

is to degrade the petroleum by using bacteriological action. The Department of Health is currently preparing cultures to determine if the bacteria to be utilized are of a pathogenic nature, for the protection of the public in any areas treated by this system.

D. Treatment of petroleum on the beach

The petroleum crude that reached the beach zone outside of the San Juan Bay, coated the sand and the rocky coasts with a thin layer of black-colored, paraffin-like substance that had lost most of the volatile fraction. This substance could be easily collected with hand shovels and scraped with wooden hand rakes.

The Department decided to collect the contaminated material manually instead of mechanically to avoid the excessive extraction of sand from the beaches which are suffering cycles of erosion. However, 8,000 cubic meters of contaminated sand were extracted and wasted in the city dump. A labor force of 270 men worked 10 to 12 hours a day, seven days a week collecting manually the contaminated sand, the black paraffin-like substance, the impregnated adsorbents, and the contaminated seaweed. These materials were grouped together into piles on the beach where a front loader picked them up and loaded 2½-ton trucks. These trucks delivered the material to the city dump.

A rake of cyclone fence wire was built to collect the seaweed and to smooth out the beach after cleaning.

The accumulation of petroleum on the beaches of the San Juan Bay was so intensive that a depth of more than twelve inches of the sandy shores was contaminated. On the sand surface the oily layer was up to six inches in thickness. This condition makes the reconditioning of these shores very difficult; the best method so far consisted of the removal of the contaminated sand, and its replacement by clean sand.

The rocks exposed along the shoreline were cleaned with adsorbents, but this procedure was too expensive. Therefore, other means were tried. A kerosene flame thrower was used unsuccessfully to burn the petroleum. A waxy coating covered the rock after the flame was applied and the pores and joints of the rocks were sealed by this wax. The use of sand blasting was considered, but the cost prohibited this operation for general use. The use of detergents has been disregarded to clean the rocks because of difficulties in operation, toxicity pollution problems, and high cost.

In areas where detergents were used close to the beach, a quick-sand condition has developed along the shoreline. This situation has created the necessity to excavate and replace the sand with material borrowed from another beach. In some localities the sandy material was deposited deep in the ocean to determine if it could clean itself by wave action.

Cost estimate.—The total cost of the operations performed by the Department can be summarized as follows:

1. Labor force (270 men)	\$106, 000
2. Rental of equipment	35, 500
3. Purchase of equipment	38, 000
4. Purchase of materials	51, 600
5. Payments of insurance	10, 900
6. Salaries (regular employees)	19, 200
7. Transportation costs	8, 000
8. Equipment (owned by department)	12, 000
9. Miscellaneous	5, 000

Total cost (as of Apr. 15, 1968) ¹ 286, 500

¹ Rounded to 285,000.

The Governor has already assigned \$250,000.00 from the emergency fund for these purposes, but the Department is requesting an additional \$200,000.00 to continue the cleaning operation. It is estimated that final expenses of the Department will reach over the \$500,000.00 mark.

E. Activities of the other Commonwealth agencies

The Secretary of Public Works coordinated the activities of all the other Commonwealth Agencies. Their activities can be summarized as follows:

1. *Puerto Rico Ports Authority.*—The Authority assisted the Department of Public Works by providing transportation service with their patrol boats in the