INVESTIGATION OF CONTAMINATION REASONS OF BEACH SANDS

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Black sooty-like materials were observed in the sands of beach of the Waterfront areas of the Royal Commission at Yanbu – facing the Red Sea. Two kinds of samples of beach sands were collected. One sample was the blackish sooty-Like material marked as “contaminated sample” and the other was the clean or normal or un-contaminated sand and it was marked as “controlled sample”. The samples of both types of beach sands were investigated to determining the content of oil and the amount of organic matter in them. The oil content in the “contaminated sample” was determined to be about 20 times higher than the value in uncontaminated or the “controlled sample” of the beach sands. The organic matter content value in the “contaminated sample” although determined to be on a little higher side – as compared to those found in the “controlled sample” – however this value was determined to be less than 4 to 6% by weight of dry sample as is usually observed in a typical beach sand. Based on the physical and chemical analysis of the “contaminated” beach sands and comparing them with the “controlled sample”, it was safe to infer that these blackish sooty-like materials found in beach sites were due to some leaked or spilt oil in the Red Sea that were washed ashore during the high tide periods.

Keywords: Oil spill, Organic matter, Degeneration, Regeneration.

1 INTRODUCTION

Some unusual phenomena were observed as the development of some black sooty-like materials were noticed to have appeared on the sands of the Royal Commission-Yanbu maintained beach sites known as Waterfront.

Samples of the contaminated beach sands with black sooty-like materials were collected and were brought for tests in the Royal Commission Laboratory. The sample was properly marked and placed and stored in a controlled temperature conditions in the laboratory. The sample of the sand was marked as the “contaminated Sample”.

Another sample of clean and clear beach sands was also collected from the same location. It was marked as “controlled sample” or “uncontaminated sample”. This was also placed and stored in a controlled temperature conditions in the laboratory.

These samples were later transferred to a commercial material testing laboratory in the locality for its chemical analysis. The mandate given was to determine oil content and the content of organic materials in both the contaminated sample (with black sooty-like materials) and the controlled or uncontaminated sample of the Waterfront Beach sands.
2  STATUS OF ROYAL COMMISSION (RC) WATERFRONT BEACH POLLUTION

As observed during the visit to the actual site, some large patches of blackish and sooty-like materials were seen present – on the shores of the both sites visited.

These blackish sooty-like materials can be categorized as part of beach pollution.

The beach by and large was clean and well-maintained. These patches of blackish sooty-like materials were localized and were not widespread. This could be estimated to range from about 10 to 20% of the beach perimeter. As such it could be categorized as low to medium polluted.

Pictures from the RC Waterfront swimming pool area are attached as Figure 1 and Figure 2.

![Figure 1. Blackish sooty-like patches on Waterfront Beach.](image1)

![Figure 2. Blackish sooty-like patches on Waterfront Beach.](image2)
3 FINAL ANALYSIS BASED ON TEST RESULTS ON SAMPLES OF BEACH SAND

Contamination of the beach sand as observed in the case of RC Waterfront Beach Sands could be due to various reasons. Two of the principal reasons suspected were primarily due to oil spills and/or de-generation/re-generation of organic matters.

In order to arrive at the reason and cause of this contamination – in terms of formation of blackish sooty-like materials - of the RC Waterfront Beach sand, the following two types of samples of beach sand were sent to a private commercial laboratory – for its chemical analysis.

a. Contaminated sample
b. Clear or controlled sample or uncontaminated sample

The following tests were performed on the above two types of samples of beach sands.

a. Oil content
b. Organic matter content by ignition loss method

4 SUMMARY OF TEST RESULTS REPORTS

The test results are summarized as below:

Table 1. Summary of test results report on samples of sand from RC waterfront.

<table>
<thead>
<tr>
<th>SNo.</th>
<th>Sample Type</th>
<th>Oil Content %By Weight of Dry Sample</th>
<th>Organic Matter %By Weight of Dry Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test Method</td>
<td>Test Result</td>
<td>Test Method</td>
</tr>
<tr>
<td>1</td>
<td>Uncontaminated Sand Sample</td>
<td>APHA/AWWA (5520B)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>2</td>
<td>Contaminated Sand Sample</td>
<td>APHA/AWWA (5520B)</td>
<td>0.02</td>
</tr>
</tbody>
</table>

5 PERMISSIBLE VALUES OF OIL CONTENT IN BEACH SANDS

Mostly accidents that involve tankers, barges, pipelines, refineries, drilling rigs, and storage facilities become the principal causes of oil spills into rivers, bays, and the ocean. Spills can also occur by mistakes caused by humans for being careless and, also due to equipment breaking down, etc.

As per a rough estimate, the above contribute to about 5 million gallons of oil that leak to the ocean annually. This estimate can also vary from year to year. Oil may have been leaking for thousands of years – with varying rate of release for a given period of time. The statistics from the U.S. Department of Energy state that over 1.3 million gallons (4.9 million liters) of petroleum are on record to have spilled into U.S. waters from oil tankers and pipelines in a typical year (EPA 1999).

It is interesting to note – however – that because of the fact, that most kinds of oil are less dense than water, most spilled oil actually floats on the water surface. It also tends to spread out and eventually is pushed across the water by wind and currents.

It is on record that a substantial volume of oil finds its way into the sea via urban run-off into rivers, oil discharges from land-based industries and of course the effluents from municipal sewers. The point to note here – however - is that the concentration of oil in such discharges is rarely high enough to become a cause of gross contamination of the seashores. Such leaks sometimes appear as brown bands or oily sheen in the tide marks left by waves on a sandy beach.

Oil pollution is normally not seen to be uniform in either thickness or coverage. Contamination due to leak can range from pools of liquid oil to light staining and/or sheen. Due
to winds, ocean waves and ocean currents, oil are found to be deposited ashore in streaks or patches rather than as continuous layer.

An estimate and assessment of the quantity of oil found on a given stretch of coastline is needed for the purpose of managing shoreline clean-up. Such estimates are usually done by means of visual inspections. Such an exercise would become impossible if the oil is hidden from view.

Experience has determined that the volume of the leaked and penetrated oil would pose grave challenge ad would be impossible to estimate. But for a uniformly saturated sand, a useful rule-of-thumb would be that the pure oil content is approximately one-tenth (1/10) of the depth of oily sand. For calculating oil volumes, the occurrence of water-in-oil emulsion could cause an error. Research has determined that stable emulsions typically contain 40 to 80% of water - that is, the volume of “pure oil” may be as little as one-fifth (1/5) of the observed volume of pollutant (ITOPF 2008).

6 TEST RESULTS ON OIL CONTENT FROM FUGRO-SUHAIMI

As can be seen in Table 1 the oil content - in terms of percentage of weight of dry sample – for the uncontaminated sand sample is less than 0.001% while in case of the contaminated sample the value is 0.02%. That is, the oil content in the contaminated sand sample is 20 times more than that of the uncontaminated sand sample.

This is evidence of the fact that the blackish sooty-like material on the RC Waterfront sand may be due to oil accumulation of spilt and/or leaked oil – somewhere in the deep sea and washed ashore due to high-tide.

7 PERMISSIBLE VALUE OF ORGANIC MATTER CONTENT IN THE BEACH SAND

According to the traditional definition of "organic", a substance is organic if it consists of carbon compounds. The beach sand may contain other stuffs in it also - like, little bits of seaweed, driftwood, fish skeletons, shells, and lots of other organic materials (Galgani et al. 2011).

Study shows that sandy beaches provide a number of ecosystem services, such as the breakdown of organic matter, nutrient mineralization and also water filtration. These environments are considered as biofilters and able to regulate the transportation and transformation of organic matter from land to sea and vice-versa. It is due to the porous structure of the sediments and the colonization by microorganisms.

It has been observed that during seawater circulation - in permeable intertidal sands - organic matter degradation works to alter the composition of percolating fluids and causes remineralization products discharge into surficial waters. As a result, coastal seawater nutrient and organic matter composition change seasonally due to variations in pelagic productivity.

Scientists have also concurred that organic matter biodegradation proceeds due to the reasons of multiple enzymatic reactions that involve different oxidants as well as a number of intermediate compounds. Research has also established that microbial reworking of organic matter can result in a substantial microbial contribution to the total organic matter pool (Hossain et al. 2014).

7.1 Test Results on Organic Matter Content from Commercial Laboratory

As can be seen in Table 1, the organic matter content - in terms of percentage of weight of dry sample - for the uncontaminated sand sample is 1.80% while in case of the contaminated sample the value is 2.58%. That is, the organic matter content in the contaminated sand sample is 1.43
times more than that of the uncontaminated sand sample. However, this value of 2.58% is less than the value of 4 to 6% as is usually found in beach sands.

From the above it can be safely inferred that the blackish sooty-like material on the RC Waterfront sand may not be due to de-generation and/or re-generation of organic matter in the beach sands.

8 CONCLUSIONS

These blackish sooty-like materials observed at RC Waterfront swimming pool are or can be termed as one kind of pollution.

These were observed to be located at some small areas only and were not widespread. From a rough estimate made about its thickness and stretch, it can be safely concluded that they only cover roughly about 10 to 20% of the beach perimeters only. As such they can be termed as low to medium polluted.

Oil content in the contaminated sample of the beach sand was observed 20 times more than those in the clear or uncontaminated sample. This suggests the fact that the blackish sooty-like materials found in the beach sand may be due to some spilt or leaked oil in the sea that were washed ashore during the high tide.

Organic matter content found in the contaminated sample of the beach sands were determined to be 2.58% which is less than 4 to 6% that are usually found in the beach sands. This suggests that the blackish sooty-like materials were not due to de-generation or re-generation organic matter in the sands.

References


EPA, Understanding Oil Spills and Oil Spill Response, United States Environment Protection Agency (EPA), December, 1999.
