Oil Spill Bioremediation Products
Asking the Questions

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NOAA
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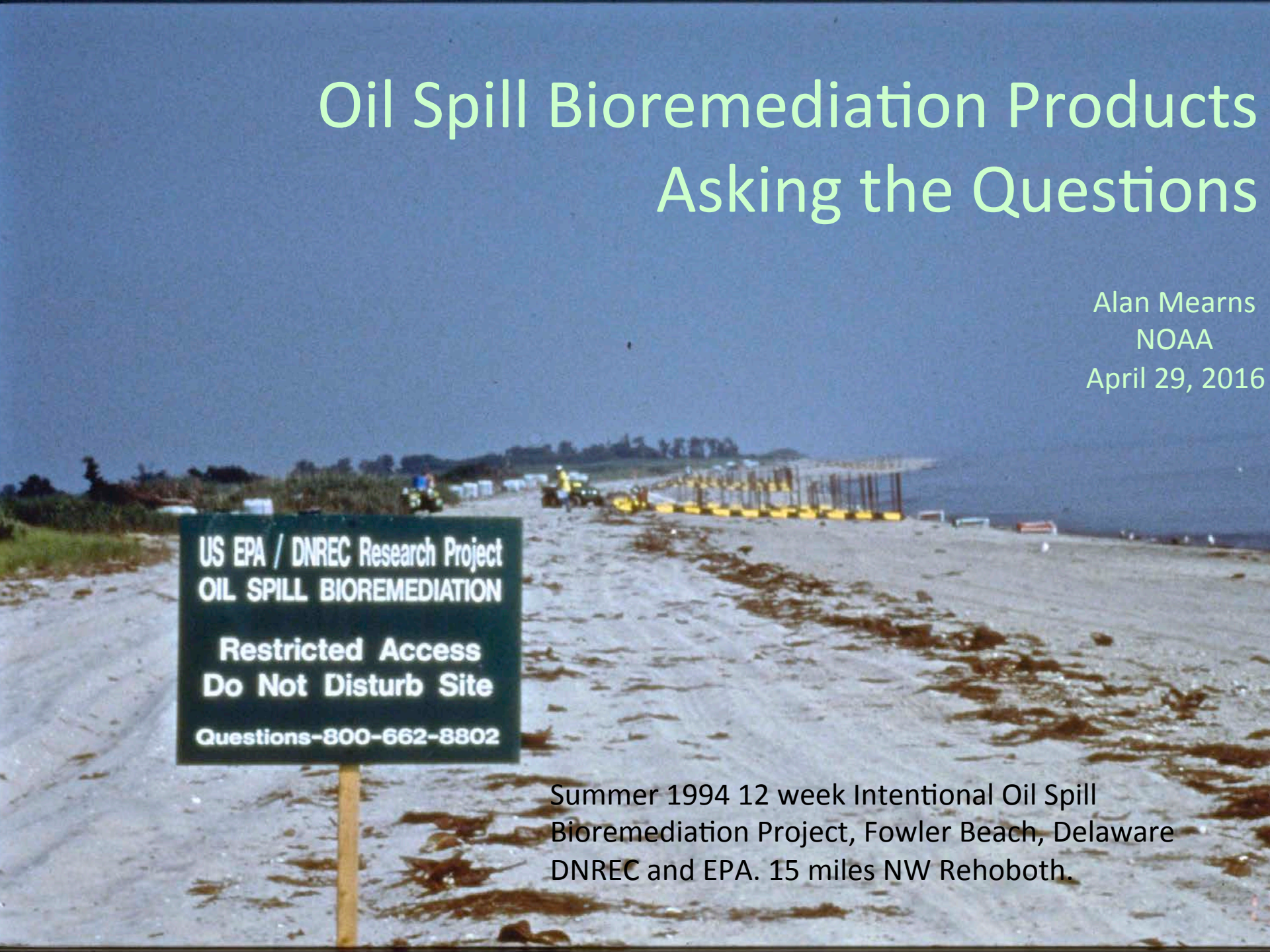


Summer 1994 12 week Intentional Oil Spill Bioremediation Project, Fowler Beach, Delaware DNREC and EPA. 15 miles NW Rehoboth.

Bioremediation vs Biodegradation?

Bioremediation: The **act** of adding materials to contaminated environments to accelerate the natural biodegradation process.

Added Materials can include:

- Nitrogen and Phosphorous (nutrients)
- Oil-degrading microbes
- Surfactants
- Other emerging materials (eg.,nano techologies)
- Organic materials (bagasse, sludges)
- fast-growing plants (phytoremediation)

What's Information is Out There?

- Peer Reviewed Literature - nearly 600 publications about bioremediation of spilled oil
- Over 100 papers on use of nutrients (N,P)
- EPA National Product Schedule lists about 2 dozen commercial products
- The EPA listed products have been tested in laboratory flasks for
  - Product toxicity to marine and aquatic animals
  - Product effectiveness in degrading diesel and crude oil

What's Information is Not Out There?

- With the exception of nutrient formulations there are no peer-reviewed papers on specifically-named products on the Product Schedule.
- With the exception of nutrient formulations there are no peer reviewed publications on the effectiveness of Listed Products in actual marine field situations.
- There are no peer reviewed publications on the extent to which the commercial products reduce toxicity of treated oil

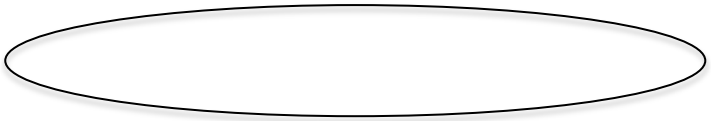
What Questions Should You Ask About A Bioremediation Product?

1. What's in it?
2. How Does it Work? (mode of action)
3. What Does it Degrade?
4. How Fast Does it Work (compared to alternatives)?
5. To What Extent Does it Reduce Toxicity of Oiled Substrate?
6. What Supporting and Peer Reviewed Data is Available?

1. What's In It?

A. Read the Label.

"Contains Nitrogen, Molasses, Non-Ionic surfactants, Sugar, Protease, Phosphorus, Amylase and Anionic surfactants"



B. See EPA SubPart J.

C. Ask Vendor.

2. How Does it Work? (Modes of Action)

- What are the functions of the ingredients?
- Stimulates Oil Degrading Micro-organisms?
- Does it Change the form/fate of the oil or Disperse it?

3. What Exactly Does it Degrade?

- PAHs?
- Alkanes?
- Total Petroleum Hydrocarbons?

4. How Fast (Days) Does it Accelerate Hydrocarbon Degradation?

- Compared to No Response?
- Compared to Nutrient Additions?
- Compared to other Products?

5. To What Extent and How Fast Does it Reduce Toxicity of the Treated Oil Spill ?

- To marine and aquatic invertebrates?
- To fish?
- To Birds and Wildlife?

Note: I looked at NPS data on toxicity of treated oil. Data were discovered for 6 of 24 products. In 3 cases, the additive increased the toxicity of the oil.

6. Where Can you get Independent Supporting and Peer Reviewed Data?

- Ask the vendor
- Do a literature review
- Sponsor a full scale mesocosm or intentional oil spill study (viz a vis DNREC 1994)

Example Question

What Do the Enzymes Do?

Enzymes are biological molecules (proteins) that act as catalysts and help complex reactions occur everywhere in life.

An **amylase** is an enzyme that catalyzes the hydrolysis of **starch** into **sugars**.
Potatoes are high in starch.

A **protease** is any enzyme that breaks down **protein** into **amino acids.**
Meat is high in **protein**

Trigger Question: Do they also degrade petroleum hydrocarbons?

More Example Questions

What Do the Surfactants Do?

Surfactants are compounds that lower the surface tension (or interfacial tension) between two liquids or between a liquid and a solid. Surfactants may act as detergents, wetting agents, emulsifiers, foaming agents, and dispersants.

Trigger Question: Does product disperse oil?

What Does the Molasses Do?

Molasses is a thick, dark brown syrup obtained from raw sugar during the refining process, a version of which is used in baking.

Trigger Question: Does the molasses stimulate growth of non-hydrocarbon degrading bacteria (MPN)? What kind? Serve as a surfactant?

Another Example Question

To What Extent Does it Reduce Oil Toxicity?

Compared to no additives?

Compared to Nutrients?

For sensitive marine organisms?

Trigger Request: Please provide data on rate of toxicity reduction of treated oil

What's Happening Today?

- Sub-Part J Revision
- EPA Bioremediation Fact Sheet revision
- Oil Spill Recovery Institute (in Alaska) RFP
- ~~Planning NOS/NCCOS Mesocosm study of Bioremediation products~~
- One NGO is sketching out a peer field study for one Product on the Schedule

Oil Degradation Additives

Request for proposals

The Oil Spill Recovery Institute (OSRI) in Cordova, Alaska is interested in determining the potential effectiveness of oil degradation additives that are on the Environmental Protection Agency's National Contingency Plan product schedule that could be used in response to an oil spill.

Program objective

The objective is to determine much degradation agents accelerate the removal of oil from the environment, the hydrocarbon components that remain after degradation, and the toxicology of the agents.

Several products have been proposed as additives to spilled oil to speed up the natural degradation of oil by microbes. Few have been tested in conditions expected in the Arctic or Subarctic. We desire to test the efficacy of these agents prior to a spill so we can understand their potential for spill remediation and their potential effects on the environment. There is a need to understand how much the agents accelerate degradation, what the natural response time is to the additive, and what end and intermediate products are produced. Determination of toxicity is also desirable for understanding the impact of using these products. Testing is to be done at temperatures and salinities representative of Alaskan waters, with microbial assemblages from those waters, using bioremediation agents listed on EPA's NCP product schedule. Of particular interest are enzyme additives. Depending on the number of degradation agents to be tested, and if toxicology tests are included, we expect the tests to last one to three years and cost $50K-$150K per year depending on the scope and complexity of the testing. OSRI will provide up to $75K in fiscal year 2016 for such projects.

All proposals must link the research activities to OSRI's mission and goals. A description of OSRI and our mission and goals is at http://www.pws-osri.org/. Grant application materials can be found at http://www.pws-sri.org/grants/policy_manual.shtml with appendices D and F of most importance. OSRI has a single application form for all size grants, but does not expect that all areas within the application form will be relevant to every request for proposals. **The deadline for submitting applications is February 19, 2016.** Funding can begin as early as July 1, 2016. Applicants are encouraged to contact Dr. Scott Pegau, OSRI Research Program Manager (wspegau@pwssc.org), if you have questions regarding this opportunity.

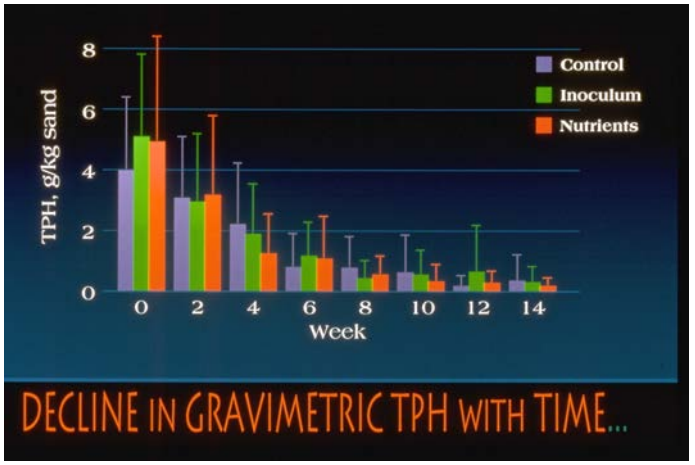
Oil Spill Recovery Institute, P.O. Box 705, Cordova, AK 99574, 907-424-5800 x222.

Oil Spill Recovery Institute

Oil Degradation Additives
Request for Proposals
December 15, 2015

OSRI Proposal are now under review

In closing, I wish we could do more of this!



Thank You
Ben Anderson!

Thank You