Usage of natural resources for the management of an oil spill

Abstract

This experiment investigates what technique is the most effective for the management of an oil spill with natural resources that are available to 3rd World Countries, as these places do not have the sufficient money or resources to deal with this problem. There were three techniques tested; a bamboo boom, the bamboo boom with a biological agent and the biological agent, as well as a control with no technique. The effectiveness was measured through the distance between the height of the water level at the beginning of the experiment and the height at the conclusion. This measured the amount of evaporation, and hence, which simulated environment was able to function to the highest degree of normalcy, with the largest distance being the most desirable outcome. This was chosen as my method because it demonstrates how effective each technique was at managing the impact that the oil spill had on the environment. The hypothesis of the Boom with the biological agent being the most effective was proved incorrect, with the biological agent alone having the most water evaporate, with an average of 11mm against the 9.3333 of the boom with the biological agent. Following this was the boom and then the control.

Hypothesis

That the technique boom + biological agent will be the most effective at managing the oil spill

Aim

To investigate the most effective technique for the management of an oil spill using natural resources that are available to a 3rd World country.

Background Information

While there have been amazing developments at the cutting edge of oil-spill clean-up, such as the recent invention of a cloth that can remove 99.99% of the oil from the water[1]. However, very little has been done to help people who live in 3rd world countries to manage oil spills, especially when the companies responsible refuse to pay to clean up the oil-spill[2] or to continue to pay[3]. On the MSDS (material safety data sheet) about crude oil, under the heading of "ecological information", it states that "Dissolved components will either be absorbed by sediments or evaporate to air. In aerobic water and sediment they will biodegrade"[4]. This shows the scientific process behind the reaction of the oil towards both the water and the added biological agent. Another piece of information about the biological agent, is because it is manure, it contains bacteria and other micro-organisms[5], which then biodegrade the oil down into fatty acids and carbon dioxide. The added nitrogen and phosphorous that are present in herbivorous manure also help to stimulate the growth of these micro-organisms. The biological agent that I have chosen also has the additional benefit of being not only extremely cheap, but also it is readily accessible, for all people, and is something that may have gone to waste beforehand. The undissolved oil remains a problem, however, this proposed method addresses as much of the oil as possible, however it does not get rid of all the oil.

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[1] "Unmixing oil and water" Science News. 7/2/2013. http://www.sciencenews.org/view/generic/id/343319/description/Unmixing_oil_and_water

[2] "BP partner refused to help pay for Gulf spill." Sydney Morning Herald. 24/3/2013. http://www.smh.com.au/environment/conservation/bp-partner-refuses-to-help-pay-for-gulf-spill-20100714-10aum.html#ixzz2OQ1PQPOq

[3] "Us BP spill appeal" Reuters. 24/3/2013 http://www.reuters.com/article/2013/03/15/us-bp-spill-appeal-idUSBRE92E12Y20130315

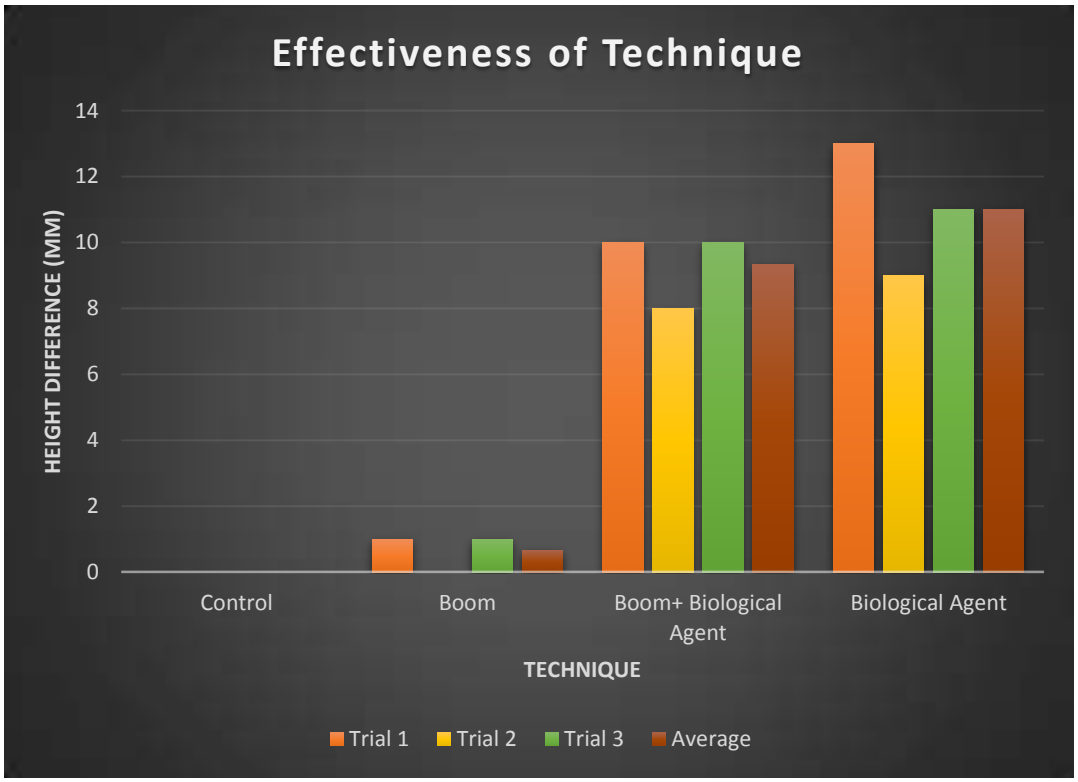
[4] Shellre Material Safety Data Sheet-Crude Oil, p.7

[5] "How do you clean up an oil spill" Delaware Sea Grant Program. 14/2/2013. http://www.ceoe.udel.edu/oilspill/cleanup.html

Method

1. Measure and subsequently cut 6 45cm lengths of bamboo with a similar width and tie ends together of each piece with a bread tie.
2. Fill 12 4L containers with 3L of sea water and arrange on a flat surface outside
3. Place a mark at the water level height with permanent marker for each of the containers
4. Label the first three containers as Control #1, #2 and #3, the next 3 as Boom #1, #2 and #3, the next as Boom + biological agent #1, #2 and #3 and the final 3 as Biological agent #1, #2 and #3.
5. Pour 20mL of gear oil into each container
6. For the containers labelled “boom” place a boom around the oil
7. For the containers labelled “boom and biological agent” place a boom around the oil and then add 25g of biological agent over the surface of the oil
8. For the containers labelled “biological agent” add 25g of the biological agent over the surface of the oil
9. Bump the flat surface 30 times a day twice while walking around the surface to simulate wave action.
10. After three days, add 15g of biological agent to the containers labelled “biological agent” and “boom and biological agent”
11. After three weeks, mark on the side of each container the current water level height
12. Measure the distance between each mark
13. Record results and observations

Results



Effectiveness of Technique				
Technique	Trial 1 (mm)	Trial 2 (mm)	Trial 3 (mm)	Average (mm)
Control	0	0	0	0
Boom	1	0	1	0.66667
Boom+Biological Agent	10	8	10	9.33333
Biological Agent	13	9	11	11

Discussion

Considering the restricted budget and limited international influence that the majority of 3rd world countries and regions have, the management strategy that they employ has to be one that utilises natural resources that are readily available and inexpensive. Using these guidelines, the technique that is the most effective for the management of an oil spill is the use of biological agents, with the tested agent being herbivorous manure. This is shown through the averages, where the biological agent achieved an 11mm average while the next closest was 9.3333mm. As shown through the background research, the biological agent did assist in the biodegradation of the oil in all containers in which it was present. After the biological agent was added, the average height difference changed from 0 and 0.6667 to 9.3333 and 11, clearly demonstrating the link. However, something that emerged was the importance of reaction time. There was very little difference between the boom + biological agent and the biological agent containers, however clearly the biological agent containers experienced a greater effectiveness. However, the boom containers had proved the suggestion in the background research that the bamboo acted as a low-potency biological agent as while it did not contain the spill, a slightly higher level of evaporation was achieved over the control, and oil was seen to be bonded to the bamboo. My other hypothesis as to the difference in results for the bamboo+ biological agent and the biological agent containers is that the boom acting to keep the oil concentrated in a singular location prevented the biological agent from acting at a high degree of efficiency.

An anomaly however, was that without exception, the containers that were in the number 2 position had a lower effectively rate. I believe that the cause perhaps may have been the position on the table, but I do not know what could have been different between positions 1 and 3 and position 2.

To improve the experimental design of my experiment, I believe that I should have had a 5th row of containers that did not contain any oil, as a comparison as to how a healthy marine ecosystem should function. I would next time record each day as to the difference between the water level and the original water level to later show under which timeframes the oil spill experiences the greatest amount of change and the marine systems acts with the greatest degree of normalcy. The other area that I would change would be to design a system to deliver a greater simulation of currents and wave patterns, to again make the circumstances more realistic.

I unfortunately was unable to use crude oil for my experiment, which would have made my experiment more realistic, however, because of the extreme volatility and flammability of crude oil (class 3-Flammable material), it would not have been safe to do so and it is not available to the public.

Acknowledgements and Bibliography

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Letter

Dear Mr Burke/Mr Carr,

It has come to my attention that while there are improvement constantly being made on the highly technological clean-up of an oil-spill, there are no measures that have been put into place or recommended for 3rd world countries that only have access to natural resources, to manage the effects of an oil-spill. This is increasingly becoming a problem as the big oil companies will attempt to avoid paying the entire cost of the clean-up of an oil-spill, as is currently being seen through Bp's appeal to avoid paying for an extra clean-up/compensation payout to the affected people form the 2010 Gulf oil spill. While because of the magnitude of the oil-spill and subsequent media coverage has enforced action to be taken, this is not always the case, and as such, I believe that there should be management strategies that are recommended to 3rd world countries/regions that have previously been/potentially in the future affected by an oil-spill.

I have recently concluded an investigation into natural resources that can potentially assist in the management of an oil-spill. I have concluded that the most effective measure is the use of biological agents, which in this case is herbivorous manure. As outlined in the Ecological Information section of the Material Safety Data Sheet about Crude oil, the biological agent allows the absorption of the oil by sediments and subsequent biodegration in aerobic water and sediment. The chosen biological agent also contains nitrogen and phosphorous which assists and stimulates the bacteria and other micro-organisms that it also contains, to further naturally biodegrade the oil down into fatty acids and carbon dioxide. Because of this information, its quick and cheap availability and its performance in my study, in which it allowed the simulated marine system to function closer to normalcy than any of the other proposed solutions, I highly recommend this course of action.

For a short-term need or to quickly protect a vulnerable area, I suggest the use of a boom. In my study, I used bamboo because of its buoyancy and its properties that allow it to absorb certain substances. I understand that while bamboo is cheap, it is not readily accessible for many countries and if it is introduced, it can quickly become a noxious weed, which would become another ecological disaster. However, in this circumstance I recommend a wood of similar properties to be used.

If you have any further queries about my study, recommended courses of action or any similar query about this area of study, do not hesitate to contact me at isabe.woodforde@optusnet.com.au.

Yours Faithfully,

Isabelle Woodforde