

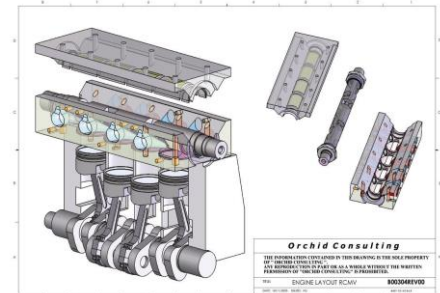
Mitton Industrial Cavitation Reactor Systems

Using Cavitation to
Reclaim our World's Water



Corporate History

- 2004** Reactor originally engineered for automotive applications
- 2005** Unique harmonic characteristics discovered
- 2006** Experimentation with water, air and vacuum begins
- 2007** Discovery of controlled cavitation process leads to focus shift from automotive to water remediation applications
- 2008** Interest growing from leaders in oil and gas and industrial wastewater sectors
- 2013** Secure two license agreements (food and oil and gas) and win Deloitte Technology Green 15 award
- 2014** Partner with German Rechner Sensors to optimize and automate system. Secure license in lake water remediation



Company Support

- Patents granted in Canada, European Union and India
- WIPO status maintained, new IP filed 2015.
- Patent protection maintained annually while maintaining pending status in U.S., Australia and New Zealand
- In-house engineering using S-W CAD-3D based modeling -- easily shared with contract fabricators and customer engineers
- Rapid consulting model means ready to assist in global application assessment, commissioning and deployment

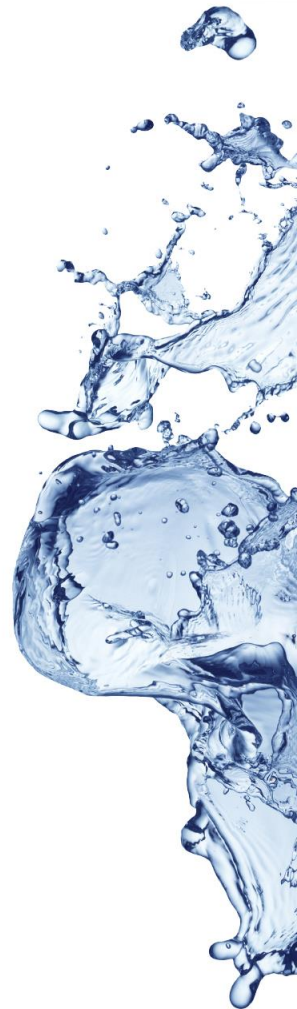
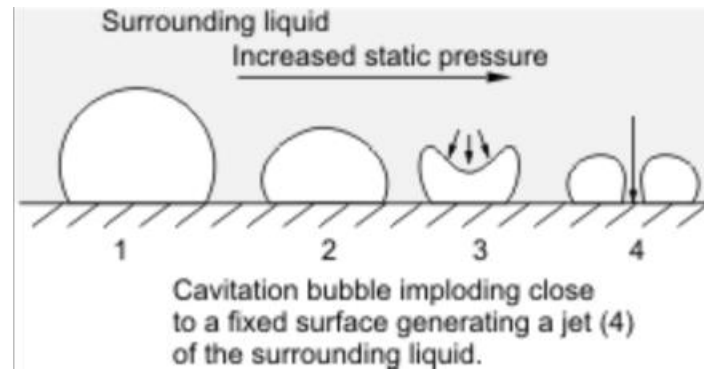




What is Cavitation

- The formation and violent collapse of vapour cavities in a flowing liquid in which the pressure of the liquid falls below its vapour pressure
- Typically occurs on or at the junction of a surface
- Normally considered a very destructive force

Understanding Cavitation



The Destructive Force



In most cases, cavitation is an undesirable occurrence. In devices such as propellers and pumps, it causes vibration, noise, loss of efficiency and damage to components.

When cavitation bubbles collapse, they force liquid into very small volumes creating powerful shock waves and localized regions of extremely high temperature approximating conditions on the surface of the sun.

Nature's Way Intensified

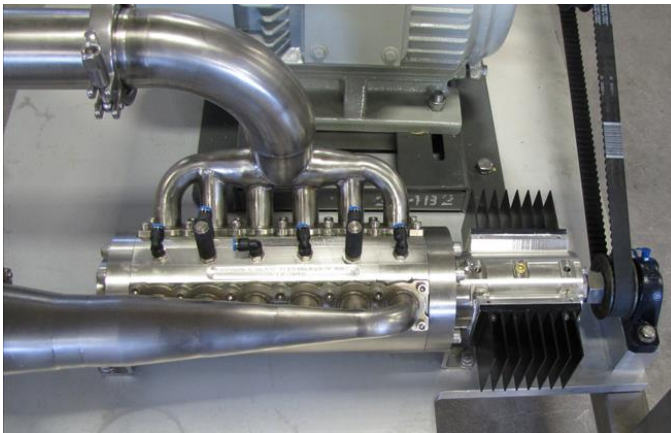


Naturally occurring cavitation is everywhere. It is nature's way of cleaning water

Like fire, wind, electricity, or nuclear power, it is a powerful force that can be harnessed, controlled, intensified and applied



Mitton Reactors Repurpose Cavitation from Destructive to Constructive



The robust, scalable, and highly efficient line of Mitton reactor systems ranges from the MCR-125 (125 LPM) to the NEW MCR-2000 (2000 LPM) -- and reactors are stackable to process volumes of 40,000 LPM and beyond.



High speed photography (1000 fps) shows the powerful rolling harnessed cavitation field generated within the reactor core. While it is a destructive force, this cavitation does not affect the reactor itself in any way.





What Does Conquering Cavitation Mean?

- Controlled cavitation offers an in-line **chemical reactor** that facilitates otherwise difficult and high-energy reactions.
- Creating a field of controlled cavitation, using a nominal amount of mechanical energy (1kW to treat 1000 US Gal), makes intense forces available to induce **chemical changes**.

What we Can do...

Anaerobic Biomass Digestion: accelerates digestion of biomass in methane harvest for power generation

Polymer Recovery: achieves recovery of flock or gum removal in sticky tanks

Produced Water Remediation: mobile or fixed process can recover water by stratifying polymers, heavy metals and chemicals into dividable, recoverable layers

Industrial Filtration: stratification of materials for removal of TSS

Industrial Organic Sludge Remediation: (Industrial Food Waste & Sewage)
BOD/COD/TSS reduction of over 50% in 45 minutes

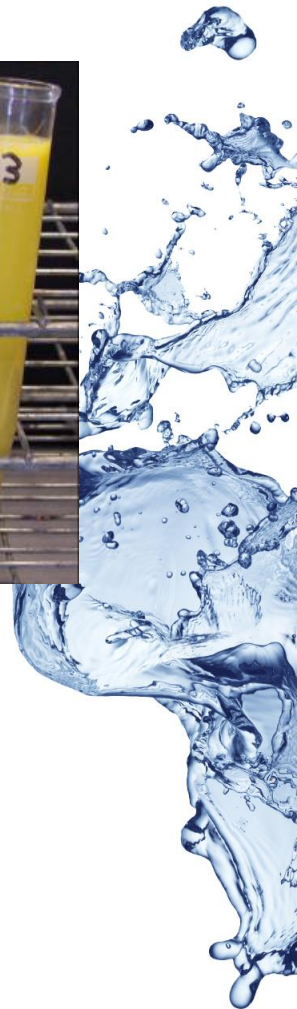
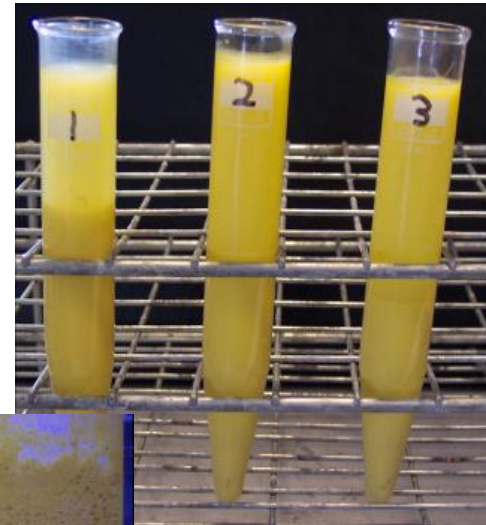


Examples of Processes

- Biofuel treatment
- Shock **emulsion separation** for decant and recovery of water and commercial products
- Segmentation of oil sand tailings for bitumen recovery
- Elimination of PRO in brewery processing
- Wastewater remediation/leachate from landfill sites

Thin Stillage Recovery

and Ethanol Extracted from Waste



Produced and Flowback Water

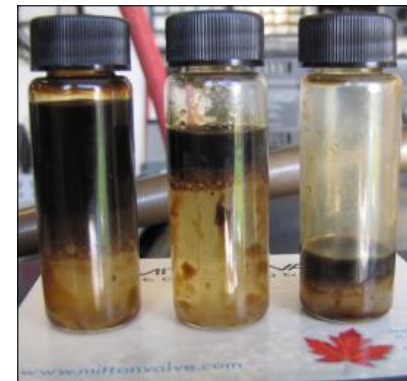
Texas Permian Basin

Remediation of produced water from drilling operations in the Texas Permian Basin.

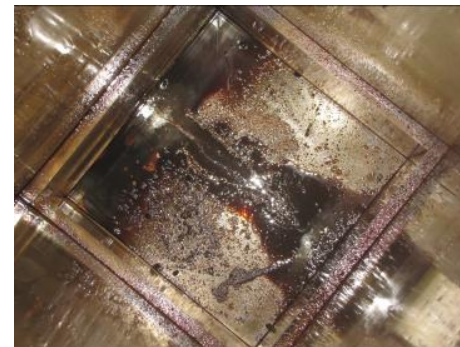
- Additional skim oil recovery
- Water remediation and cleanup
- H₂S conversion and elimination
- Volume exceeded 6000 barrels (252,000 gallons) using a MCR-250 over four days of daytime operation



Reclaimed Motor Oil



Separation of used motor oil after one pass
Through the reactor – no heat or chemicals required

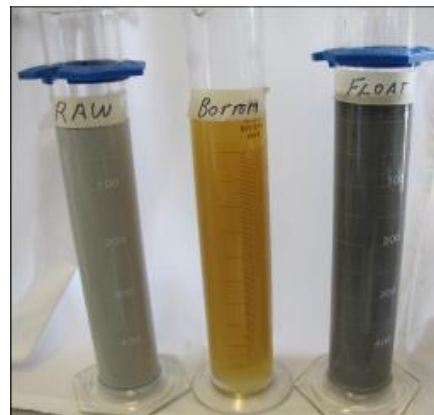


Oil Separation from Glycol / Water

Adding air to the reactor process causes oils and polymers to float to the surface for easy collection while allowing stratification of solids and water

Can an be used to enhance an existing system or as a stand alone process

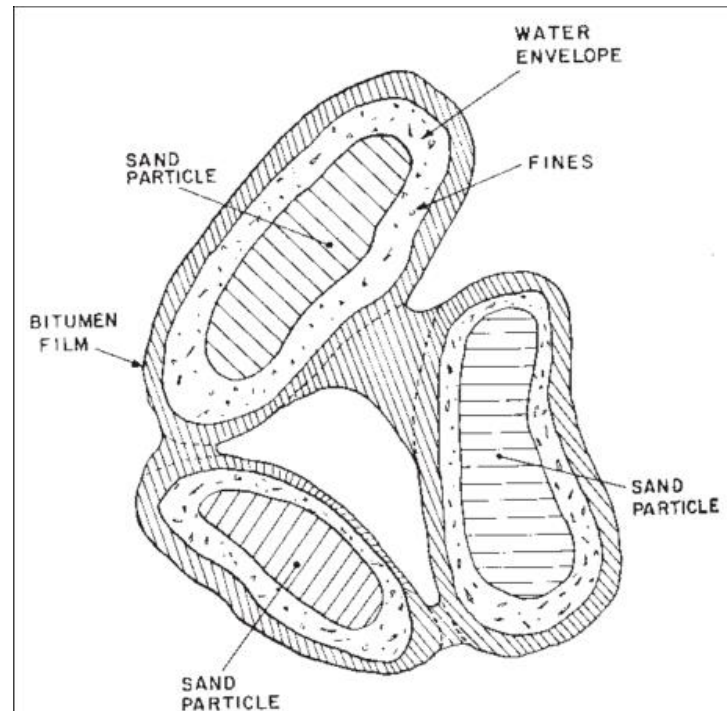
Shown here breaking an oil emulsion



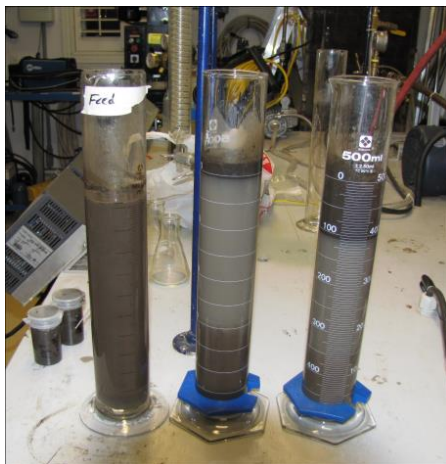
Oil-sands Tailings Remediation

and Bitumen Recovery

Each grain of fine sand is covered by a film of ancient seawater surrounded by a slick of heavy oil



Oil-sands Tailings Remediation and Bitumen Recovery



**Segmentation of
Mature Fine Tailings**
5 passes – 81% recovery

Recovered Froth



Recovered, Refinable
Bitumen



Oil-sands Tailings Remediation and Bitumen Recovery

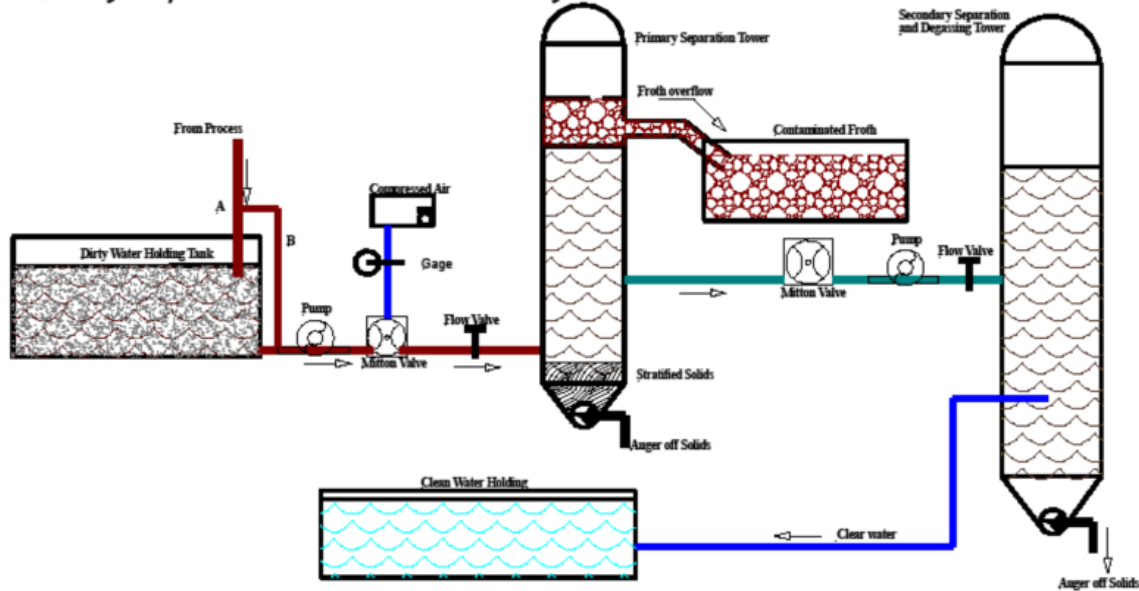


Recovered 2.5 L of Bitumen from 60 L of Tailings

Note the layers of recovered water and solids (clay) on the left



Slurry Separation and Water Recovery Flow Sheet



This drawing and process depicted here is, is the property of Mitton Valve Technology Inc. The technology is patent protected.



Mitton Reactor Size Range

- **MCR-125**: Small industrial system for pilot and low flow applications -- flows 125 LPM at 60 PSI
- **MCR-250**: Heavy duty unit ideal for sewage and black water uses – flows 250 LPM at 75-80 PSI
- **MCR-500 / 1000 / 2000**: *High flow and heavy duty* applications -- can be used in stacked configuration for large volume projects and to handle flows with higher viscosity or increased solids content

Equipped with sensor arrays and systems designed automate operations and maintain optimal cavitation while processing heterogeneous fluid streams

Stackable to enable potentially unlimited processing volumes

Reactors can incorporate entrainment system for introduction of gases such as air, oxygen, CO₂, ozone, chlorine dioxide, and nitrogen into the harnessed cavitation field in the reactor chamber

Benefits Overview

- Resistant to the effects of the cavitation it generates
- Low energy use: 1 kW to treat 1000 US Gallons
- Standard connections, easy portability and minimal footprint enable easy integration into existing processes
- Endemic Rechner sensor array and automation system optimizes and correlates variables such as motor speed, pressure/vacuum, acoustic frequency and flow rate while reporting them in real time to selected web interfaces

Benefits Overview

- Stackable design enables upwardly scalable solutions
- Easily processes sludges and slurries that would bog down other systems
- Operates under both positive and negative pressure
- Entrains gases into – and extracts gases out of – solution in liquids
- Intense molecular-level pressure, heat and shear enables low-energy emulsion breaking, cell lyses, hydroxyl radical generation and radical chemical design processes



Company Support



Mining the Water: Laboratory Test Results*

Parameter	Raw (mg/L)	Treated (mg/L)	Reduction (%)
Iron	110	0.195	99.98
Magnesium	71.9	15.5	78.44
Manganese	1.5	0.0362	97.60
Potassium	18	8.36	53.55
Sodium	26.8	18.7	30.22
Aluminum	47.8	0.104	99.78
Arsenic	0.175	0.0046	97.37
Barium	0.647	0.0293	95.47

*Flowers Chemical Laboratory Inc. January 22, 2015



Mining the Water: Laboratory Test Results*

Parameter	Raw (mg/L)	Treated (mg/L)	Reduction (%)
Chromium	0.0487	0.0010	97.95
Lead	0.282	0.00930	96.70
Molybdenum	0.457	0.0156	96.58
Nickel	0.0907	0.00120	98.68
Zinc	8.75	0.119	98.64

*Flowers Chemical Laboratory Inc. January 22, 2015



Mining Applications?

We are always looking to industry experts for informed insight into new applications and opportunities

Please feel free to approach us with ideas!

Welcome to The Cavitation Age

We look forward to addressing your suggestions and questions

mittoncavitation.com

