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Your Best Choice for Odor, H₂S & TRS Control

Majdi El-Sadek *M.Eng.*
Business Development Manager

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Presentation Outline

- Our company
- Understanding odors and odor control using available technologies
- What is Biofiltration?
- BIOSORBENS™ first PERMANENT biofilter media
- BIOREM Products
- Installations and Local References
- Benefits of BIOREM systems
- Questions?

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About BIOREM

- Most Experienced Biofilter Company in North America!
 - Over 550 Worldwide Installations for VOCs & odors
 - 27 installed systems in Middle East & Africa
 - Worldwide representation
 - 16 Years of Biotechnology Expertise
 - Resident Researchers and Extensive Laboratory Facilities
 - specialize in Odor and VOC Air Pollution Control:
 - H_2S & TRS (DMS, DMDS), NH_3 , Mercaptans, VOCs

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Continuous Growth

- Going Public: BIOREM is now Traded on TSXV: BRM
- BIOREM acquired Biocube LLC in July 2005
- Offices in Canada and USA
- MYTILUS™ Bioscrubber and POPCORN™ media
- International initiative – Middle East, China and Latin America

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Installations Near You!

Name

No. of Systems

South Africa

7

Wadi Mousa (Petra), Jordan

5

RSOMP, Saudi Arabia

14

DQ, Saudi Arabia

3

Saudi Aramco, Saudi Arabia

1

Buraidah WWTP, Saudi Arabia

1

Bahrain

2

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What is Odor and Odor Control?



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Contaminant Identification

- **Sulfur compounds**

H ₂ S	rotten egg	soluble	< 0.001 ppmv
DMS	rotten cabbage	insoluble	“
DMDS	sulfide	insoluble	“
MM	rotten cabbage	slight	“

Hydrogen sulfide (H₂S), TRS: di-methyl sulfide (DMS), di-methyl di-sulfide (DMDS), methyl mercaptan (MM)

- **Total Odor Removal**

- No discrimination on type of odor
- Important as some contaminants have higher odor threshold than H₂S
- ODOR = Dilution until 50% of panelists cannot smell anything



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Available Technologies



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Activated Carbon

- Phase transfer only (no destruction)
- Can be effective for treating transient loads and intermittent airflows
- Short bed life means frequent media changes
- Small systems have low capital costs but high maintenance
- Poor performance in high humidity climate
- Potential hazardous waste



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Chemical Scrubbers

- Good for knocking down high concentrations of H_2S
- Very high operation & maintenance costs
- Short contact time
- Phase Transfer and chemical reaction
- Difficult to treat peak loads
- High profile, not visually appealing!



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Biotrickling Filter

- Ideal for elevated H₂S applications
- Short contact time
- Appropriate for low concentration, water soluble compounds
- Nutrient addition may be required



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Bioscrubber

- Appropriate for water soluble hydrocarbon applications
- Maintenance and operation attention required



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Biofiltration

- 1923 - Biofiltration is developed in Europe.
- 1955 - Biological methods are proposed to treat odorous emissions.
- 1970's - Biofiltration deemed a success in Europe.
- 1990's Biofiltration recognized in the U.S. market.



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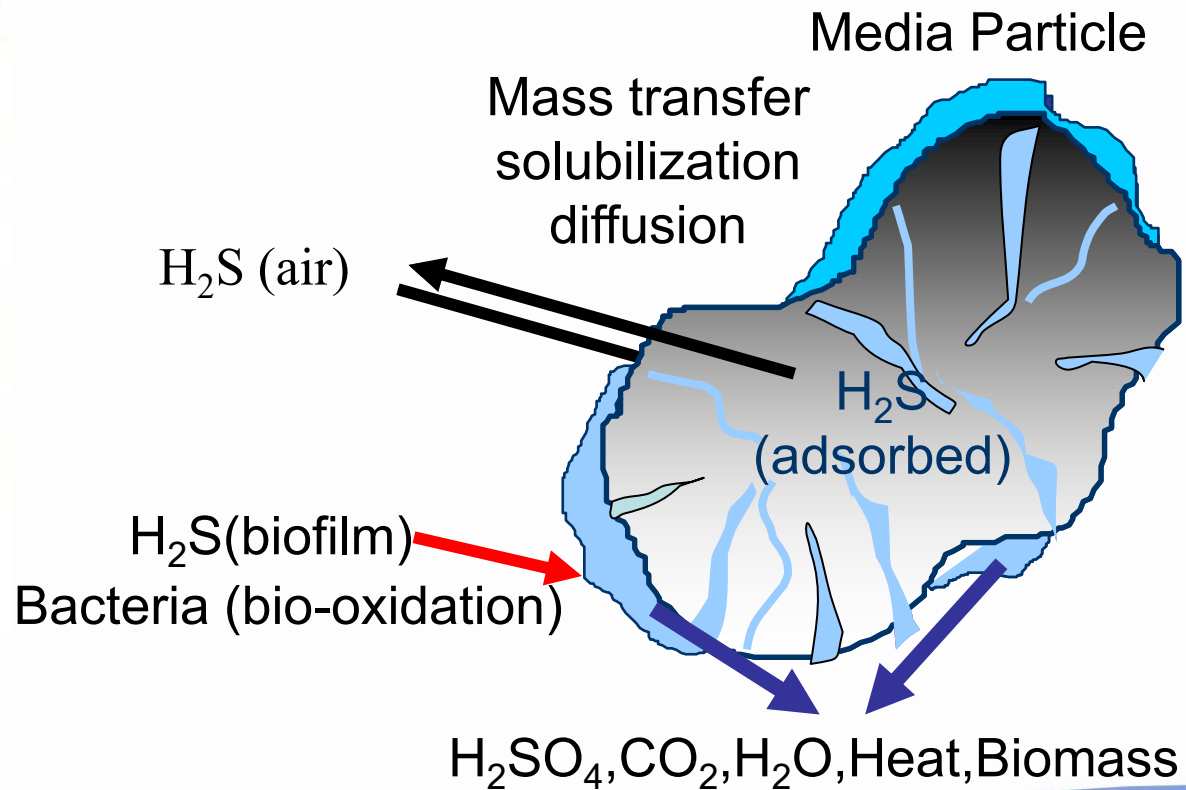
Biofiltration

- Proven, predictable, reliable performance
- Self-regenerating
- Virtually maintenance free
- Total odor removal
(not just H₂S)



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Biofiltration Illustration



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The 1st Generation Biofilter! (Woodchip Media)



We don't do this anymore!

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In-ground Woodchip biofilters

- 60 Seconds EBRT means huge space requirement
- Organic media can quickly decompose leading to:
 - Compaction
 - Poor moisture control
 - Air channeling and breakthrough
 - Frequent media changes
 - High O&M, freight and media disposal costs

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City of Broomfield, Colorado Main WWTP

In-ground Woodchip Biofilter... This system is overgrown with weeds!

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BIOSORBENS®

First **PERMANENT** Inorganic Media In North America!



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BIOSORBENS®

- Hydrophilic Mineral Core
- Nutrients, buffers and adsorptive ingredients
- Hydrophobic Components
- High Surface Area



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BIOSORBENS®

Longevity

- Long lasting (10 Years and beyond!)
- No Decomposition
- No Degradation
- No Compaction
- Extended Warrantee
- Performance Guarantee



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BIOSORBENS®

Added Features

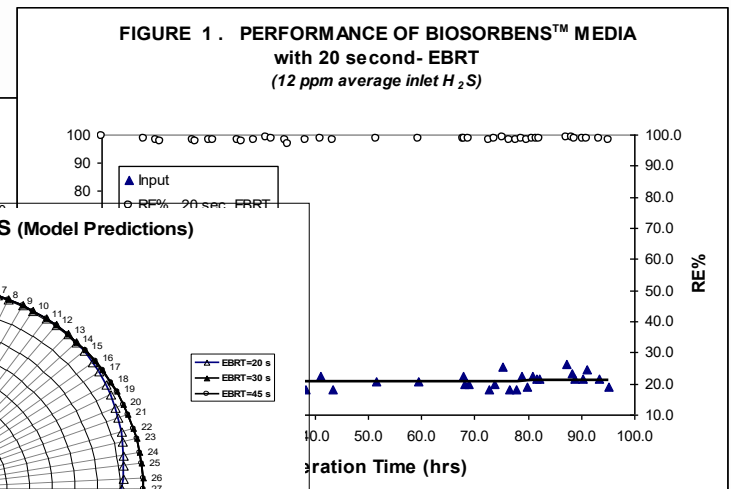
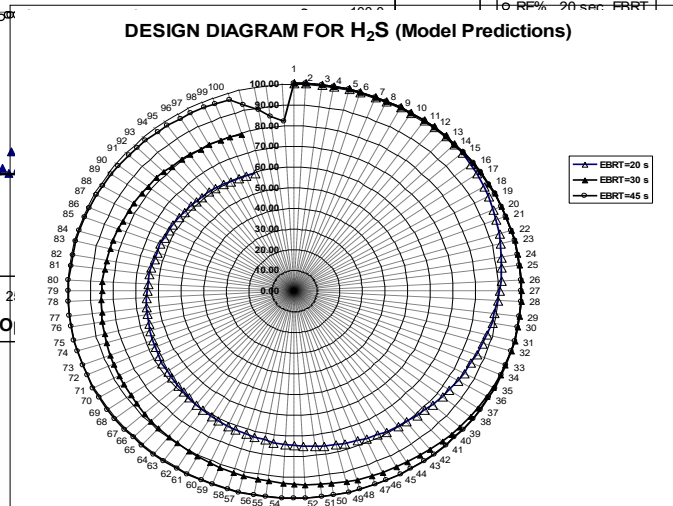
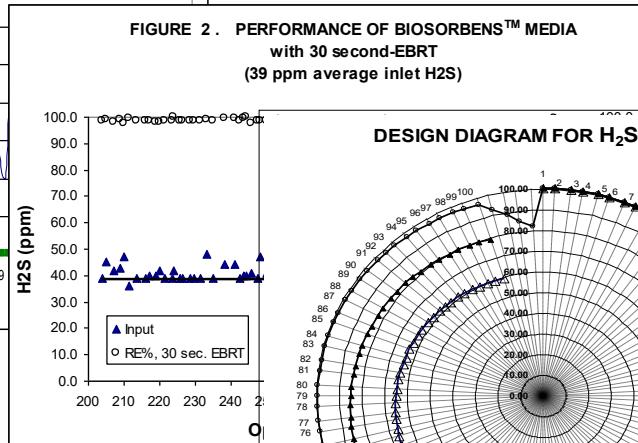
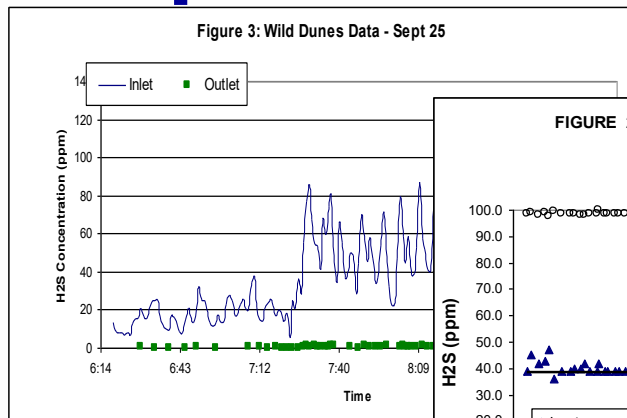
- Low pressure drop
($0.25\text{ kPa} - 0.50\text{ kPa}$)
- Low Volume (1/4!)
- Consistent Performance
- Buffers built in!
- Good Biological Env't
- pH Neutral
- Regenerate/Recycle
- Expandable Capacity!
- Proven performance



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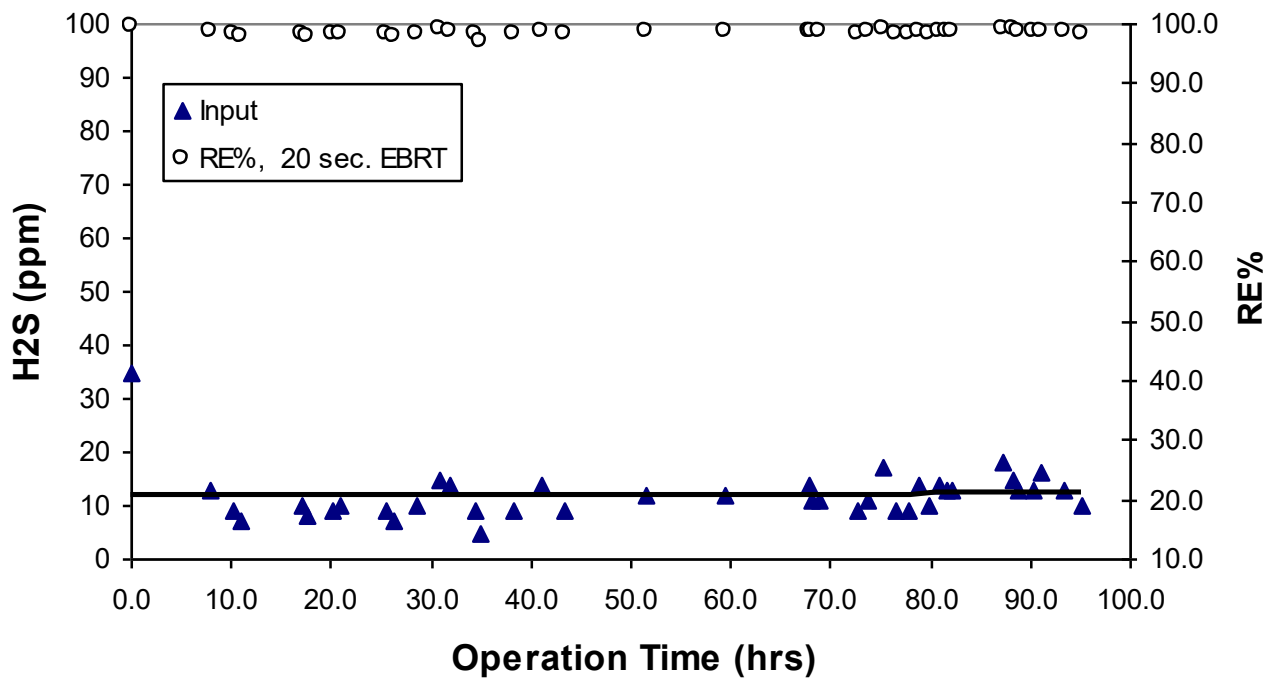


Odor removal charts and performance graphs



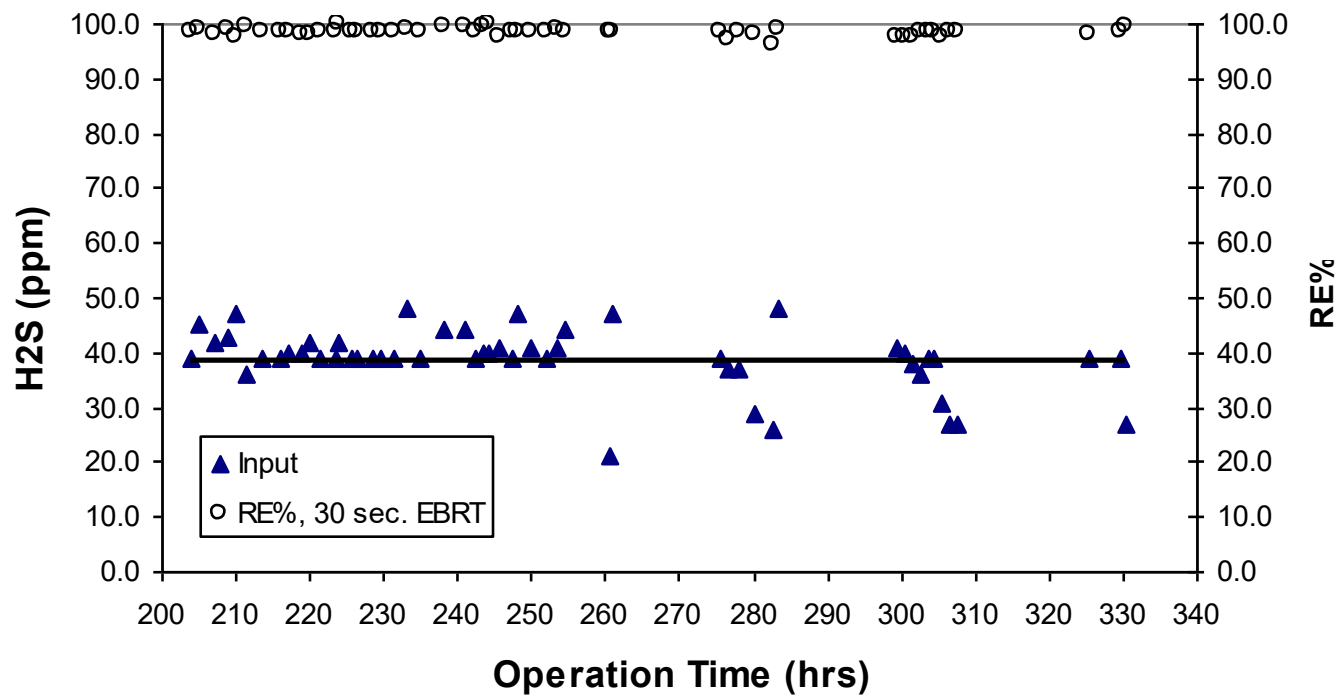
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**FIGURE 1 . PERFORMANCE OF BIOSORBENS™ MEDIA
with 20 second- EBRT
(12 ppm average inlet H_2S)**



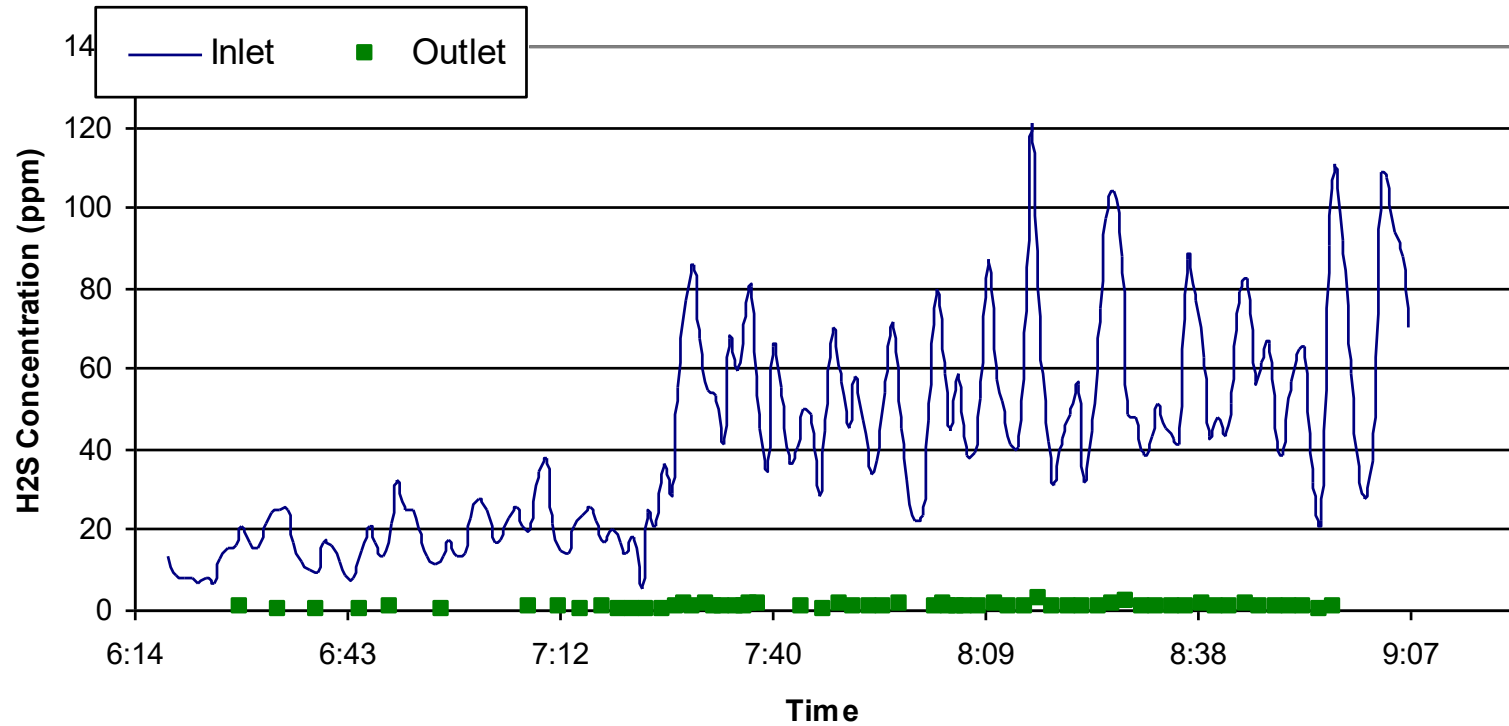
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**FIGURE 2 . PERFORMANCE OF BIOSORBENTS™ MEDIA
with 30 second-EBRT
(39 ppm average inlet H₂S)**



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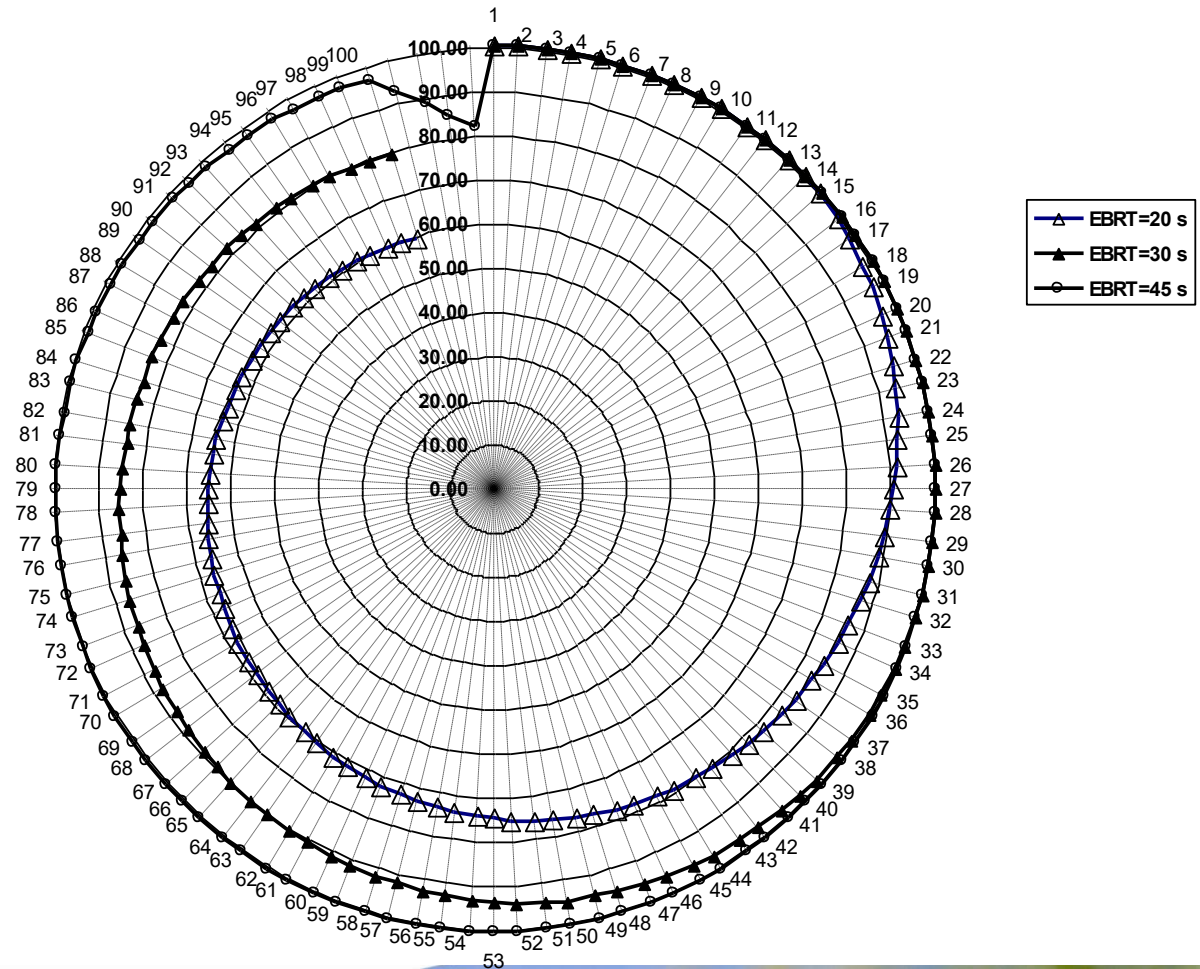
Figure 3: Wild Dunes Data - Sept 25



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DESIGN DIAGRAM FOR H_2S (Model Predictions)

Pinwheel Diagram



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BIOREM Products



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BIOREM Products

- BIOCUBE™ High levels of H₂S, 170 - 3,000 m³/hr
- BASYS™ Low to moderate levels of H₂S,
3,000 to 20,000 m³/hr
- BIOFILTAIR™ Low to moderate levels of H₂S,
20,000 to 850,000 m³/hr
- MYTILUS™ Very high levels of H₂S, any air flow
- SAM™ Synergistic Air Management System
- BIOSERVE™ Media monitoring service

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BIOCUBE™

- Above ground, modular systems
- Optimized media for maximized performance and life.
- Integral plenums assure even air distribution.
- Tray design eliminates compaction problems associated with deep bed systems.
- Polyurethane foam insulation allows all-
climate operation.

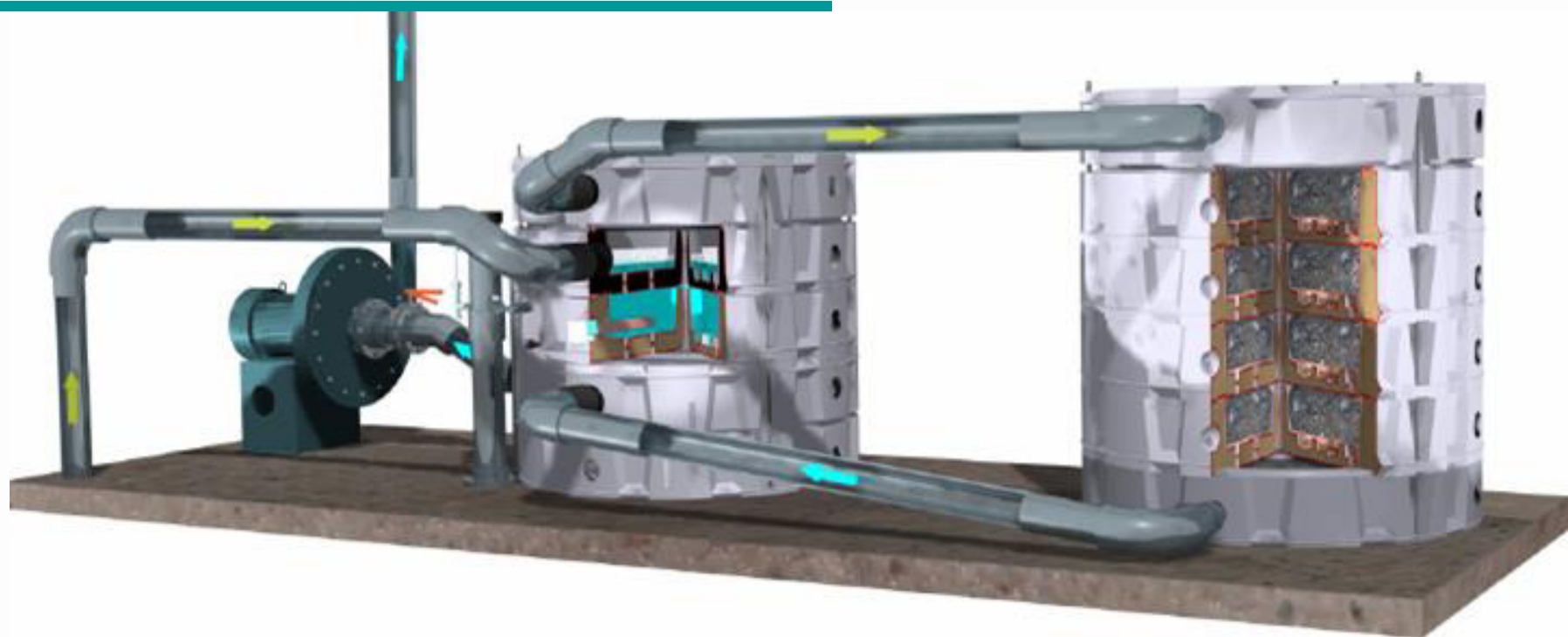


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BIOCUBE™ Process



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Escondido, CA



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Trailer and Pilot Studies

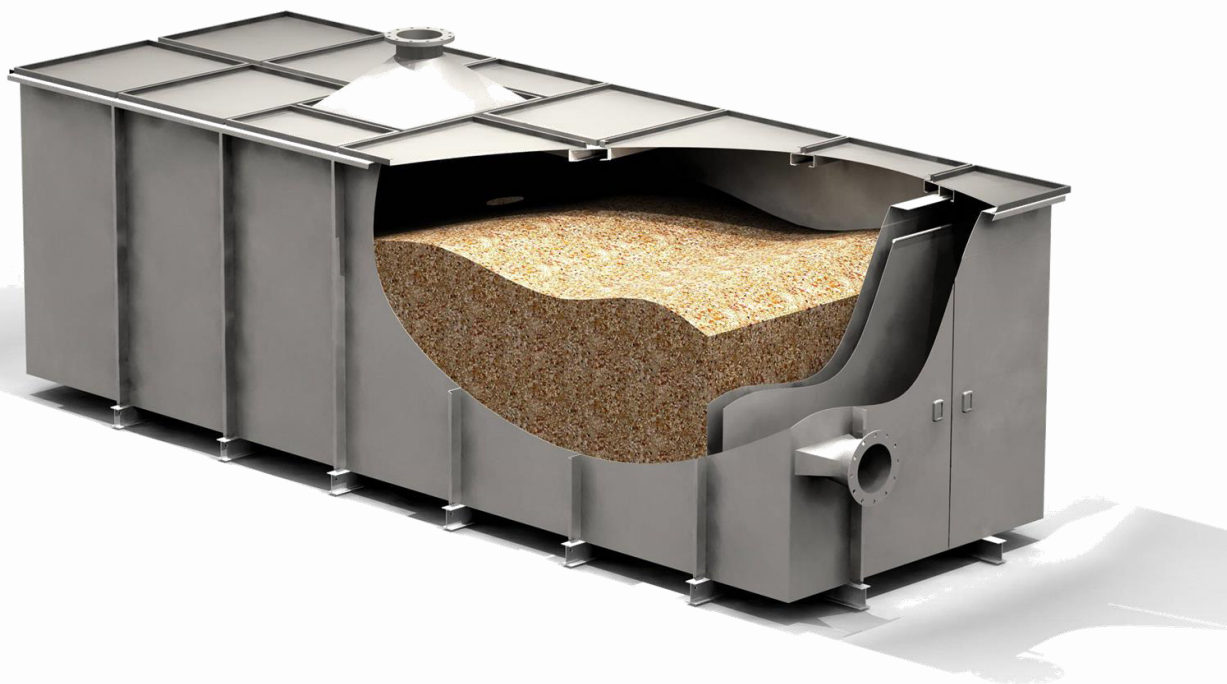


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BASYS™ Patented Modular Biofilter



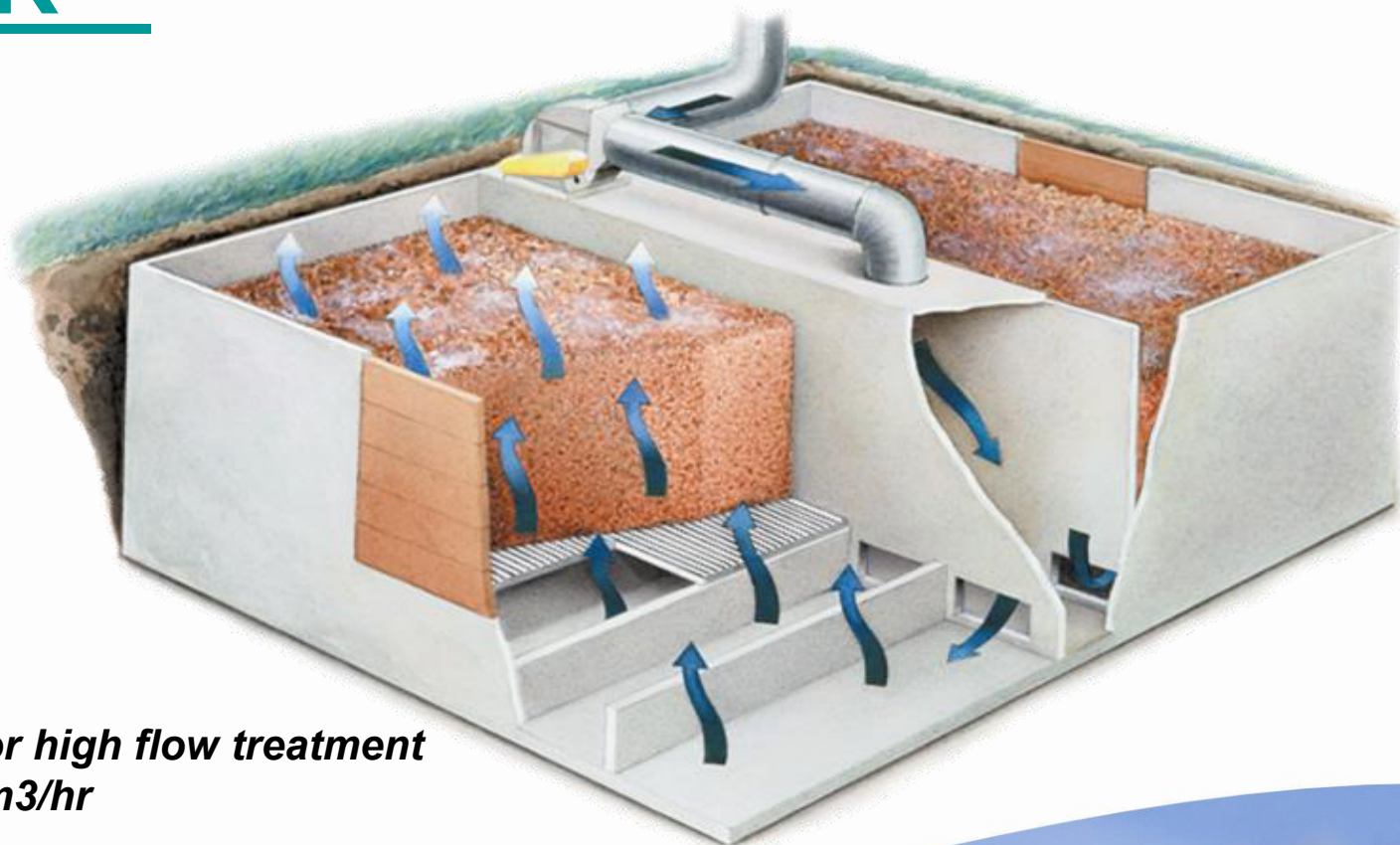
*Completely integrated,
compact treatment
from 3,000 – 10,000 m³/hr*

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BIOFILTAIR™



***Reliable odor control for high flow treatment
from 10,000 – 850,000 m³/hr***

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MYTILUS™

- Bioscrubber or Biotrickling Filter
- Short contact time and small footprint
- Fully integrated vertical tower design
- POPCORN™ LWE mineral based PERMENANT media
- Ideal for elevated H₂S applications
- Headworks (grit removal, bar screens), pumping stations



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South Hutchinson Island, Florida, USA





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BIOSERVE™

- BIOREM Media Tests

- Moisture Content
- Nutrient Level
- pH
- Fines Content
- Bacterial Enumeration
- Bacterial Speciation



- Plant Operations

- Back Pressure
- Air Temperature
- Flow Rate
- RH

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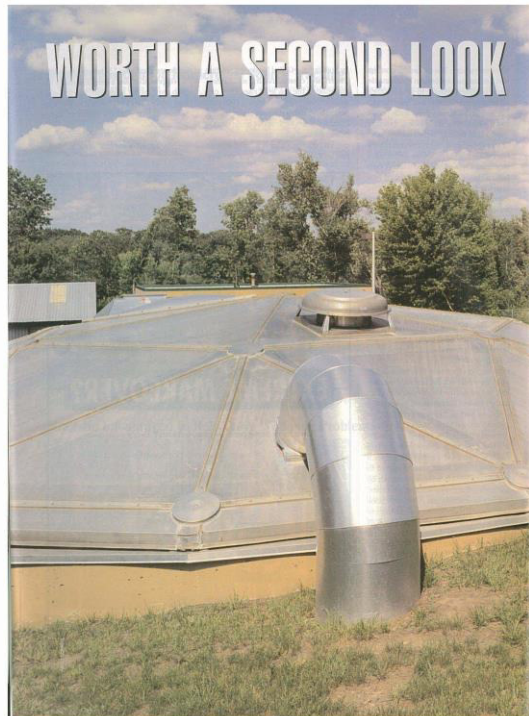
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BIOSERVE™

- Level 1 – (Standard)
 - On site manual monitoring – daily readings by operator
 - 24 hour Dedicated Service Manager.
- Level 2 – Option - Semi-automated
 - Remote monitoring with manual adjustment alert
- Level 3 – Option - Fully automated
 - 24/7 Remote monitoring via internet with remote adjustment of key parameters

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Technology Comparison



WORTH A SECOND LOOK

Published Literature

Biocube™ News

Sept 1998
Issue No. 4

In the 1980s the City of Treasure Island's wastewater treatment plant was taken out of service. Instead of treating their wastewater, the City of Treasure Island arranged to pump 1.2 MGD to 2.8 MGD (dry ref. weather flows, respectively) of wastewater to the City of St. Petersburg for treatment. At that time, the odor problem associated with their treatment plant was solved, however, the odor levels coming from their master pumping station were deemed unacceptable.

In 1990, Bay Engineering, Inc. was contacted to study different control methods. The odor control options considered included chemical treatment, Odophos™ and Biocube™, wet scrubbers, activated carbon, biological enzymes/bacteria addition and biofiltration.

Odophos™ is a chemical solution that has an instantaneous reaction with H₂S. Consideration must be taken to avoid overdosing, which can cause solids to settle and build up in gravity or force mains. It also presents a health hazard to employees. Consumption was estimated at 250 - 300 GPD for this site, which made it too expensive for use.

Biocube™ is a chemical solution (calcium chloride) that has a reaction



Odor Control at the Master Pumping Station - City of Treasure Island, FL.

time of 1-2 hours. Therefore, it would be applied upstream of the pump station at multiple points. Although the rate of Biocube consumption was estimated to be less than Odophos™, Biocube™ was shown to be the most expensive of all odor control options.

Activated Carbon is a highly effective traditional method of dry air scrubbing. Odorous compounds are adsorbed into the pores of the carbon media, which has to be subsequently regenerated and eventually replaced. The system becomes inoperable during the regeneration process, unless the system has a redundant bank of carbon that can be made active while the first is regenerated.

Wet Scrubbing using Sodium hypochlorite and Sodium hydroxide solutions is also an effective traditional means of treating odorous air streams. However, considering the very high maintenance requirements as well as the cost of chemicals, and

safety hazards associated with wet scrubbers, the City decided not to use a wet scrubber at this site.

Enzymes and bacteria, such as J-11™ (biological enhancer) and S.L.F. Treat™ (biological inhibitor) were also studied. Both suffer from the chance of being washed away during periods of heavy rainfall.

The Biocube™ Biofilter was chosen based on efficiency and cost (see matrix on reverse side for details).

The system was designed for 500 CFM and consists of four Pen-packs, MBR/MS, 3/6 SS centrifugal fan and NEMA 4X control panel. The footprint was 15' X 40' and the system uses 50 GPD of water. The biofilter system has been running > 99.9% H₂S (20-150 ppm) since 12/97.

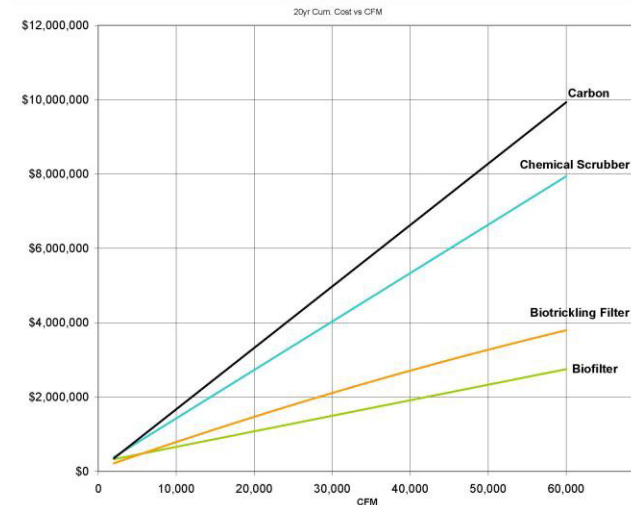
For more information on this project, contact Larry Hickey of Equipment Plus, Inc. (352-237-1869) or Roger Hruszkow of Biocube, Inc. (845) 246-3717.

-LH-

Biocube, Inc.

100 Rawson Road
Suite 230
Victor, NY 14564
Tel. (716) 924-2220
Fax. (716) 924-8280
<http://www.biocube.com>

Life Cycle Cost Analysis



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Thank You!

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