

HUMASORB® TREATMENT SYSTEM FOR ARSENIC CONTAMINATED WATER

Presentation at

Vendors Forum

Arsenic Water Technology Partnership

New Mexico Environmental Health Conference 2003

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PRESENTATION OUTLINE

- Introduction to HUMASORB®
- Properties and Advantages of HUMASORB®
- Arsenic Removal by HUMASORB®--Case Studies
 - Laboratory Scale using contaminated water
 - Arsenic removal from process waste water containing organics
 - Arsenic removal from waste brines containing multiple metals
- HUMASORB® System Deployment Information
- System Requirements and Residuals
- HUMASORB® System Advantages



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WHAT IS HUMASORB® ?

HUMASORB®--Contaminant removal media derived from naturally occurring humic substances

- ✓ High cation exchange capacity
- ✓ Ability to chelate and bind metals
- ✓ Ability to adsorb organics



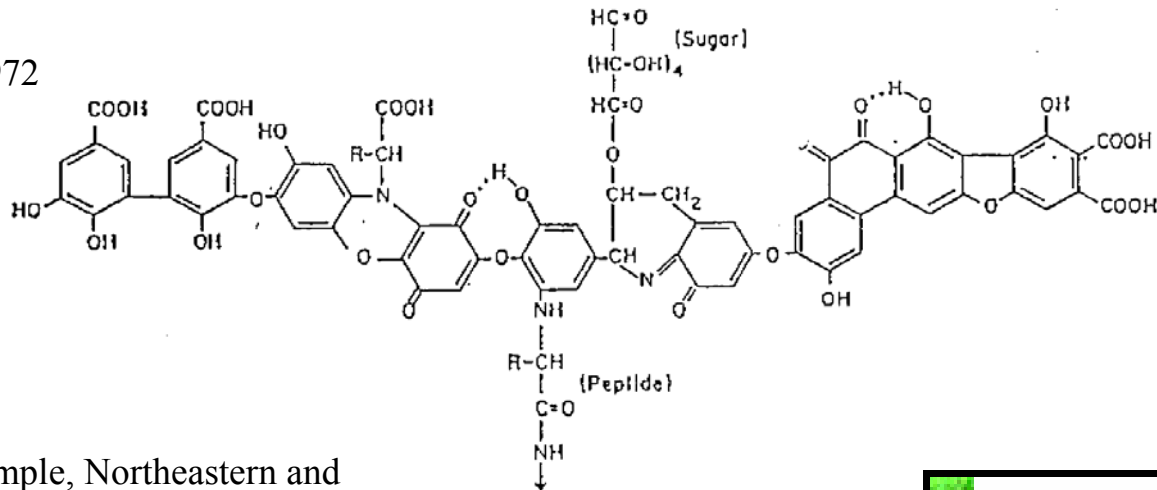
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HUMIC SUBSTANCES

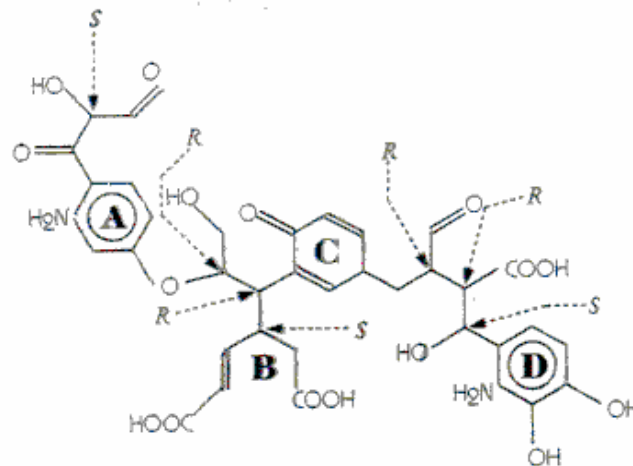
- ☆ Natural dark brown or black, Carbon-rich and highly functionalized organic macromolecules comprising of carboxylic, phenolic, carbohydrate and enolic groups
- ☆ Humic Substances family can be classified into three main fractions based on aqueous solubility
 - ☆ **Fulvic Acids** - The babies ($\langle M_w \rangle$ 5 KDa)
Soluble at all pH
 - ☆ **Humic Acids** - The Children and adults
(lowest $\langle M_w \rangle$ 12KDa)
Soluble at high pH
 - ☆ **Humins** - Deceased member, Insoluble at all pH

MODELS OF HUMIC ACID MOLECULE

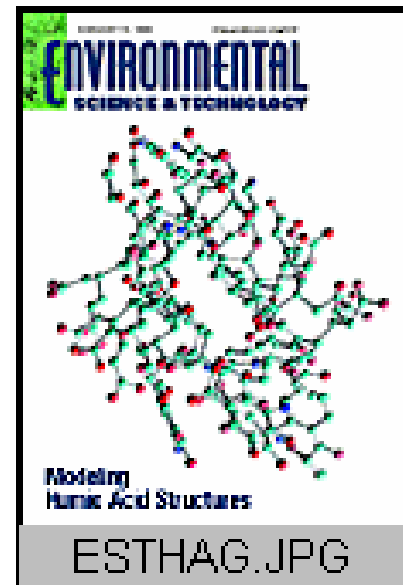
A. Stevenson, 1972



B. TNB, 1998 (Temple, Northeastern and Birmingham)



Empirical Formula: $C_{36}H_{30}O_{15}N_2 \cdot xH_2O$
 $x=0-15$



HUMASORB® STABILITY STUDIES

- Ambient Conditions (1,4,6 months)
- Temperature--50°C (1,2,3,4 Weeks)
- Temperature--4°C (2,4,6 months)
- 100 ppm Na₂SO₄ and Na₂CO₃ (1-day, 3, 6 months)
(~420 ppm sulfate; 260 ppm carbonate)
- 100 ppm CaSO₄ and CaCO₃ (1-day, 3, 6 months)
(~240 ppm sulfate; 150 ppm carbonate)
- 10,000 ppm Na₂SO₄ and Na₂CO₃ (3 months)
(~42,000 ppm sulfate; 26,200 ppm carbonate)
- Biological Stability (1,2,4,6 months)



HUMASORB® IS PROVEN FOR MULTIPLE CONTAMINANT REMOVAL

HUMASORB® EFFECTIVE ON:

Metals:

Barium, Lead, Cadmium, Chromium, Nickel, Mercury,
Arsenic, Copper, Zinc, Aluminum, Cobalt, Beryllium, Iron,
Zirconium, Gold, Manganese, Magnesium, Vanadium, Boron

Radionuclides:

Uranium, Strontium, Cesium, Cerium (Plutonium Surrogate),
Rhenium (Technetium Surrogate)

Organic Contaminants:

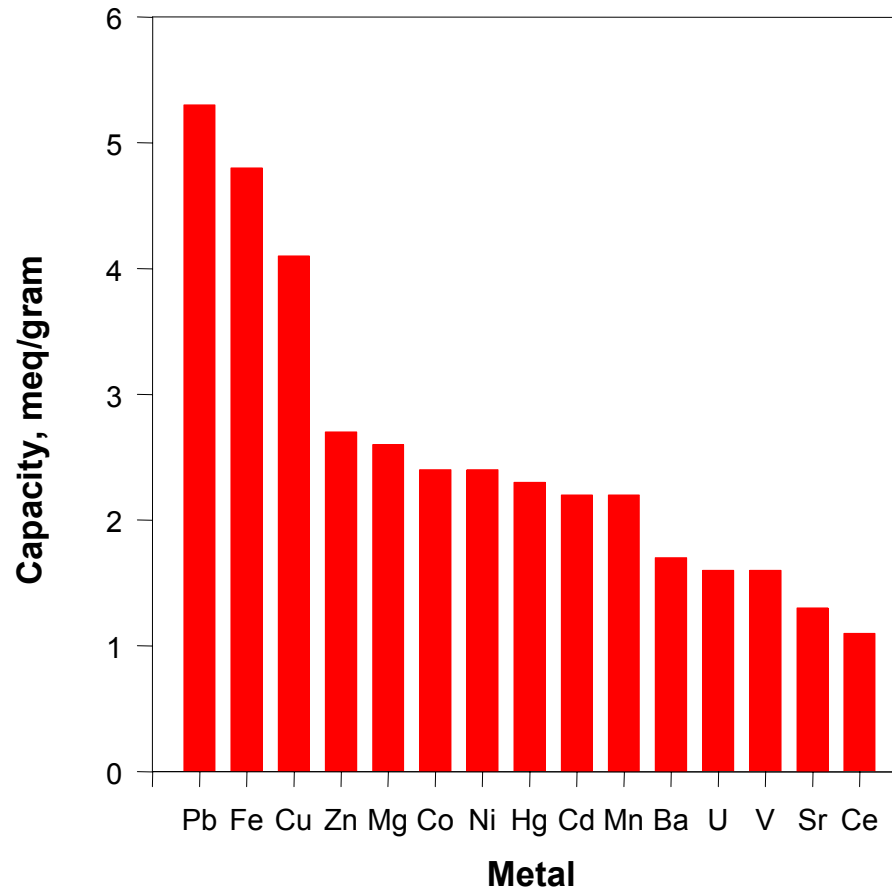
TCE, PCE, PCB, Chloroform, Carbon Tetrachloride

Additional contaminants under evaluation



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HUMASORB® HAS HIGH CAPACITY FOR METAL REMOVAL

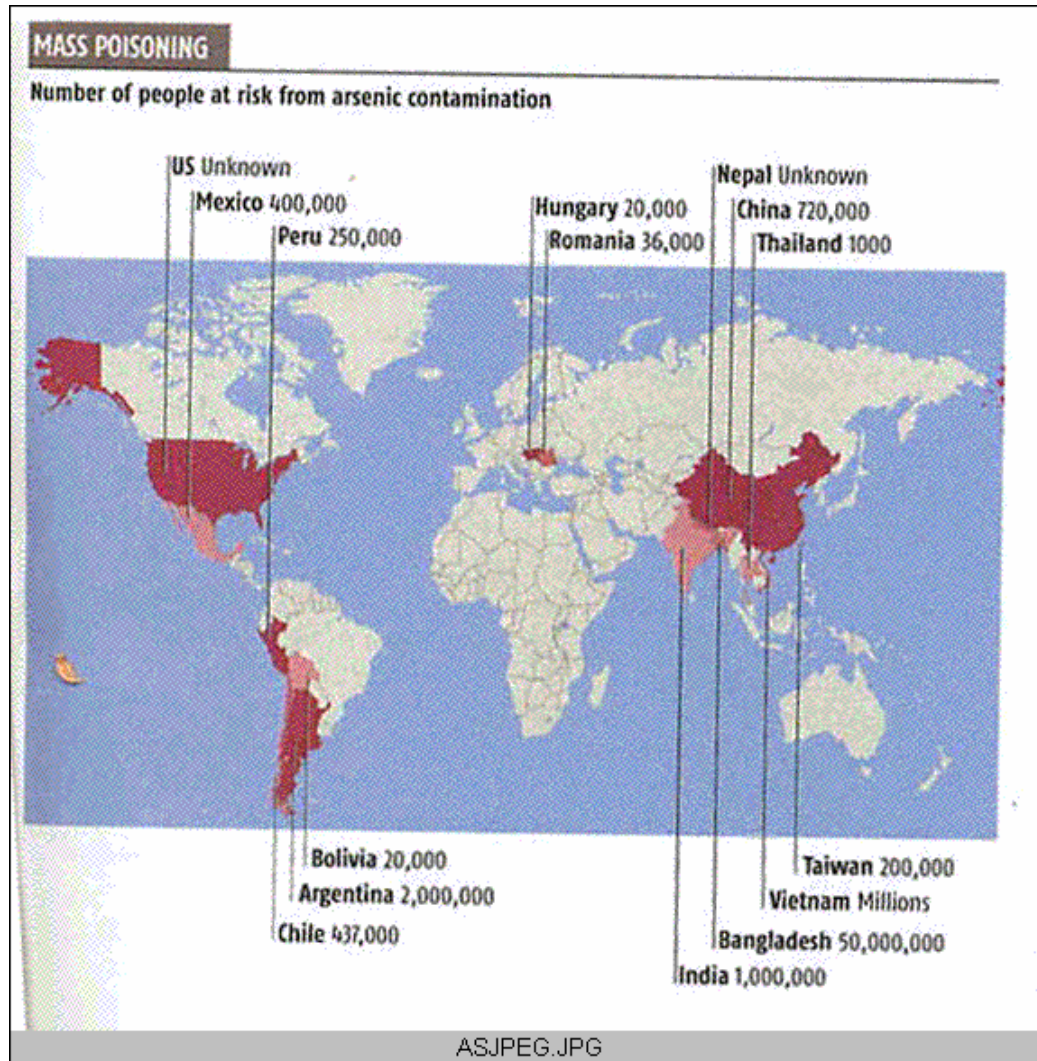


**:
Capacity Estimated from Langmuir Model and/or
Experimental Observation



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ARSENIC CONTAMINATION IN WATER IS A WORLDWIDE PROBLEM

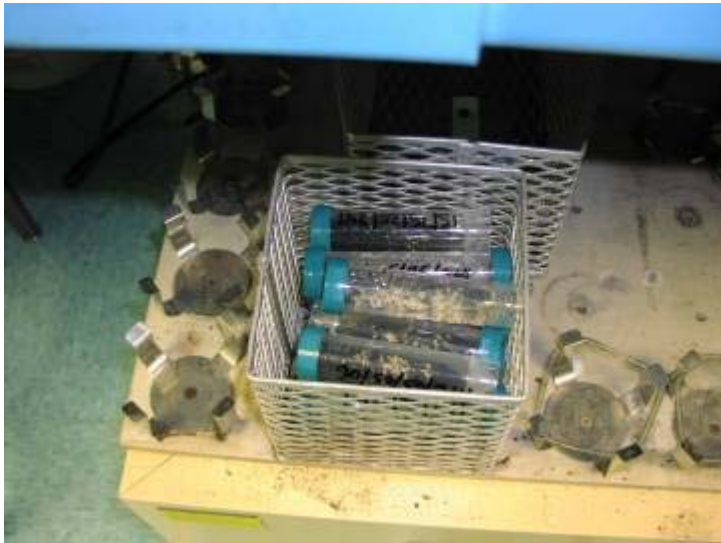


** Adapted from New Scientist, August 2003



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HUMASORB® IS EFFECTIVE IN ADSORBING ARSENIC FROM CONTAMINATED WATER



Sample	Arsenic (V) Concentration, (mg/L)
Initial sample (Before Treatment)	928
Final Treated Sample	ND

HUMASORB® IS EFFECTIVE FOR TREATMENT OF CONTAMINATED WATER IN POU SYSTEMS

Tests conducted in Prototype HUMASORB® Matka (Clay Pot) System

Contaminant	Concentration in Untreated Water, ppm	Concentration in Treated Water, PPM	WHO Guidelines for Drinking Water, PPM
Lead	5-20	ND	0.01
Arsenic	5-20	ND	0.01
Chromium	5-20	ND	0.05
Fluoride	3 – 20	ND	1.5

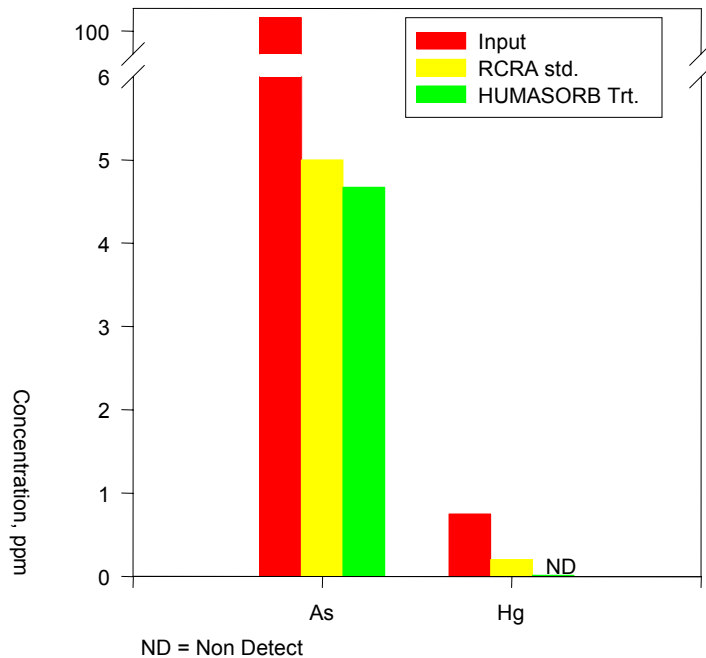
ND: Not Detected; Detection Limit: 0.002 ppm



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HUMASORB® Technology is Effective for Arsenic Removal from SDS at Johnston Island

Concentration of metals in a composite sample collected at the end of 145 bed volumes



SDS Contains:

- Organic Compounds
- Sodium
- High TDS
- Toxic metals

Arsenic was present as an uncharged species, while mercury was present as cationic in the SDS

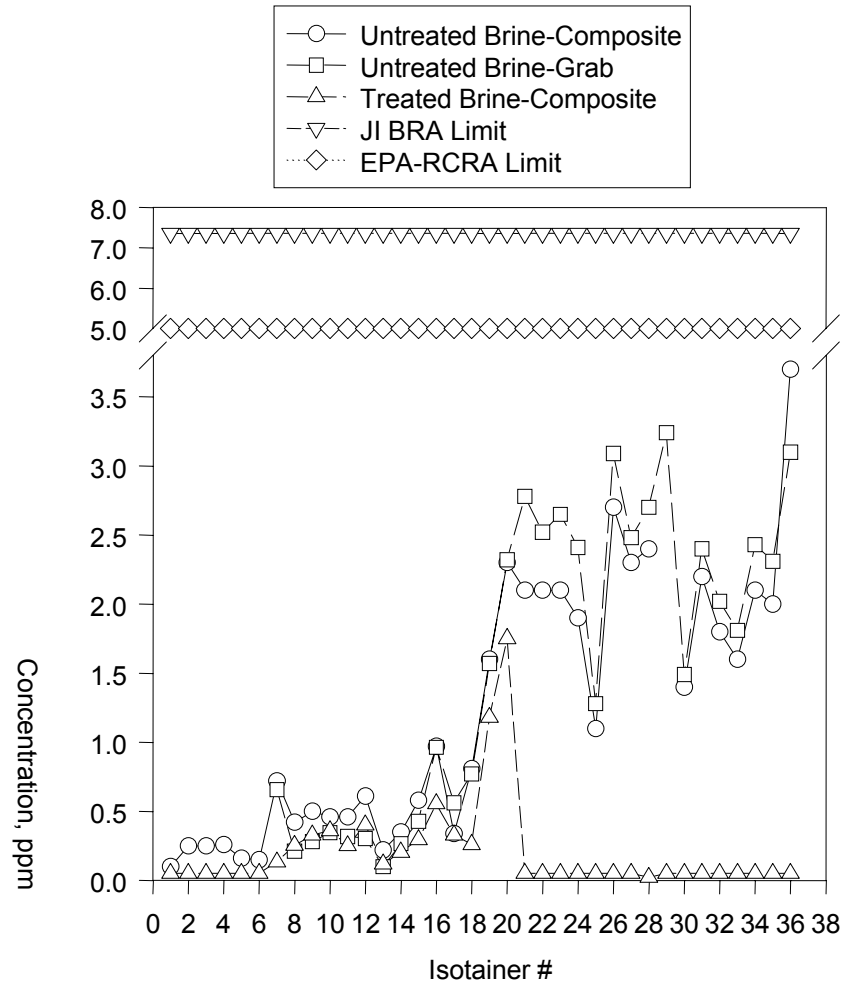


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HUMASORB® Technology is Effective for Arsenic Removal from Brines at Johnston Island

Brines Contain:

- Sodium
- Bicarbonate
- Sulfite
- Fluoride
- Phosphate
- High TDS
- Toxic metals



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HUMASORB® MATKA (Clay Pot) SOLUTION

- 💧 Incorporates HUMASORB® for contaminant removal
- 💧 Removes multiple contaminants to produce drinking water
- 💧 Cools water by respiration
- 💧 Easy to use and simple system



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HUMASORB® MATKA SYSTEM



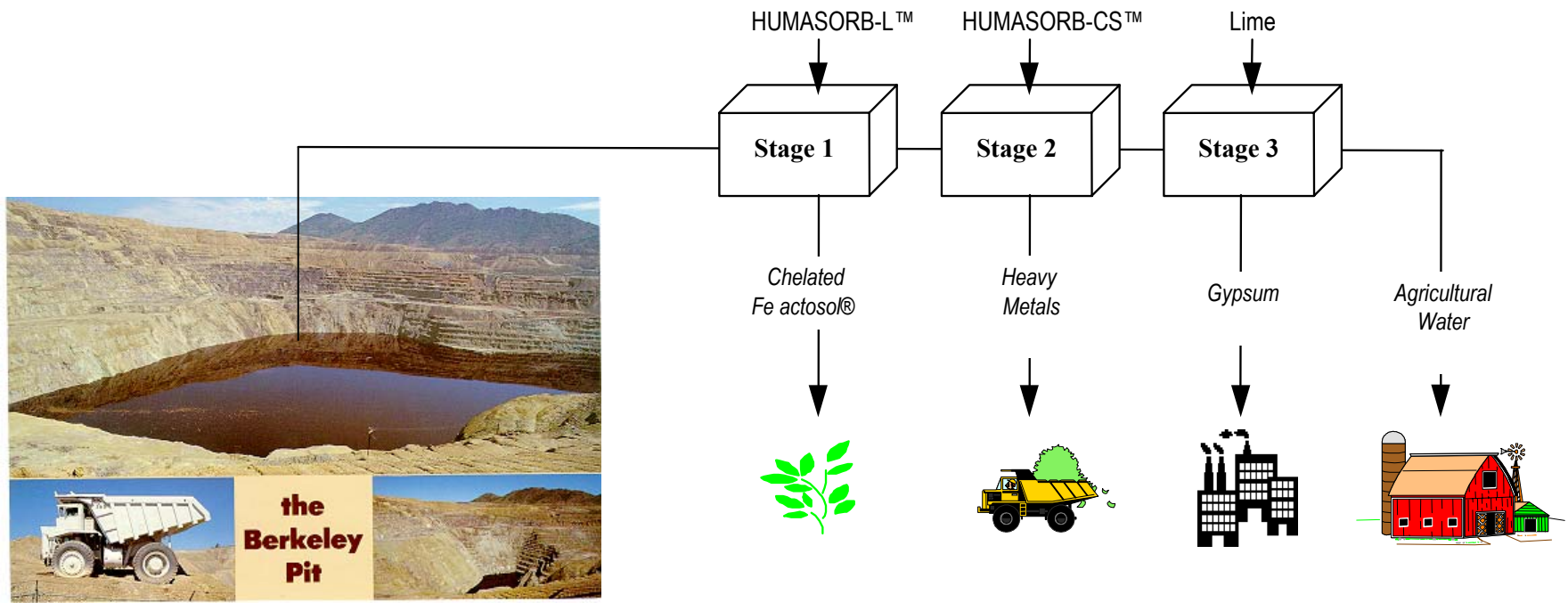
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HUMASORB® DEPLOYMENT EXPERIENCES

- Berkeley Pit, Montana
 - Demonstration for treatment of abandoned mine waters in Montana
- Johnston Island in the Pacific
 - Treatment of brines produced at chemical agent disposal facilities
- Sadat City, Egypt
 - Wastewater treatment and reuse as agriculture water
- India
 - HUMASORB® System demonstration for toxic metal removal



SIMPLIFIED FLOW DIAGRAM OF THE ARCTECH PROCESS TO CONVERT BERKELEY PIT WATER TO FERTILIZER AND AGRICULTURAL WATER



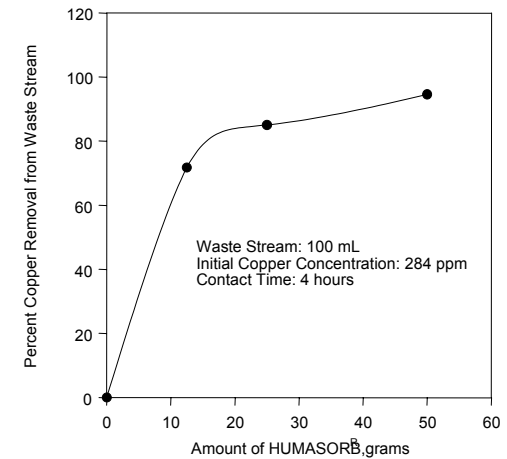
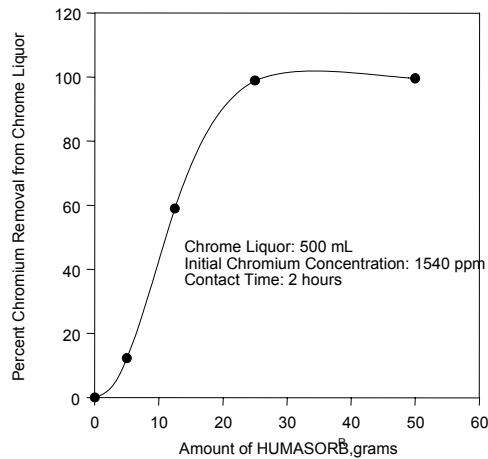
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HUMASORB® MOBILE TREATMENT UNIT (Used for treatment at Berkeley Pit and for SDS at JI)



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HUMASORB® DEMONSTRATION SETUP FOR TESTS IN INDIA



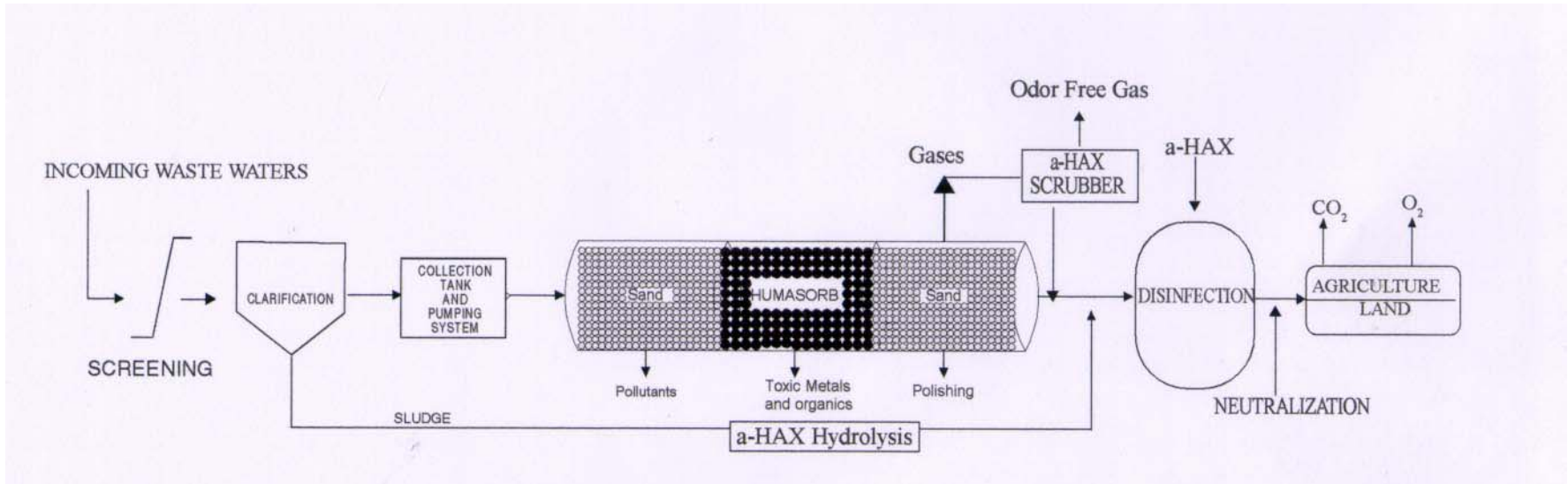
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HUMASORB® SYSTEM DEPLOYED FOR BRINE TREATMENT AT JOHNSTON ISLAND



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HUMASORB® System will Convert Wastewater Into Agriculture Water At Sadat City in Egypt





- 💧 Economically self-sustainable
- 💧 Organic fertilizer water for creating vegetation in sandy soils
- 💧 Carbondioxide capture to reduce greenhouse gases

PROCESS REQUIREMENTS AND RESIDUALS

Utility Requirements

-  Power: None (POU Systems); Minimal for other systems

Residuals

-  Small amount of spent media or sludge
-  Non-hazardous sludge--pass TCLP

HUMASORB® PROCESS ADVANTAGES FOR TREATMENT OF ARSENIC CONTAMINATED WATER

- Proven technology for effective removal of arsenic and other toxic metals
- Robust process for metal removal from waters of varying characteristics
- Solids generated are non-hazardous
- Effective for application in various sizes (POU, small systems, etc.)
- Simple system for easy operation



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