In addition to oil that has seeped through into the substrate, it is inevitable that some beach material will become soiled in the process of oil recovery. Leaving oiled material on the beach will generally be unacceptable. There are unlikely to be many suitable sites available for substantial amounts of landfill, so the remaining option is to collect the oiled material and wash it.

11.1 Using a truck-mounted concrete mixer

Oiled beach material is scraped off as described in Chapter 10. This is loaded into concrete mixers and washed with seawater and kerosene. The oily wash water is collected and allowed to separate. The oil is recovered and the water can be re-used. Washed beach material is discharged from the mixer and returned to the beach.

Earth-moving equipment with shovels or loaders is used to carry batches of oily sand, pebbles etc. off the beach onto a nearby hard surface where the washing is to be carried out. Figure 50 shows schematically a suggested arrangement of equipment for beach material washing.

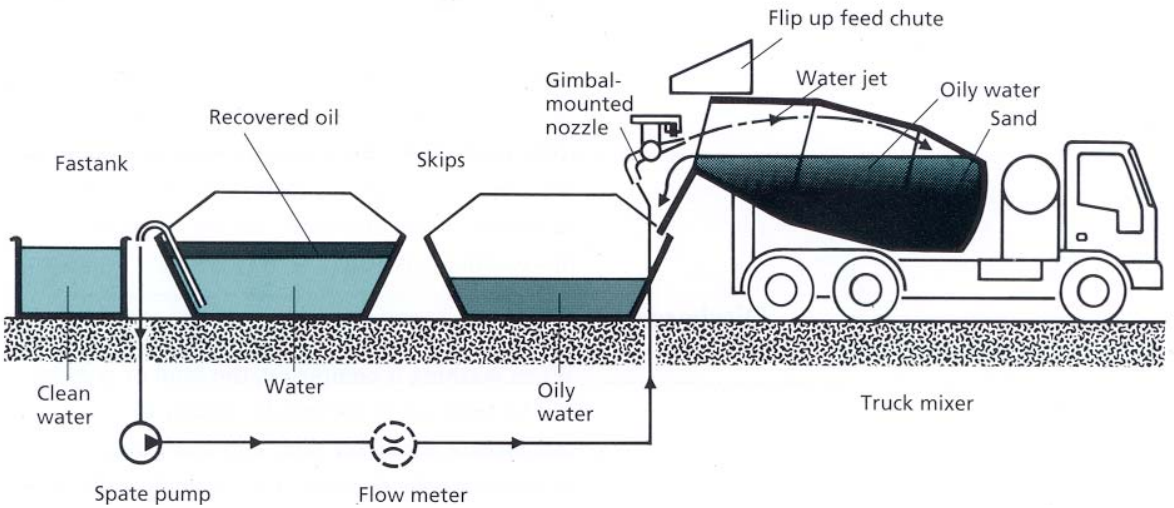

Figure 50 Washing beach material using a truck-mounted concrete mixer

An excavator is used to load oiled sand or pebbles into a truck mixer, preferably via a feed hopper (Figure 51) to minimise spillage. The washing takes place in a truck-mounted concrete mixer with discharge of oily water into water-tight skips. A typical mixer has a capacity of $6m^3$ and will take about 10 to 20 minutes to load. A supply of fresh seawater is needed, contained in skips or portable tanks and pumped into the mixer. An excavator or similar vehicle is also required to load beach material and barrels of kerosene into the mixer, preferably via a feed hopper which is mounted on scaffolding just above the chute

to the mixer. Note that with this arrangement the excavator must be able to raise its bucket more than 5 m above ground level.

Figure 51 Hopper allowing easy loading of oiled material into the washer

For lightly oiled material (up to about 1 % oil), mixing and washing with seawater may be sufficient. However, for more heavily oiled sand, conditioning with kerosene is necessary. The volume of kerosene required will vary according to the degree of oil contamination but 100 litres for a full load will generally be sufficient.

The mixer is run for four to five minutes at a speed of about 10 to 15 rpm. The mixer is slowed to about 2 rpm while water is pumped to fill it up. Oil or emulsion should appear at the surface and the mixer may he run faster for a minute to free all of the oil from the sand. To wash the sand thoroughly, the speed is now reduced to about 0.25 rpm and fresh seawater pumped in to the exposed part of the base of the mixer at a flow rate of about 0.14 m^3/min. This encourages the floating oil to overflow out of the mixer into a skip. The process is allowed to run for about an hour, by which time the oil content of the sand or pebbles should have been reduced to acceptable levels of 0.01%, or less. Between 0.5 and 1.0m^3 of seawater is required per tonne of sand.

The oily water is left to separate out and the oil recovered using skimmers or other devices. The remaining water should be recycled to wash subsequent batches of beach material, keeping the total amount of fresh seawater used to a minimum. Batches of very heavily oiled material may need to be washed more than once but the efficiency of this technique is generally very good. When washing is completed, the sand or pebbles can be returned to the beach, usually by discharging the mixer and using a loader to distribute the material

just above the advancing surf line. If the cleaning has been successful, no specks or sheen of oil should be visible as the sea washes over.

For a single truck mixer, the total time from loading to discharge is typically 1.5 hours for a full load of around 10 tonnes, i.e. about 6 tonnes/ hr of washed material. If the area available is large enough, the efficiency can be improved by having some mixers loaded while others are washing and others still are being discharged.

11.2 Larger scale washing using a 'Sand Scrubber'

The Sand Scrubber (Figure 52) separates oil from oiled sand by the use of two Jet pumps. The Jet pumps induct oiled sand into a re-circulating water flow and create regions of intense turbulence in the water which strip the oil from sand particles. This action transfers the oil from the sand into the wash water. An upward flush of water through the Elutriator tank carries the liberated oil towards the top of the tank where some of it overflows a weir. This water flow also causes some sand 'fines' to be carried over with the oil.

Figure 52 The Sand Scrubber

Partial separation of oil from water (and of sand fines from water) takes place in a re-circulation tank where more oil is separated by weirs and the fines sink to the bottom. The water is then re-circulated back through the jet pumps, picks up more oiled sand and subjects it to the same processes. The Sand Scrubber detects when the consistency of the sand and water slurry is similar at two different levels within the mixing tank and a dump valve is automatically opened to release the cleaned sand as a slurry with the wash water.

The process is therefore a combination of a continuous and batch-wise; oiled sand can be continuously fed into the Sand Scrubber, but the cleaned sand is dumped out as a batch of slurry.

Operation of the Sand Scrubber for maximum effectiveness requires skill. Water levels in the tanks must be balanced by judicious filling (not too much otherwise it floods, too little and the weir flow is lost), taking into account volume displacement caused by sand addition. The balance of water levels is lost as soon as Sand Scrubber dumps the cleaned sand and operator experience is required for rapid re-adjustment to achieve balanced water flows.

The oil is very effectively removed from the sand by the action of the Jet pumps, but the separation of oil from water requires settling tanks or ponds for much longer to allow better oil separation.