USE OF ELASTOL DURING THE UNOCAL SPILL ON THE NECHES RIVER 24 APRIL 1993

Prepared for:

Regional Response Team VI

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May 1993

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Spill Summary

On 20 April, 1993, at about 0500, there was a release of approximately 2,100 barrels (88,200 gallons) of Kuwaiti crude oil (API gravity = 33°) from the UNOCAL facility at Port Neches, Texas. Much of the oil spread to Grays Bayou directly across from the facility, on the north side of the Neches River. Sheens were not observed more than three miles down river, though there were pockets of black oil along the river and at the entrances to small bays. Several different types of skimmers were deployed, including two skimmers operated by response contractors and the U.S. Coast Guard (USCG) Gulf Strike Team's Desmi skimmers and the Vessel of Opportunity System which was operated by the CG Cutter Papaw. By 22 April, two main pools of oil remained: one at the entrance to Grays Bayou and one at the inlet entrance next to the dayboard 29 right on the descending bank of the Neches River. Skimming activities continued on a 24-hour basis at these two sites. Estimated total recovered oil as of 23 April was 1,700 barrels (total skimmed liquid was 6,193 barrels). The USCG skimmers were released by noon on 23 April.

Objectives of Elastol Use

The possibility of using Elastol to increase the efficacy of skimming operations was discussed during the 20 April Unified Command meeting. Information on use of the product was gathered and evaluated by the National Oceanic and Atmospheric Administration (NOAA), who recommended that Elastol was usable with the oil spilled, but that application should be limited to pooled oil, not on sheen. NOAA also indicated that tests should be conducted prior to use of Elastol in marshes, and only if proper monitoring could be established. UNOCAL submitted a request to the Federal On-Scene Coordinator (FOSC) on 23 April to use Elastol. The Regional Response Team (RRT VI) held a telephone conference at noon on 23 April to discuss the three proposals submitted for Elastol use:

1) Allow the OSC/UNOCAL to test deploy Elastol in a controlled, monitored, limited open water area affected by the oil spill.

2) Allow the OSC/UNOCAL to deploy Elastol at the open water's edge, 6-10 feet into the marsh area.

3) Allow the OSC/UNOCAL to use Elastol on open water areas, only if the test of Elastol on open water was deemed successful by the OSC.

The RRT voted to approve proposals 1 and 3, that is, the trial use of Elastol on open water only and along banks of the bayous, and continued use of Elastol on this spill if the trial was successful. The request to test the use of Elastol on small areas in the marsh was not approved. The test application was to be monitored by appropriate Federal and State agencies, and UNOCAL was to document the efficiency of the test. NOAA was asked to assist UNOCAL in developing an acceptable work plan.

The official UNOCAL objectives of the Elastol test were to:

1) Determine whether free-water entrainment with Elastol is less than with conventional oil skimming.

2) Determine whether oil pick-up efficiency can be increased by using Elastol when compared to conventional skimming.

3) Determine what portion of applied Elastol is recovered with oil skimming versus that portion which is lost due to water entrainment, dissolving, sedimentation, or other reasons.

4) Document acceptable application parameters (mix rate, thickness of application, time to cure, etc.) if the product trial is successful.

However, by the time the test was actually planned, the amount of free-floating oil on the water had been significantly reduced, and there was no longer the need to increase open-water skimming efficiencies. However, UNOCAL was interested in testing the use of Elastol to recover black oil which remained in small areas or "fingers" of open water into the marsh. These fingers of water into the marsh were very shallow, making it impossible for workers to reach the oil remaining in them, even with small boats. UNOCAL hoped that these small patches of oil, once treated with Elastol, could be pulled out of the shallow areas with rakes. Therefore, the intended use of Elastol was to aid in removal of small pockets of oil floating on the water surface adjacent to the marshes and in narrow channels of open water extending into the marshes. There was no intention to apply Elastol to oil on marsh vegetation or to oil floating in the vegetation.

Application Methods

The plan was to conduct the initial test on oil which had accumulated in the booms at the entrance to Grays Bayou. Figure 1 is an aerial photograph of the test area, taken about 0800 on 24 April, the morning of the test application. The oil trapped in the booms, adjacent to the shoreline was selected for the test. This patch of oil was the largest single accumulation of oil left on the water surface.

The equipment used to apply the Elastol during the test was a pump delivery system loaned to UNOCAL by Colonial Pipeline Company who had recently used Elastol on a diesel spill in a creek draining into the Potomac River. Figure 2 shows the delivery system. The large metal hopper in Figure 2 was used to hold the Elastol product. A ball valve below the hopper was manipulated to feed the product into the water pump assembly. The pump was provided without a hose attachment; UNOCAL found a hose on-site to attach to the pump. The equipment used was the same recommended by the manufacturer.

The product used was the slurry form of Elastol. It came in 32-ounce plastic bottles with narrow openings. The product had the consistency of wet fine sawdust; it was very lumpy and cake-like. The workers were unable to get the product to pour out of the narrow neck of the bottles, even with vigorous shaking, so the top of the bottle was cut off with a knife and the product shaken out. Once in the hopper, it readily separated from the water and formed a surface layer which was crumbly and lumpy. The product was hand-mixed in the hopper, manually breaking up the lumps, however, they reformed upon standing.

There was no one on scene who had previously operated the delivery system provided by Colonial Pipeline Company. One of the NOAA scientists had seen the system in use during the Colonial Pipeline spill on the Potomac River (April 1993). It was decided to first test the delivery system on shore as an equipment check. Also, the wind had picked up and there was concern about being able to control and direct the water spray. Three quarts of product were added to the hopper, and the pump turned on. There was no problem directing the water spray in the wind. The ball valve was slowly opened, and the product was educted into the system and sprayed on the water surface (where only a very light sheen was present). The three quarts emptied out within a few

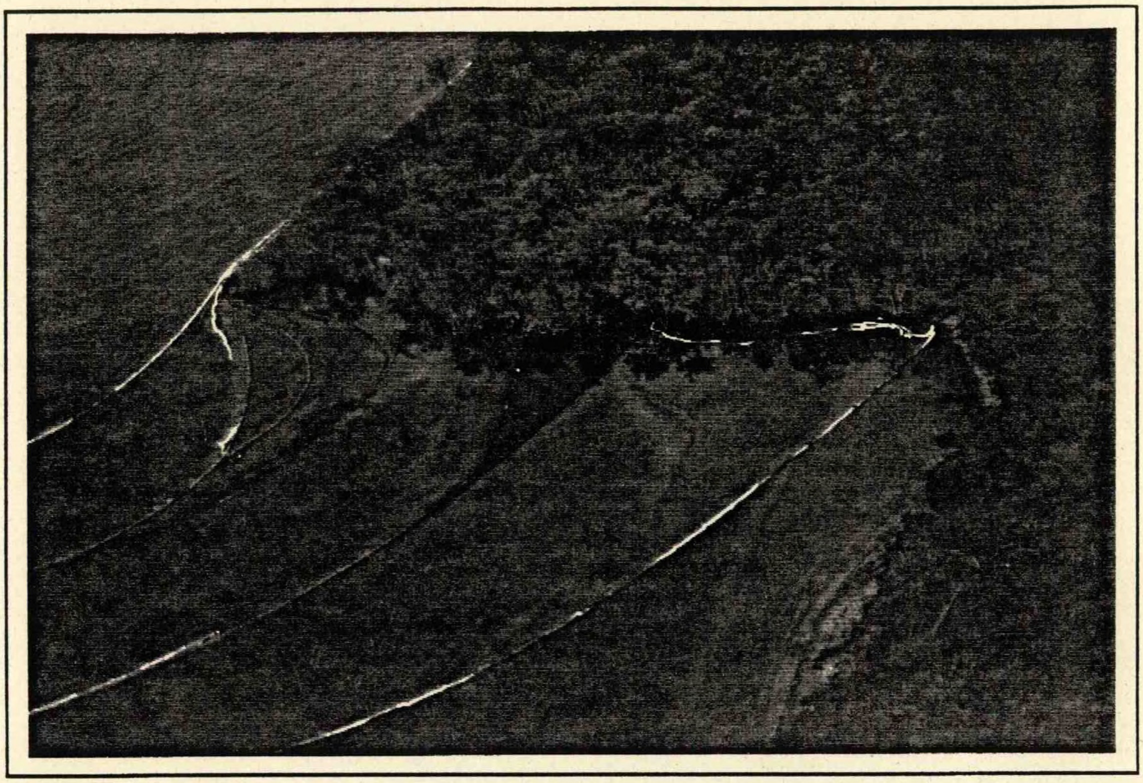

FIGURE 1. Aerial photograph of Elastol test site, four hours prior to the test.

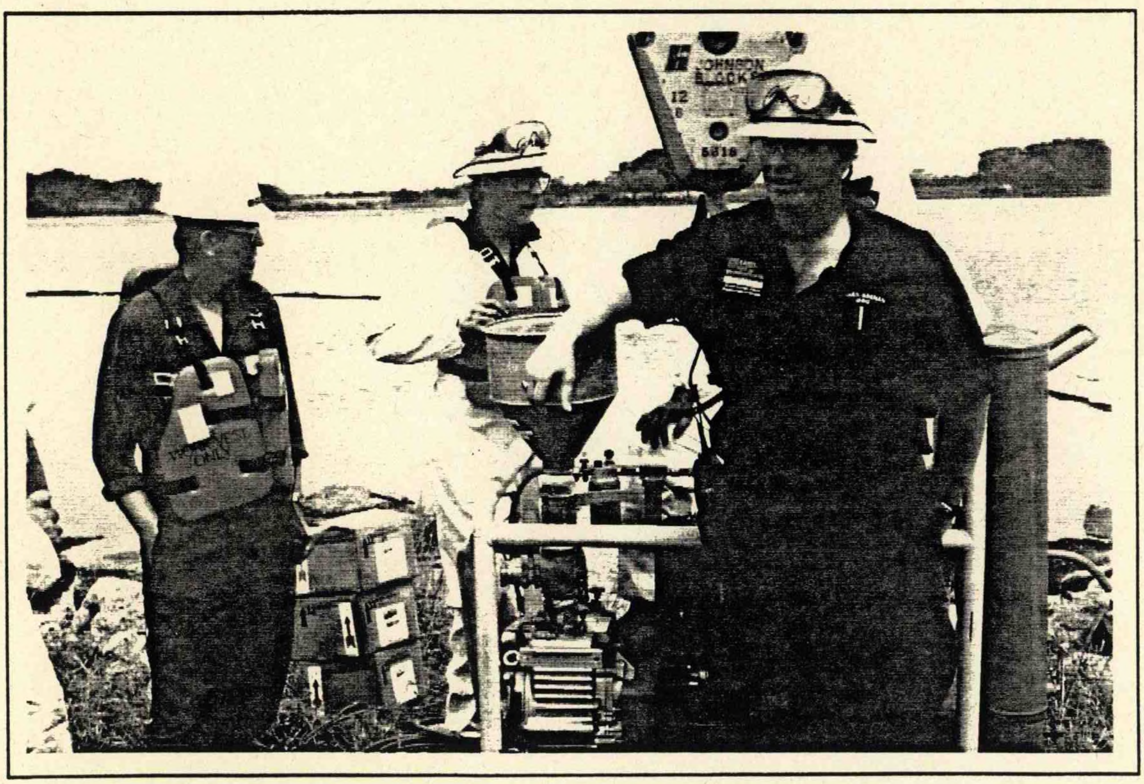

FIGURE 2. The Elastol delivery system used during the test.

seconds. The Elastol ranged in form from a fine, milky suspension to small clumps a few millimeters in size. The clumps floated on the water surface and readily mixed into the water column with mechanical agitation and the force of the water spray. The clumps gradually resurfaced after agitation stopped. Although there were concerns about the appropriateness of the available delivery equipment for the small-scale application and being able to control the application rate, it was decided to proceed with the test.

The test application on the oil trapped in the booms at the entrance to Grays Bayou was begun at about noon. The oil was trapped up against the bank, which consisted of a steep clay bank fringed by trees and shrubs. The volume of oil was estimated to be about 15 gallons, forming a relatively thick black slick of oil which had been floating on the water surface for over four days. However, the oil was still liquid. The recommended application rates vary between one quart per 300 gallons for medium crude oils to 500 gallons for heavy oils. Using the application rate of 1 quart to 300 gallons, it was calculated that 1-2 ounces of product should be applied to the slick. The bottles were vigorously shaken to mix the product, but the tops of the bottles had to be cut away to empty the product out. Two quarts of product were emptied into the hopper. Again, the product formed a surface layer on the water surface in the hopper, which was hand-mixed for about five minutes.

Because such a small amount of product was to be applied to the slick, application with a Hudson hand sprayer was first attempted. Two ounces of product were mixed with about two gallons of water. The spray nozzle was cut off since the product would not pass through the small opening. However, the Elastol floated on top of the water in the sprayer reservoir, and very little of the product was applied. Furthermore, the water spray was weak and provided insufficient mixing energy. Further use of hand sprayer was abandoned.

The pump on the delivery system was metered down to a relatively low flow rate, at about 2 gallons per minute. Figure 3 shows the water flow out of the hoses prior to the application of Elastol, although it is representative of the water pressure used during the application. In attempting to open the hopper feed valve slowly, about 1.5 quarts of Elastol were applied in one slug. Figure 4 shows the white layer of Elastol on the oil surface, reflecting the excessive and non-uniform application. The time of application

FIGURE 3. The spray nozzle and rate used to apply the Elastol to the oil.

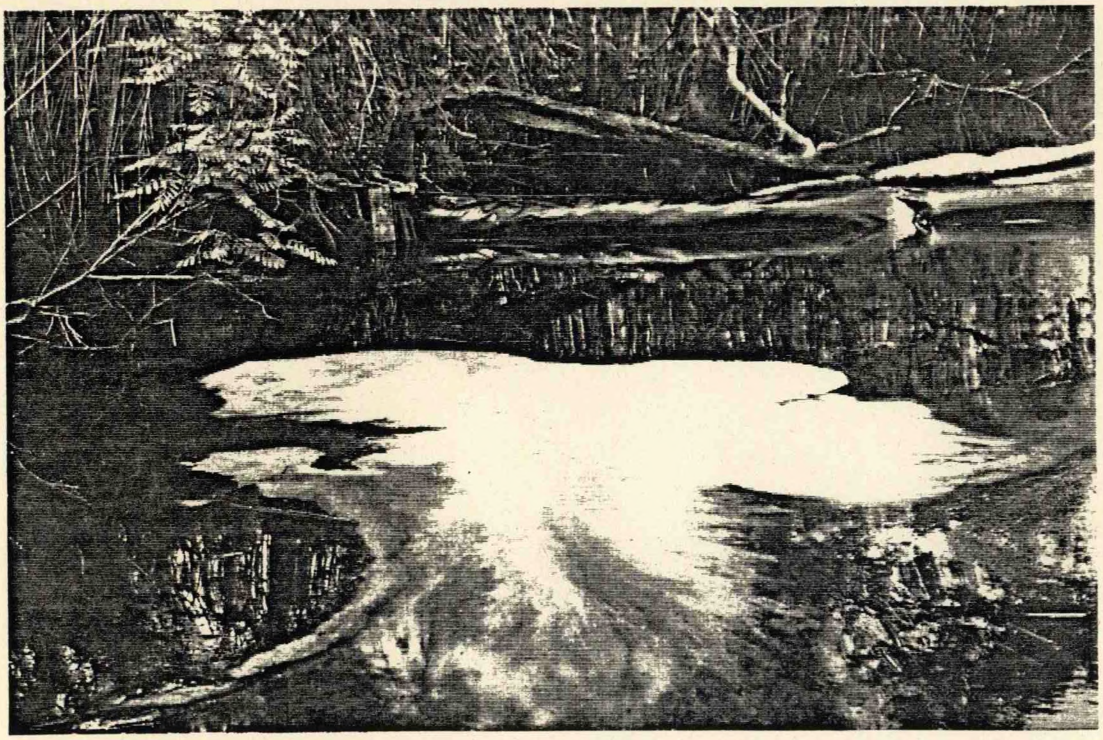

FIGURE 4. Elastol applied to the surface of the oil, in one slug when the valve was opened too far. The actual application rate was 75x the recommended rate.

was about 1300 hours. It is estimated that about 75 times the recommended amount of product was applied to the oil. After the Elastol was applied, additional water spray was used to mix the Elastol with the oil for a few minutes prior to departure from the site.

Post-Application Observations

Upon return to the site three hours after the application of Elastol, it was noted that most of the treated oil had drifted away from the shoreline and toward the center of the channel where a larger amount of oil was trapped in the booms. All of the oil held in the booms behaved as if it had been treated, leading to the conclusion that the treated oil had mixed with untreated oil. The physical appearance of the treated oil was different; the oil appeared thicker, more textured looking. The oil surface was irregular rather than smooth. The oil exhibited the "sheeting" action reported for oil treated with Elastol. Figure 5 shows the treated oil being lifted with a push-pull. For a second or two, the treated oil held together as it was lifted off the water surface by the push-pull. Strands of the oil would pull away from the lifted slick, rather than dripping. The treated oil also appeared sticky, more so than the untreated oil. It readily adhered to the containment boom and broken pieces of marsh vegetation placed into the oil. However, it was not possible to physically "pull" the treated oil as a coherent mass or sheet.

The treated oil was recovered with a small, double drum skimmer specially designed for use with Elastol-treated oil. Figure 6 is a close-up view of the oil on the skimmer drum. The skimmer picked up nearly pure oil with very little water content. The recovered oil was very viscous, almost like a thick gruel. It was obvious that the drum skimmer was the best means of recovering the treated oil since the skimmer used a wiper blade to scrap the skimmed oil from the drum. The oil flowed into a small reservoir in the back of the skimmer which could be connected to a vacuum line.

Conclusions

NOTE: It is important to review the observations and conclusions of the test with the fact that Elastol was over applied, at about 75 times the recommended rate.

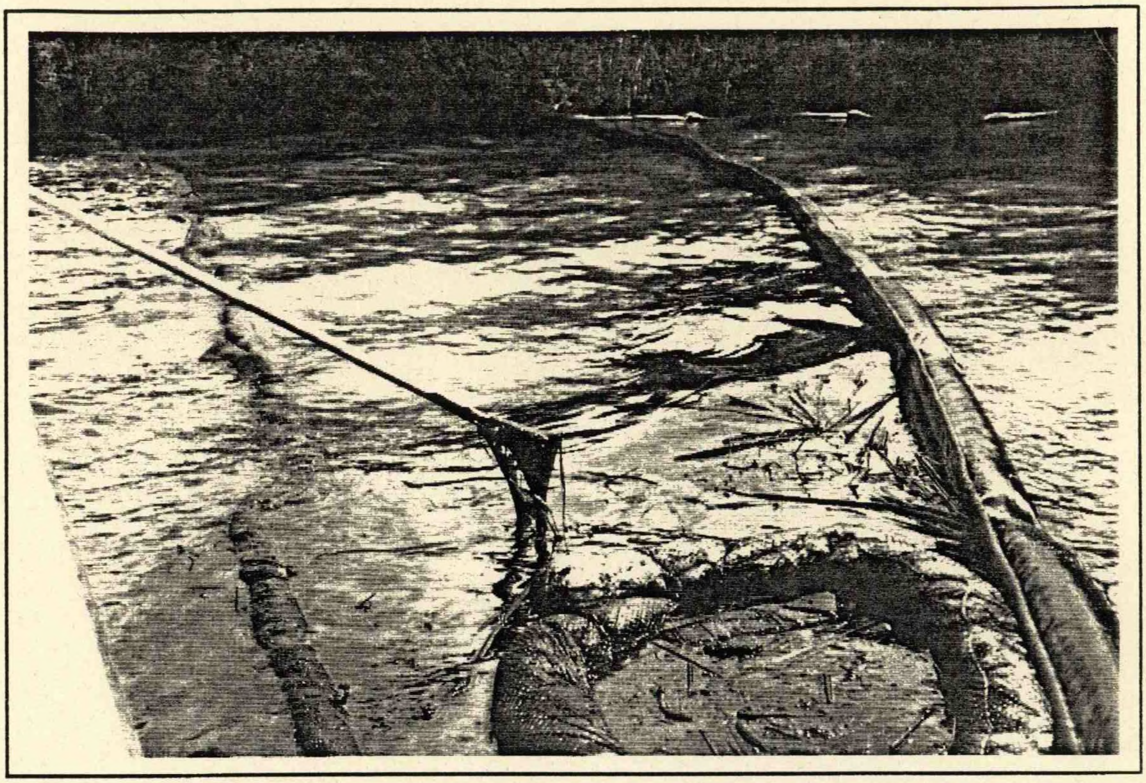

FIGURE 5. The "sheeting" behavior of the treated oil, when lifted by the push-pull.

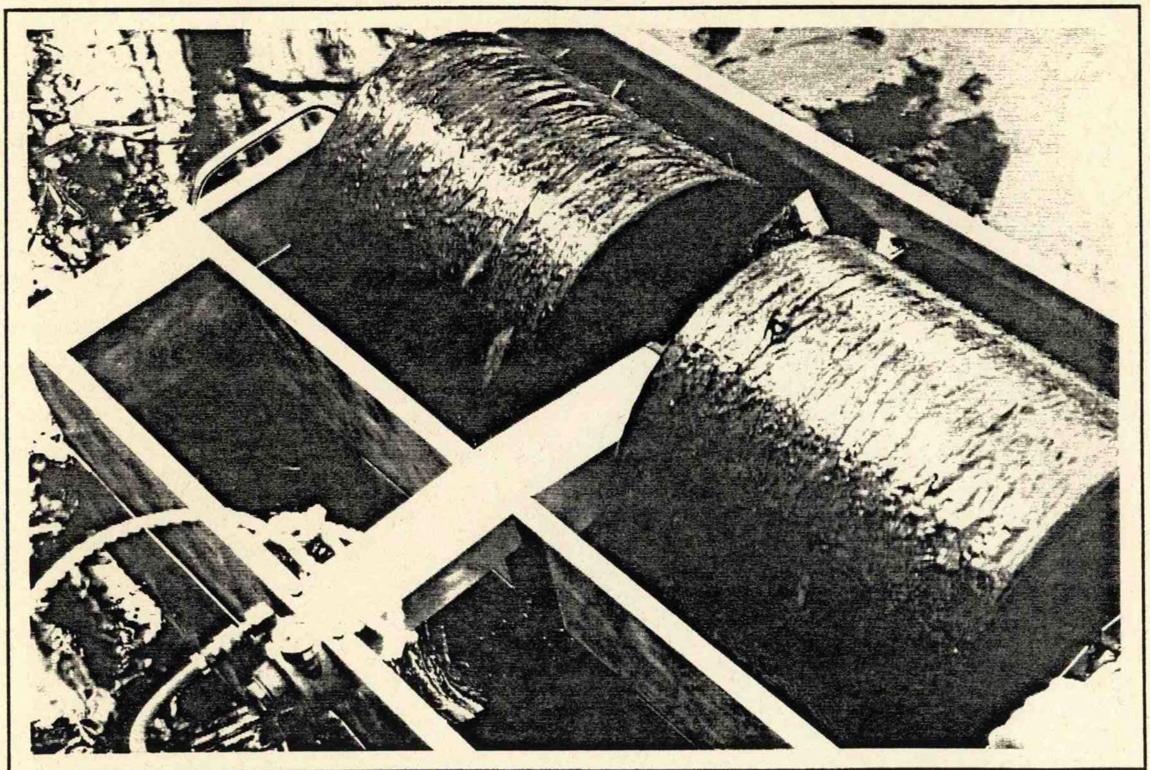

FIGURE 6. The small drum skimmer used to skim the treated oil from the water surface.

Elastol did change the physical properties of the oil, making it more cohesive. It worked on oil which had weathered for over four days. The treated oil was quite sticky and viscous; it would readily adhere to most objects. The effect of over-application on the stickiness of the treated oil is unknown. It was hypothesized that, if the application rate had been more in line with the recommended rate, the treated oil would have maintained its viscoelastic nature and may have been less sticky.

It was the consensus of the observers that the current delivery technology was not appropriate for use in the shallow, narrow channels in the marsh, where there were still pockets of free, black oil. The concerns were that:

1) The water spray would force the oil further into the marsh during application;

2) It would not be possible to control the small amounts of product needed for the small patches of oil;

3) The treated oil could not be mechanically pulled out of the channels; and

4) The treated oil was sticky enough to adhere to the vegetation, perhaps making it more difficult to remove.

UNOCAL decided not to attempt further use of the Elastol at this spill because the recovery of free oil trapped in booms was nearing completion, and the problems associated with the delivery system prevented them from using it on the small patches remaining trapped adjacent to the marshes.

The lumpy consistency of the product and the difficulty of getting it out of the bottles led to the hypothesis that perhaps the product had a shelf life. However, according to the manufacturer, the product does not degrade during storage, but it will settle to form a hard, cake-like material such as that observed during the test. The product brochures state a shelf life of at least three years at temperatures below 150 degrees F.

The manufacturer has a new liquid version of Elastol which may not have the problems noted for the slurry. Also, according to the manufacturer, the liquid product immediately modifies the oil.

UNOCAL did collect samples from the untreated oil prior to the application and various post-application samples, but they have decided not to analyze them. Also, NOAA has a short video of the test, which is available from CDR Jon M. Barnhill, the NOAA Scientific Support Coordinator in New Orleans, Louisiana.

Lessons Learned

1) If the slurry form of Elastol is lumpy, it must be mixed such that it regains its fine flowing slurry composition. A drill-operation paint stirrer is a good, on scene tool to use.

2) Do not over-apply the product. Over application may lead to non-advantageous changes in oil properties, such as the formation of a sticky, gel-like material. In discussion with the manufacturer after the test, it was suggested that an application concentration of 200 parts per million (ppm) would have been adequate for the treatment of this type of oil. The test concentration was about 16,000 ppm.

3) If only a small area is to be treated, the larger pump delivery system is not appropriate or easy to control. A readily available alternative recommended by the manufacturer is the type of spray systems developed for application of liquid lawn fertilizers. The sprayers operate on the Venturi effect and can be used to apply small concentrations of product in a highly dilute manner. Excess water applied during treatment has no reported adverse effects, and in fact, the water spray aids mixing. If such equipment is used, it would be necessary to determine if the product would flow through the sprayers, especially if the slurry is used. The liquid product might work better with this application.

4) Have personnel experienced with the product and equipment involved in the application.