

An Oleophilic Hydrophobic Magnetic (OHM) Sponge for Environmental Remediation (NSF STTR Award: 2151578) Vikas Nandwana^{a,b}, Vinayak P. Dravid^{a,b}, Monisha Michael^b a - Northwestern University, Evanston Illinois; b- MFNS Tech Inc., Glenview, Illinois Motivation Y Results ** Customer dise OHM Sponge • OHM Sponge can selectively remove oil from oil/water mix, regardless oil **Produced Water** Interviews is present on the water surface OR below it. with end • It has the ability for fast absorption of oil with minimal/no water intake. users and OHM sponge can work with any shape/size and types of oil. decision Water makers **OHM sponge performance in different conditions** OHM OHM Sponge can be reused At any pH (acidic or basic) 5 Squeeze & re-use; many times! dozens of times without any cit In US alone, >20,000 spills in 2021 Sepa change in performance. ranging from 10 to 126k gallons (Oil/Ga Ca Absorption capacity of OHM Chemical sponge is not influenced by Existing solutions 5 **Sqk** 10 salinity, pH and type of oil. Ter Treat Skimmers Mass absorption capacity is 2 3 4 5 6 7 8 9 10 Sa 11 13 measured using ASTM F726 79 Cycles pH **(හි** 40 35 standards. **හි** 40 **හි** 35 Removes all types of oils Mass absorption capacity In salty or fresh waters $=(m_2-m_1)/m_2$ Ocean Salinity **1** 30 ~ 0.6 here, m_1 and m_2 denote the 25 25 Cap weight of sponges before and **9** 20 **Partial Oil Recovery** Fast after the absorption test. **Slow, Inefficient** Abs **Sq** 10 Absorption capacity of OHM sponge is temperature EDX independent between 2-40°C. 0.125 0.25 0.5 ne octane Dodecane oform Oil Dodecane Motor pump C Sorbents Salt Concentration (M) (g/g) Commercial Crude Oil Removal with OHM Sponge (g/g) Temperature Independent Cycle 1 Cycle 2 Cycle 3 Butto city Capa **Regulatory** Approvals **Efficient, Selective** Fast Expensive, Physical Waste Azerbaijan Middle Middle South West Texas OHMSETT 2 °C 22 °C 40 °C Eastern Light American Heavy Blend Eastern **Our Solution Temperature of water Extra Light** Heavy - **O** = Oleophilic, OHM Media Oil/Water **Commercial or** California Depa Produced Activated OHM media is another OHM Media **H** = Hydrophobic Mix Used Sponge Fish & Wildlife mixture Media Carbon Shell Water formulation of OHM ohm OHM **M** = Multi-functional U.S. Environme **4**.... inside sponge that can be Coating OHM Media ✓ Repurpose | used as a filtration Protection Age Repurpose ✓ Remove OHM media to remove oil Reuse ✓ Recover Media impurities from any Col Recycle ✓ Reuse oily wastewater (such + ✓ Recycle as produced water) **Pre-Pilot**



US oil/gas industry generated 800+ billion gallons produced water in 2021





✓ Reduce Restore

Commercial

cellulose sponge

coating layer

OHM nanocomposite Clean Water

down to concentrations less than 5 ppm.

// Stewards of the Environment//

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Market study and Future work						
covery in NSF Boot-camp program22+Focus Fields			Current Pain Points	OHM Sponge Advantages	S	
	Oil spill response	Wastewater treatment	Single use and slow	Re-usable and Fast	alue Pro	
	Soil remediation	Food processing	Hazardous Waste	No/minimal Waste	opositio	
media OHM sponge			High Cost	Low cost		
Nater ration is, Food ls, Pow L.3 B tiary tment .3 B	d, P Ver)	Post Oil Spill Lanagement \$24 B Sorbent \$2 B	impact Future Prospects • Heavy metals • Excess nutrie • PFAS, microplastics	impact impact int f, etc., The state of t	temediation lettos ses	
Outreach & Broader Impact						
Developed oil spill demo kit.						

Demonstration at local schools/social media outlets. • PR: <u>TEDx</u>, <u>NBC</u>, <u>FastCompany</u>, <u>WBEZ</u>, <u>OHMSETT</u>, <u>The</u> Economist, USA Today, the guardian.

ne	Status				
	National Oil Spill Response Research & Renewable Energy Test Facility for independent testing of novel technologies for oil spill clean up. <mark>Approved</mark>				
artment of	Provides approvals of Oil Spill Clean-Up Agents (OSCA) for use in CA waters. Approved				
ental ency	Evaluates products for oil spill removal under NCP category of sorbents. Under process				
laborat	ons 😥 Acknowledgements 🕑				
	Onversations Dr. Rajesh Mehta, Program Manager, NSF				
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	Soft and Hybrid Nanotechnology Experimental Resource North western University Atomic and Nanoscale Characterization Experimental Center				

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