American Society of
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Use of Cotton and Cotton By-products for Oil Spill Remediation

Environmental degradation caused by the massive oil spill in the Gulf of Mexico can be greatly reduced by using natural products, such as cotton, in lieu of synthetics to absorb and recover oil from the ocean. Cotton and many cotton byproducts are much more efficient than synthetics in absorbing oil. Agricultural engineers reported in 1994 that cotton fiber can absorb about 40 times its weight in oil, as compared to synthetics that currently absorb 10 to 20 times their weight. The oil absorbed by cotton along with the cotton itself will degrade naturally in the environment, which is not the case for synthetics. Additionally, cotton fiber and its fibrous byproducts can be reused to absorb additional oil.

Research by agricultural engineer and ASABE Fellow Wm. Stanley Anthony at the U.S. Department of Agriculture (Anthony, 1994) demonstrated that cotton lint absorbs up to 80 times its weight in oil, and cleaned lint cleaner waste can absorb up to 67 times its weight in oil. Gin waste products containing more lint fiber by weight were more effective than those whose composition was dominated by non-lint materials such as hulls and seed cotton cleaner waste. With chemical modifications such as the addition of acetic anhydride, the absorptive capacity can be increased. Furthermore, cotton can be reused through several cycles after removal of absorbed oil although the oil absorption decreases (Deschamps et al., 2003). Based on these reports, lint-containing cotton fiber and fibrous gin waste products appear to be superior to many of the synthetic materials currently being used in the oil cleanup.

Unlike synthetic products like polypropylene, cotton will compost naturally and lead to bioremediation of absorbed oil.

Assuming an absorptive capacity of 50 times the weight of properly dispersed cotton fiber, a 500-pound bale of cotton fiber could absorb 25,000 pounds of oil (76 barrels of oil based on a specific gravity of 0.933). As of April 1, 2010, there were 8 million bales of cotton and cleaned lint cleaner waste in storage in the U.S.

As demonstrated by the research done by agricultural engineers more than fifteen years ago, natural fibers can be provide effective materials for dealing with oil spills. It is likely that other natural fibers from the products of forestry and agriculture would also perform well; however, their efficacy has not been researched as thoroughly as that of cotton. Updated engineering research and development are needed to further develop cotton and other natural fiber oil absorbent materials in preparation for inevitable future oil spills.

References

Anthony, W.S. 1994. Absorption of oil with cotton products and kenaf. *Applied Engineering in Agriculture* 10(3): 357-361.

Deschamps, G., H. Caruel, M.E. Borredon, C. Bonnin, and C. Vignoles. 2003. Oil removal from water by selective sorption on hydrophobic cotton fibers. 1. Study of sorption properties and comparison with other cotton fiber-based sorbents. *Environmental Science and Technology* 37(5): 1013-1015.

Additional Research Needs

The oil spill in the Gulf of Mexico has highlighted the need for additional research regarding the efficacy of natural fibers and their by-products for use in remediating environmental damage caused by oil spills. Pertinent research questions include:

1. Absorption and Efficacy
    a. What is the oil-to-cotton (or other fiber source) mass ratio of absorption that can be practically expected in at-sea oil recovery, and what variables affect this number?
    b. Could treatments be applied to the fiber to make it more absorbent in the ocean environment?
    c. What effect does weather (temperature, wind speed, sea state, current, etc.) have on the efficacy of at oil absorption?
    d. After natural fibers absorb crude oil, does the oil break down over time such that certain fractions might be released back into the water?

2. Application and Re-use
    a. What is the most efficient way to spread natural fibers such as cotton over a broad ocean surface area?
    b. What effect does weather (temperature, wind speed, sea state, current, etc.) have on the efficacy of at-sea application?
    c. Is there an efficient at-sea method for collecting oil-laden fibers, processing it to remove and collect the oil, and re-using the fibers to collect more oil?

3. Disposal
    a. Do natural fibers improve the ability to burn spilt oil by collecting it and keeping it at the surface?
    b. What treatments could be applied to the fibers to possibly increase their propensity to effect microbiological breakdown of the oil-laden fiber mass at sea?
    c. Do situations exist in which the oil-laden fibers would sink to the bottom, and if so, what variables affect this outcome?

4. Economics
    a. Assuming a process can be developed for efficient at-sea fiber application for oil absorption,
        i. What is the estimated cost per square mile?
        ii. How does that cost relate to the size of the current spill?
        iii. Is the required amount of natural fiber available?
        iv. What would be the effect of massive use of fibers in this manner on the existing market for such fibers?
    b. What are the economic trade-offs among using baled cotton, baled motes, and other possible forms of cotton and cotton waste materials?

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