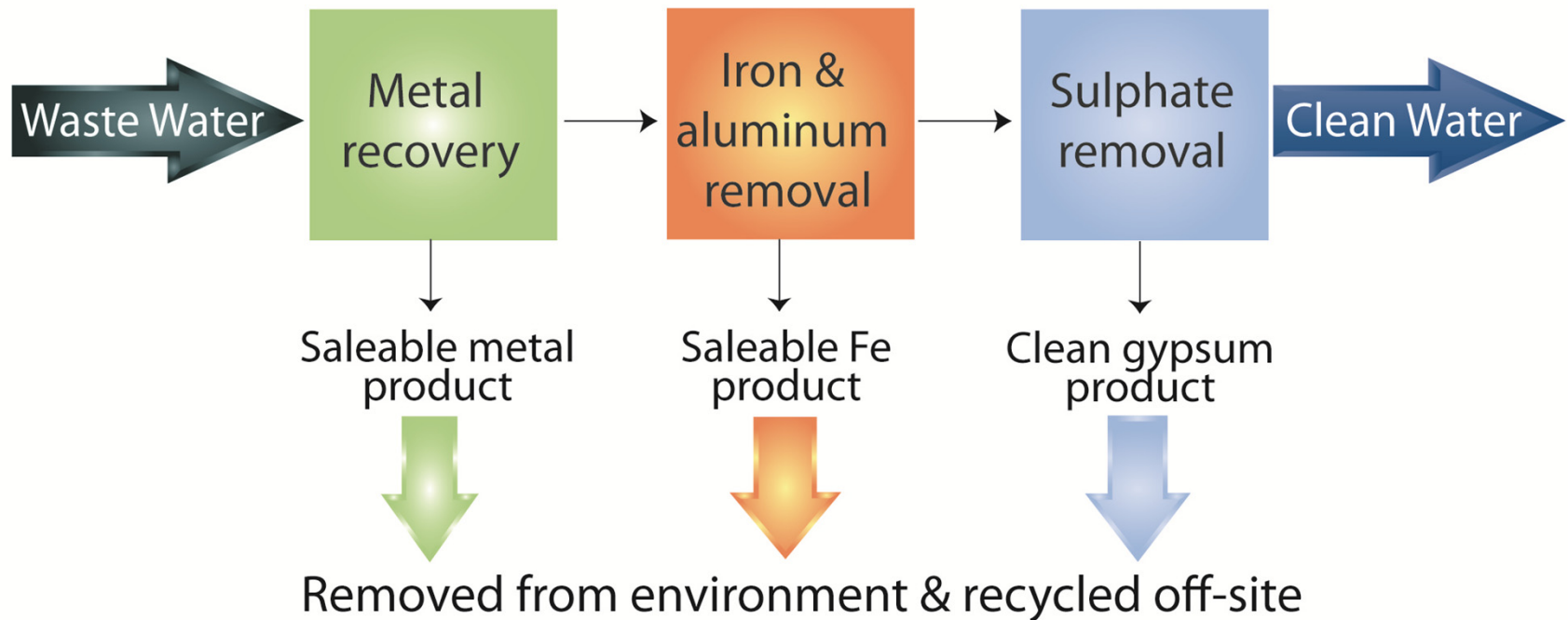
Drivers for mine water treatment



- Reduce environmental liability, comply with regulations
- Improve water conservation and re-use because of scarce water resources
- Reduce life cycle costs of water treatment by applying lower cost alternatives and generating revenue from recovered by-products



“Total Resource Recovery”





BioteQ's water treatment technologies

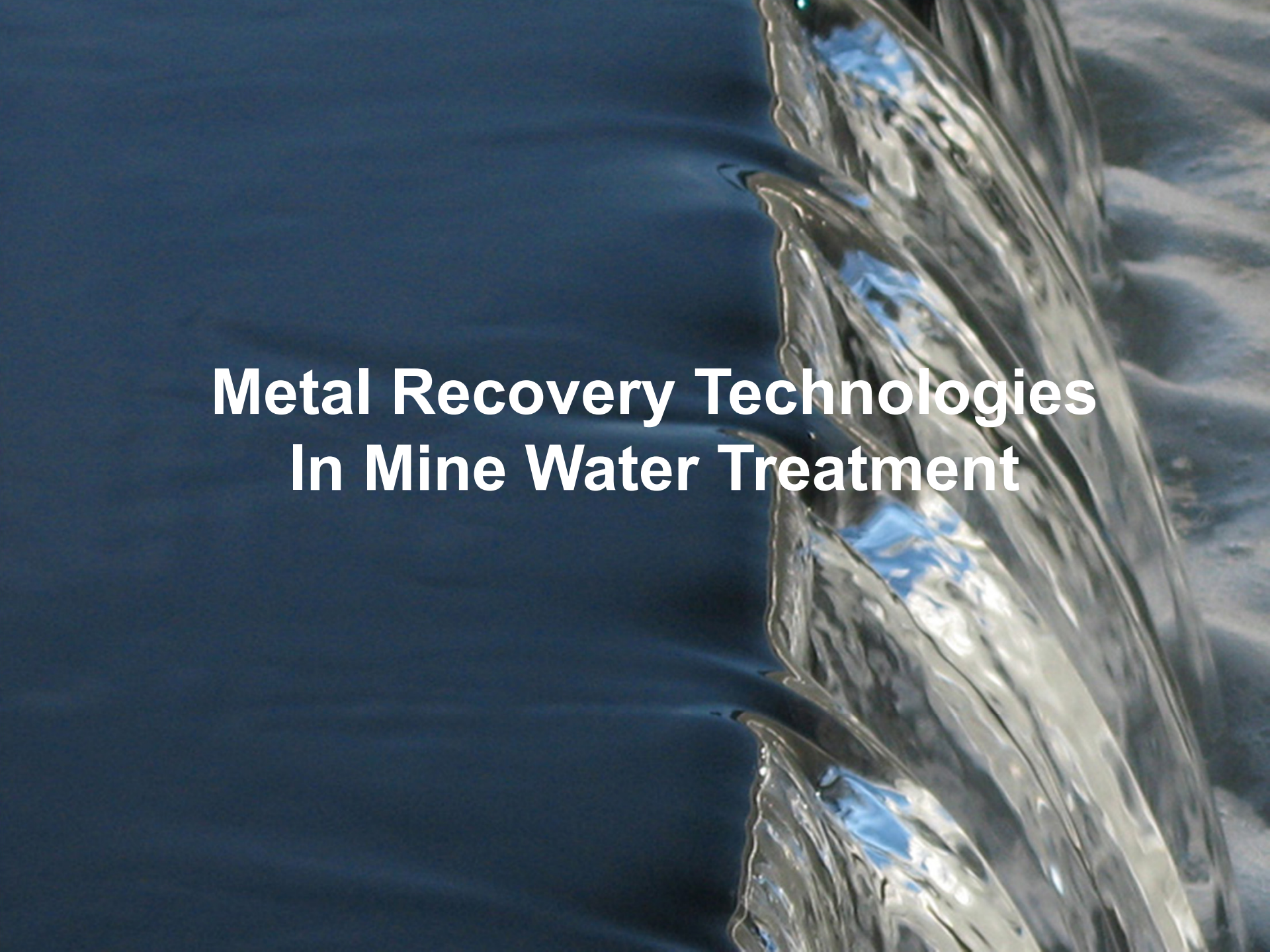


➤ Sulphide precipitation technologies

- Selectively recover dissolved metals:
(Cu, Ni, Zn, Co, Cd, Pb, Hg, As, Sb, Mn)

➤ Ion exchange technologies

- Sulphate removal
- Iron and aluminum recovery
- Specialty metal recovery
(Co, Ni, Mo, Re, Si, Ba, St, Se)

A close-up, high-speed photograph of water splashing, creating a dynamic, textured background with bright highlights and deep shadows. The water is captured in mid-air, forming a series of overlapping, translucent layers that catch the light.

Metal Recovery Technologies In Mine Water Treatment



Sulphide Precipitation Technologies



BioSulphide® , ChemSulphide ®

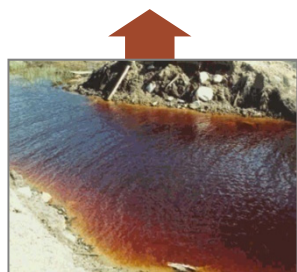
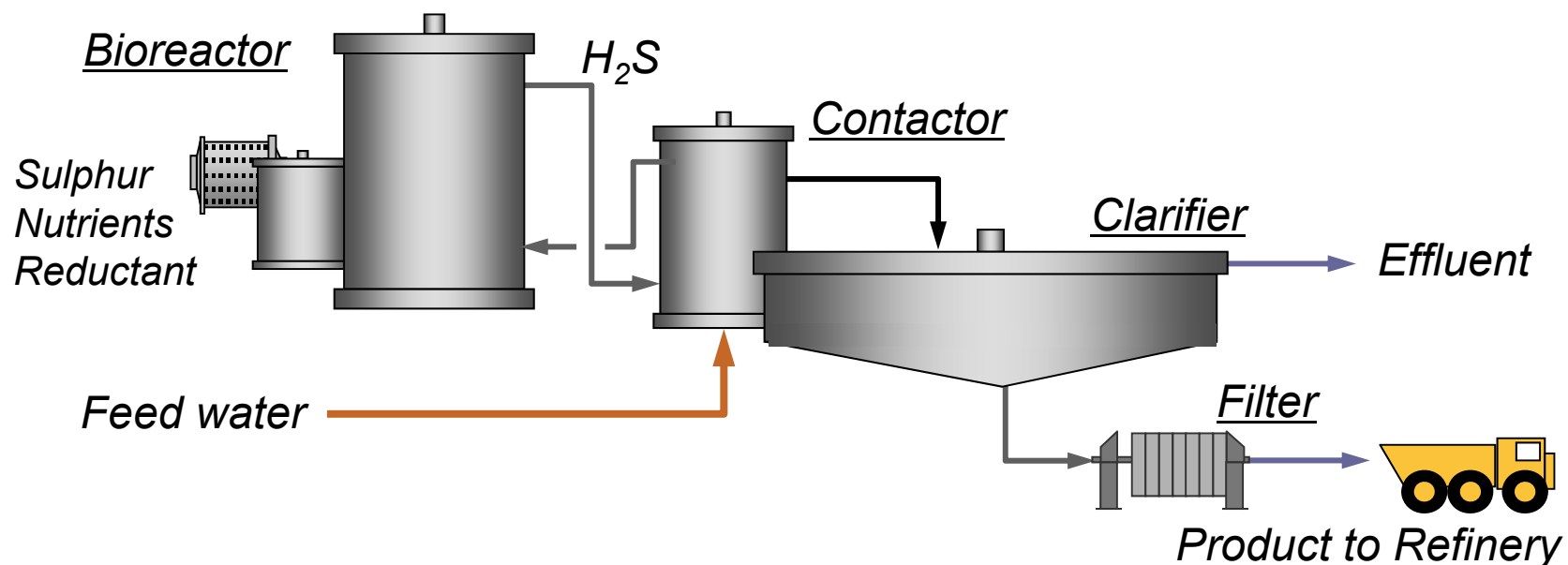
- Selectively recover dissolved metals from wastewater
- Cu, Ni, Zn, Co, Cd, Pb, Hg, As, Sb, Mn
- Produces clean water for recycle or discharge
- No sludge product for disposal
- Lower life cycle costs

BioSART™

- Gold applications -- metal recovery and cyanide regeneration



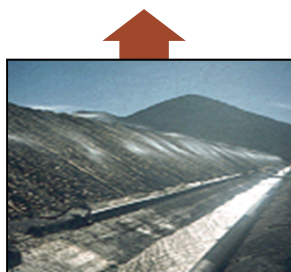
Sulphide process for metal recovery



Acid
drainage



Mine
water



Leach
solutions



Ground-
water



Bleed
streams



Benefits of sulphide metal recovery



- Reduces or eliminates waste sludge
- Reduces long-term liabilities
- Lowers life cycle cost of water treatment
 - Lower capital and operating costs
 - Generates revenue from metal by-products
- Produces clean water that meets strict water quality criteria for discharge or re-use
- Can be integrated with existing lime plants

A photograph of a large-scale open-pit mine. The mine's walls are composed of reddish-brown rock, showing distinct horizontal terracing or benching. In the foreground, a calm, brownish reservoir reflects the sky. To the right, a steep, rocky embankment slopes down towards the water, with a long, dark pipe or hose running along its edge. The sky is a clear, bright blue.

Case Studies



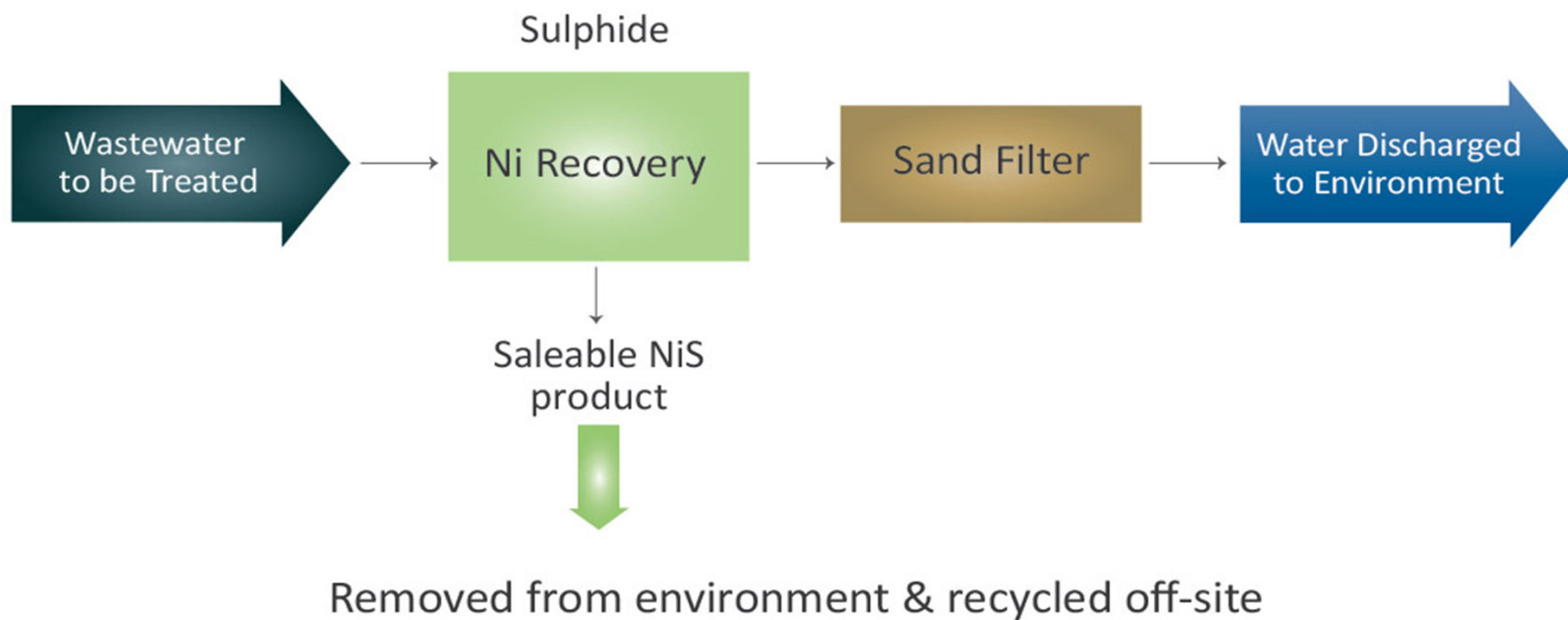
Case study 1: Raglan ChemSulphide® plant



- Build-own-operate project for Xstrata Nickel at an active nickel mine
- Plant operating since 2005
- Capital cost = Cdn \$1.8 million (2005)
- 240 m³/hr (1,050 usgpm) capacity
- Recovers saleable nickel sulphide from mine run-off, produces no sludge
- Discharge directly to receiving environment



Raglan Flowsheet





Raglan Water Chemistry

Parameter	Feed Chemistry	Effluent Targets	Actual Results
pH	6.4 to 8.0	6.0 to 9.5	7 to 8
Nickel	13 to 30 mg/L	0.50 mg/L	<0.25 mg/L
Total suspended solids	Variable	15 mg/L	< 1 mg/L

Project goal: comply with strict water quality regulations



Raglan results – compared to lime

	Sulphide	Lime
Plant capacity (max)	240 m ³ /hr	240 m ³ /hr
Sludge volume (avg flow)	0	1.7 million liters / yr
Saleable nickel	~20,000 lbs / yr	0

Eliminates sludge, recovers saleable metal by-product



10 Year NPV of Life Cycle Costs - Raglan

Cost	Sulphide	HDS Lime + Ferric
Project Development	similar	similar
Capital Cost (plant)	\$1,700,000	\$2,500,000
Operating Costs:		
Fixed Costs	\$6,034,000	\$6,034,000
Variable Costs	\$1,152,000	\$2,087,000
Environmental Liability (sludge disposal)	0	?
Total Costs (NPV 10yr)	\$8,886,000	\$10,621,000
Less: Revenues	\$1,402,000	0
Net Life Cycle Costs	\$7,485,000	\$10,621,000

*Note: discount rate = 3%



Case study 2 – Wellington Oro, CO



- BioteQ's ChemSulphide® process reviewed & accepted by US EPA
- Closed silver-zinc mine that produces ARD
- Plant commissioned December 2008
- Capacity = 150 usgpm
- Produces a saleable zinc-cadmium sulphide and clean water for discharge



Wellington Oro Water Chemistry

Parameter	Feed Chemistry	Effluent Targets	Actual Results
pH	6.19	6.5 to 9.0	6.65
Cadmium	0.112 mg/L	0.004 mg/L	<0.0005 mg/L
Zinc	270 mg/L	0.225 mg/L	<0.05 mg/L

Project goal: comply with strict water quality regulations



Wellington Oro results – compared to lime

Sulphide

Lime

Plant capacity (max)

150 gpm

150 gpm

Sludge volume (avg flow)

0

390,000 gal/yr

Saleable zinc

178,000 lb/yr

0

55% Zn dwb

30% moisture, friable
cake

**Eliminates sludge,
recovers saleable
metal by-product**





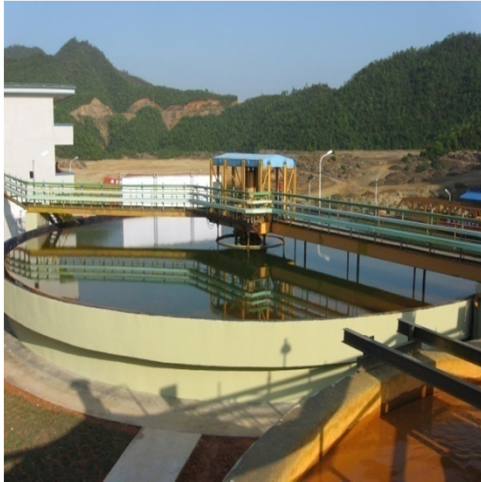
10 Year NPV of Life Cycle Costs – Wellington

Cost	Sulphide	HDS Lime
Project Development	\$330,000	\$330,000
Capital Cost	\$1,650,000	\$2,525,000
Operating Costs: Labour, power Reagents	\$495,000 \$415,000	\$495,000 \$370,000
Environmental Liability (sludge disposal)	0	\$1,838,000
Total Costs	\$2,890,000	\$5,558,000
Less: Revenues	(\$85,000)	0
Net Life Cycle Costs*	\$2,805,000	\$5,558,000

*Note: discount rate = 3%



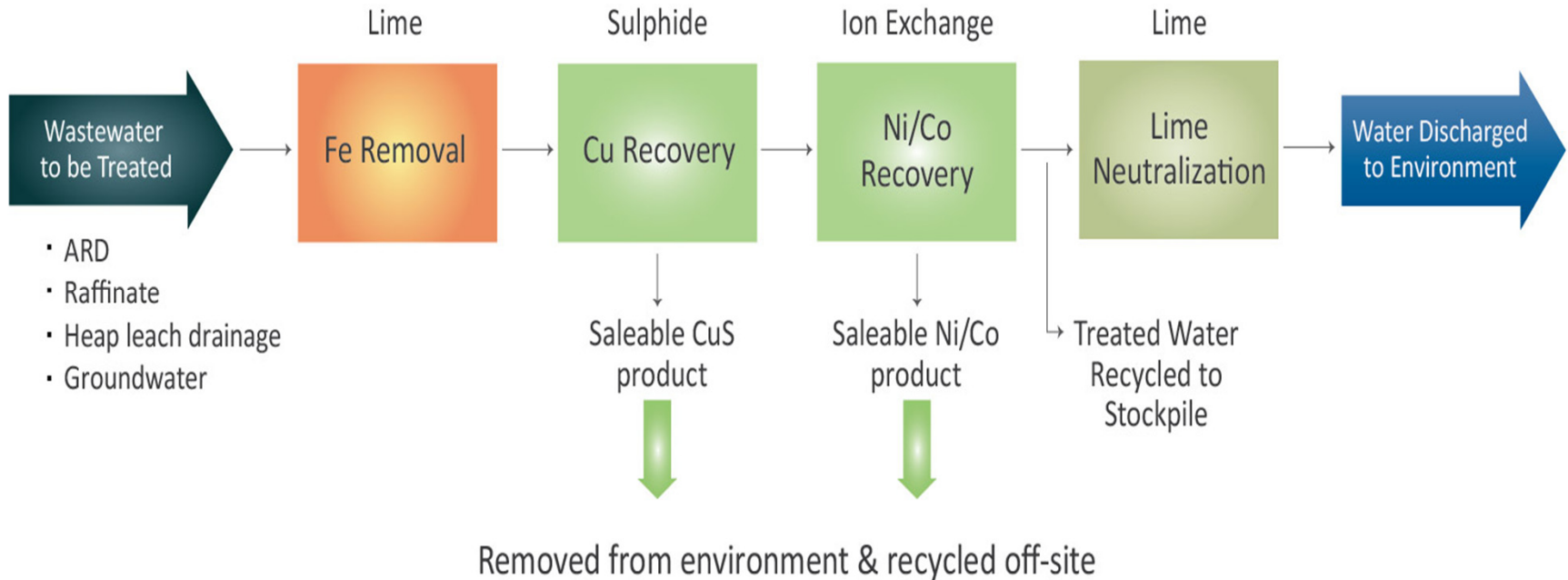
Case study 3: Dexing BioSulphide® Plant



- 50/50 joint venture between BioteQ and Jiangxi Copper Co. at an active copper mine
- Plant commissioned in 2008
- Capital cost = Cdn\$3.6 million (2008)
- Up to 1,200 m³/hr (5,300 usgpm) capacity
- Recovers copper from wastewater originating from waste dumps and low-grade stockpiles



Dexing Flowsheet





Dexing Water Chemistry

Parameter	Feed Chemistry	Effluent Results
pH	2.1 to 2.6	7 to 8
Copper	60 – 250 mg/L	<0.01 mg/L
Fe ³⁺	908 mg/L	-
Fe ²⁺	386 mg/L	<0.1 mg/L

Project goal: maximize resource recovery and provide discharge quality water



Dexing Annual Operating Results



- Capital cost \$US 8.2 million
- Water treated:
 - 5 to 10 billion liters per year
- Metal recovered:
 - 1 to 2 million lbs Cu/year
 - 100,000 to 200,000 lbs Ni-Co/year
- Mechanical availability = 97%
- Payback less than 2 years



New Developments in Water Treatment Technologies



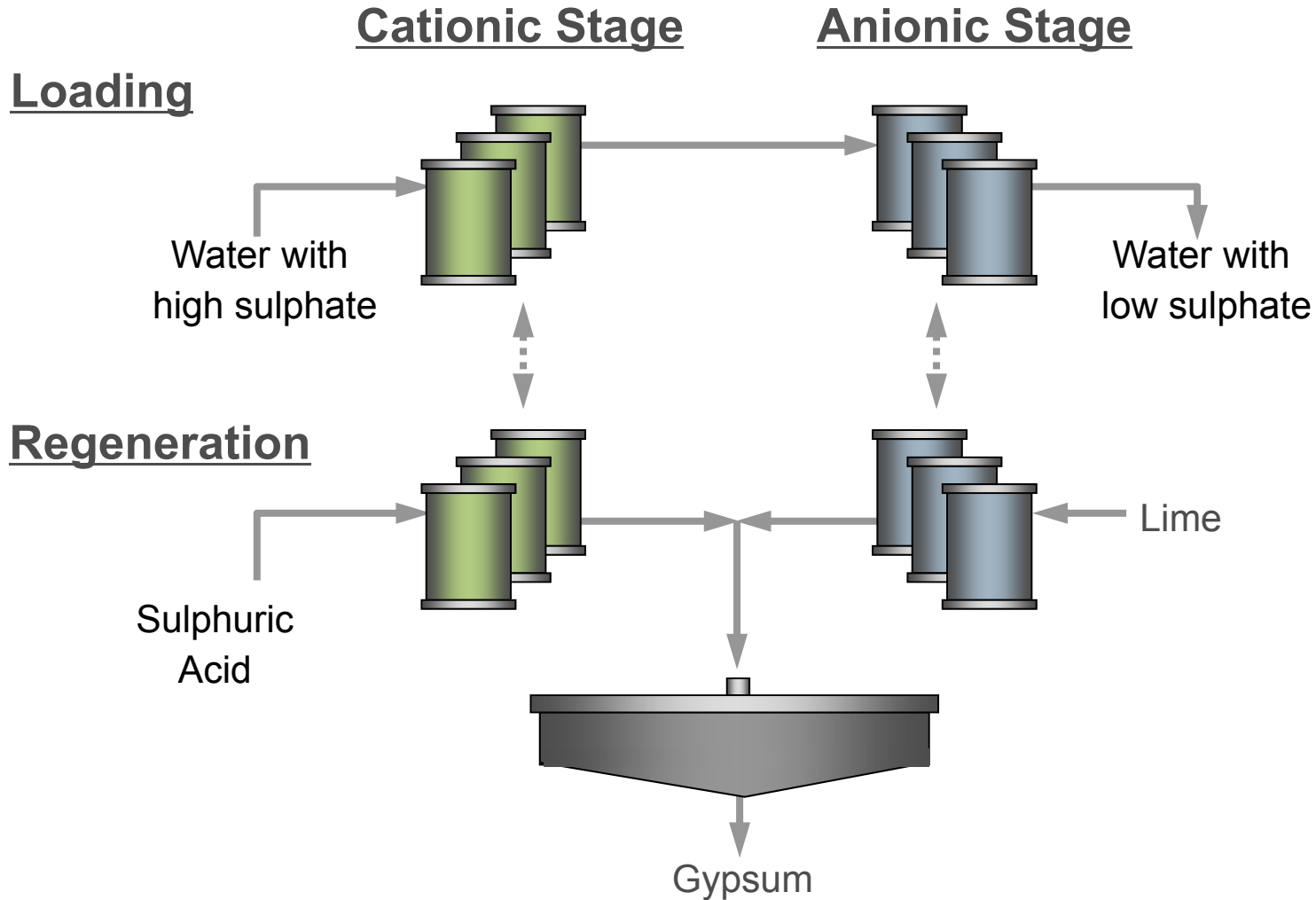
Ion Exchange Technologies



- Specialty metal recovery:
 - Co, Ni, Mo, Re, Si, Ba, St, Se
- Fe/Al recovery
- Sulphate removal (CaSO_4 , MgSO_4)



Sulphate reduction with Sulf-IX





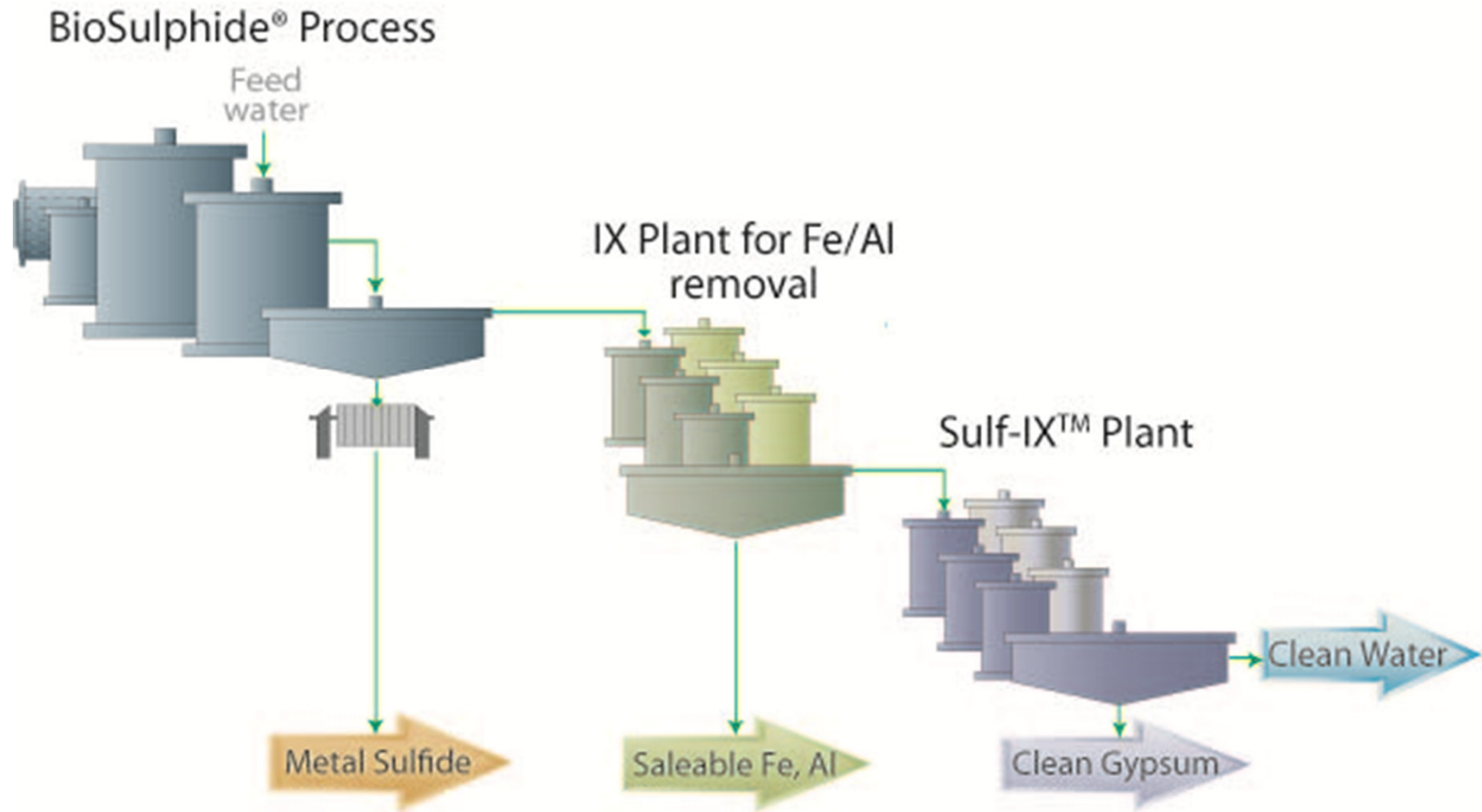
Benefits of ion exchange



- Reduce contaminant concentrations to meet strict water quality regulations
- Produce clean water and saleable by-products
- High water recovery (>99%)
- No sludge product for disposal
- Lower life cycle costs compared to RO
 - Lower capex & opex
 - Lower energy footprint



The Holy Grail of Water Treatment





Summary

- Bioteq applies innovative technologies and operating expertise to solve challenging water treatment problems
- We work with resource companies, utility operators and regulators to:
 - reduce the life cycle cost of water treatment,
 - eliminate sludge liability,
 - recover saleable by-products to generate revenue, and
 - maximize water recovery for re-use



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*Sustainable
Water Treatment Solutions*