Oppenheimer
Biotechnology Inc.

Case Study

Site Description – Crude oil (bunker C) spill at sea in Japan

Site Location: Mikuni, Japan

Contaminant: Heavy Crude oil

Site Description: In January, 1997, the Russian tanker Nakhodka broke apart and sank in the Sea of Japan. The tanker was carrying 19,000 tons of heavy fuel oil. The bow half floated for about 5 days, during this period about of 5,000 tons of heavy oil spilled into the sea. The bow then ran aground on the shelf near the Fukui coast near the town of Mikuni. The stern section contained about 11,000 tons of oil, and fell 2,500 meters to the sea floor. Sub robot video pictures show the stern to be continually leaking.

Impact of the Oil: The immediate impact was that approximately 5,000 tons of released oil was carried by wave action carried to the coast of Japan. By the middle of February the oil had impacted the coast of 10 Japanese Prefectures from Shimane to Akita, a distance of approx. 1,200 linear km. If all the inlets, bays, and promontories are included, the spill had a potential coastal impact of 12,000 km.

Description of area. The shore line is mountainous and rocky with an occasional small bay with coarse sand and cobble beach. The diurnal tides were approx. 1.6 meters. The area of the site is north of Osaka along the Japanese sea coast in Khyogo, the area of Kasumi, at a small village, Shibayama. The bay was protected by jetties. In front of the town, concrete ramps and piers housed the fishing boats. The shoreline was part coarse sand and rocks. The linear area of the bay edge was approximately 3/4 km.

Description of oil after reaching shoreline. After the initial accident, a storm carried much of the beached oil high above the high tide line.

A second impact was observed along the occasional sandy beach where the shifting sands (due to wave and tidal action) covered the oil previously deposited on the beach. This covered oil would most likely come to the surface during later sand movement.

This oil had weathered in a month to dark varnish coatings on the rocks and jetties. Oil was also found on the driftwood and plastics that are brought ashore by storms and deposited high on the beach in the rocks or sand.

One area was highly impacted with both old dark tar-like weathered oil from the initial spill, and light brown platter-like tar patties from newly released oil.

The bow half of the tanker at this time had approximately 1,600 tons of oil left which continually leaked. The residual oil from the bow section was being pumped out, but due to heavy seas was still leaking into the sea as of February. The stern section was shown to be also leaking. The result is a continuous beaching of small numbers of large blobs of oil.

In addition to the new oil, the older oil from the initial spill had filled in between rocks and breakwaters. This oil was in large blobs floating in the water as the tide changed and wave action impacted the area. At time of high tides or heavy winds these blobs floated free and joined the new oil covering the shoreline on rocks and beaches.

Weather Conditions:
The weather along the coast was highly variable. The weather, during the project consisted of heavy seas and calm seas, rain, sleet, and sun. This affected the water level along the rocks and beaches. This change in energy along sand beaches would erode the sand during high

waves and then return the sand during calm weather. This impact could account for the observed burying of oil on the sand beaches.

Recommended Treatment Application Method (in-situ) : The mechanism of bioremediation involves not only the microbes but the type of oil, the age of the oil, the type of deposition, the thickness of the oil, and the oil's position relative to the tidal height and to wave action. The microbes will only work at the oil water interface. Therefore, blobs of oil above the high tide zone will take a long time to decompose relative to the availability of moisture. The oil on rocks and sand within the tidal range will degrade at a faster rate. Conditions along an open beach will directly affect the time necessary for bioremediation.

The daily removal of a small layer of oil from a thick blob cannot be detected. Also, it is impossible to arrange adequate control sites along a variable beach environment. The visual results of bioremediation may be slow but they are the only indication. If a control site is contemplated, it should be far to the south of the treated site, out of the influence of the current that could carry microbes northward along the coast. The microbes from the treated site will move to the northeast as directed by long shore currents.

Approval for use of Oppenheimer products: The application of BioZorb® had the direct approval of Mr. Terakawa, head of the local fish cooperative; and Mayor Aoyama of Kasumi Town, Hyogo Pref. The application had the indirect approval of the local Coast Guard who knew of the bioremediation project and did not prohibit it.

Goal: The goal of the program is to cleanup the beaches to allow the local community to be able to fish and conduct business as usual prior to the spill.

Outcome: Duration of the treatment time to bioremediate the area was approximately 180 days (6 months).

Prior to our visit Mr. Kono, Mr. Terakawa and Mr. Takai of the Fuji Packing Company of Osaka, had added BioZorb to two areas, one on a breakwater and the other on rocks. Video taped daily coverage showed a reduction of thickness of the oil. Visual observation plus the video record confirmed that a reduction of oil was evident.

Our first effort was to show the absorptive property of BioZorb®. An oil covered rock was treated with the powder and the resultant oil-powder was washed into sea water, leaving a clean rock surface. The crude oil on people's hands was cleaned by the same process. These observations of oil reduction and cleansing were followed by a general application of BioZorb® in the area.

Reversal of oil toxicity on attached algae when an emulsion of products was applied to the oil. The oil was then removed as a blob. Additional applications removed residual oil and 24 hours later the algae were alive. Rocks covered with oil were cleaned by BioZorb®. The resultant powder-oil was washed into the sea where it continued to biodegrade. High pressure removed tar from concrete above the tide zone. The oil was pretreated with BioZorb®. The combined removed oil and product washed into the shore water discolored the water. In 12 hours the water was clear. No harmful effects to the marine life were detected during the following weeks. Oil blobs, treated with an emulsion of product were then peeled off the rock surface.