

stances. The best results were obtained with the following adsorbents: (1) Puramar 10, (2) Ekoperl 33, (3) Mistron Vapor, (4) Penetone, and (5) Polypropelane Fibers. Ekoperl was the most widely used adsorbent because it was available first, but the best results were obtained with Puramar 10.

The most effective methods to apply these products were with the helicopter in nearly all situations and small power boats when the slicks were close to shore. The use of goggles and masks were necessary when applying the Ekoperl, since irritation of the eyes and throat could not be overcome without their use. The products had to be spread flying into the wind when using the helicopter. These powders were inhaled by the radiator of the helicopter if they were spread with the wind or in a stationary position. About 50 sacs of Ekoperl were applied in less than 20 minutes during each flight. A close-by base of operations was a prerequisite to effectively use the helicopter.

Vacuum pumps proved to be the best methods of extracting the petroleum directly from the surface of the water when it had concentrated in thick ponds. These pumps were able to recover 45,000 gallons of crude and water per day. These pumps required little maintenance and were only plugged-up by the dirt that they sucked.

The use of mechanical means proved to be most effective in the collection of the contaminated material on the beaches. The use of adequate booms proved to be effective when skimming the petroleum in areas where calm seas prevailed. Allowing nature to degrade the petroleum on the rocks seems as the most practical way to solving this problem. The utilization of beach maintenance crews helped in keeping the removal of sand from the contaminated beaches as low as possible. Only 8,000 cubic meters of sand have been extracted. The removal of the petroleum from the beach as soon as possible seems advisable. This measure will reduce the possibilities of initiating an erosion cycle, the formation of a coquina (mixture of oil, shells, and sand), and the deposition of new sediments over the petroleum that will tend to bury it.

The application of detergents close to the beach might cause quick-sand conditions requiring the excavation and replacement of this material. Also, the organism that live on the shore are adversely affected. Laboratory and field tests proved that the toxicity of the detergents are up to 30 times more harmful to marine life than the petroleum slicks. Greater control must be exercised over the treatments applied by private enterprises. The use of detergents in bathing areas worsened the conditions in these sites.

A detailed knowledge of the weather, oceanographic, and geologic conditions of the area affected by the petroleum is required before corrective measures are undertaken. After the cause and reasons of the movement are determined, known measures and improvisations can be conducted. Scientific reasoning must be the base of any emergency plan. An unexpected change in the direction of the wind combined with the action of low tide, pushed the confined petroleum of the bay out to sea on March 19, 1968, when the beaches were practically clean. The beaches to the east of the entrance channel were once again contaminated. The sinking of the bow and stern about 8 miles offshore released again large quantities of petroleum which floated 60 miles west and landed on the beaches of Isabela. These problems could have been solved or minimized if sufficient knowledge of the weather and oceanographic conditions would have been available.

A tremendous problem was created by the great quantity of salesmen that invaded the Department during the first week after the occurrence of the accident. Since their respective products were unknown, laboratory tests were required to evaluate their qualities. Meanwhile, a state of confusion reigned over the operations. An inventory of all the available tests should be prepared to properly and quickly inform the personnel dealing with these emergencies.

An emergency plan should be prepared so that it can be easily adopted when an accident of this nature occurs. This plan should indicate the available personnel, equipment, materials, and products to deal with such an emergency. The responsibilities and duties should be clearly stated so that no time is lost to initiate the operations. A brief outline of the procedures to be followed should be prepared.

Adequate legislation taking the proper preventive measures should be approved. More control over the marine traffic should be exercised, if the reduction of these accidents is desired, especially over the construction of jumbo size tankers and "jumboizing" the smaller vessels.