JBF ENVIRONMENTAL TECHNOLOGY

Division of Slickbar Products Corporation

Dynamic Inclined Plane System of Oil Recovery and Collection

Summary

The Dynamic Inclined Plane (DIP) takes advantage of the laws of physics to collect oil from the surface of water. A key benefit of the DIP skimmer is the combination of oil collection and separation into a single step. This fully maximizes the use of both pumping capacity and available storage by allowing the transfer of only pure oil from the collection well to storage.

Description

The oil on the surface of the water is intercepted by the moving plane at the same relative velocity as that of the combined net velocity of the current and skimming vessel, (either integrated or VOSS.) Thus the oil, the moving plane, and the adjacent water velocity all move at the same relative velocity so that the oil never actually mixes with the water. The oil layer is simply redirected down the moving plane. When the oil reaches the bottom of the belt, it floats to the top of the collection well with a minimum of mixing action forming a deep oil layer at the top of the well. This thick oil layer is then pumped, water free, to storage tanks. Extensive testing and experience in actual spills show that less than 1% water is collected in the recovery oil.

Development

The Dynamic Inclined Plane oil recovery method incorporated into large Oil Spill Response Vessels (OSRV) and Vessel of Opportunity Skimming Systems (VOSS) was invented in 1970 and reduced to practice in 1971. It was during an assessment of the physics of oil on water that lead to the idea for a simple oil recovery system. Figure a below is a schematic of the cross section of a typical containment boom.

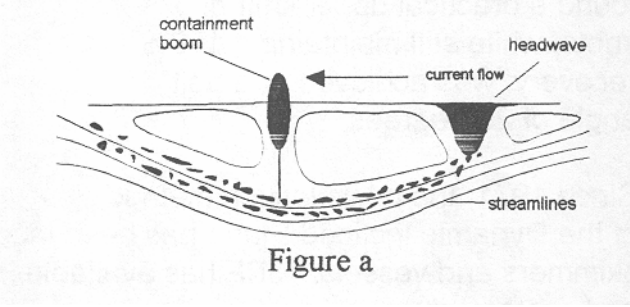


Figure a

Regardless of the geometry or the strength of the boom, it has been proven both in circulating tanks and under actual conditions that, in only one knot of current, oil will escape beneath the boom. In studying this fact, it was determined as the current increases, a large teardrop shaped oil mass is formed at a predetermined perpendicular

distance upstream from the face of the barrier. This formation is called a headwave. At these higher current speeds, oil from the headwave shears off, becomes entrained in the hydraulic stream lines and flows under the boom. This condition is found to always occur when there is any attempt to slow down the flow of oil and water in front of a boom or barrier. The only effect of increasing the depth of the boom or barrier was to form the headwave at a greater distance upstream from the boom. The oil continued to entrain under the boom.

The first attempt at developing an oil collection method based on this phenomenon occurred in 1970, during a US Environmental Protection Agency (EPA) funded contract to develop and test a fixed inclined plane underwater oil collection skimming system. From circulation tank tests, it was observed that the headwave would not form in front of the inclined plane if the plane was not inclined greater than 12 degrees. Tests with an oil of medium viscosity (1000 centistokes), found that the oil slid down the bottom of the incline, independent of draft, it was allowed to rise due to its buoyancy deep oil layer (See Figure b).

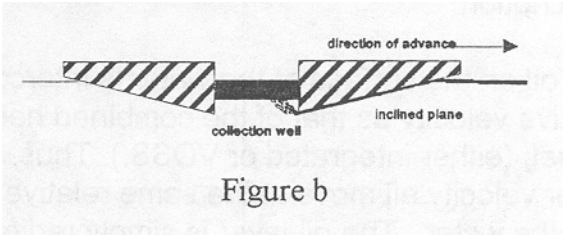
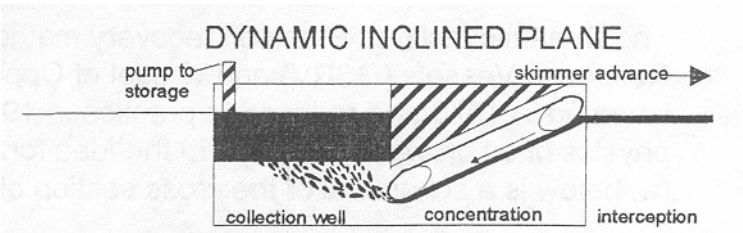


Figure b

As a result of these observations and considerable additional testing, the concept of moving the inclined plane was then tested and developed. The moving plane was accomplished by utilizing an endless belt over two rollers. By moving the belt at the same speed as the current or the skimmer's advancing speed, the velocity limitations were extended to between 2-3 knots. The occurrence of oil entrainment and the formation of the headwave were also eliminated at these speeds. This concept, to be known as the Dynamic Inclined Plane (DIP), is shown in Figure c.



The oil/water layer is redirected down the moving plane assembly to the collection well. In the collection well the bouyant forces of the oil cause it to rise to the surface. The deep layer of separated oil is then pumped to storage.

Figure c

Because there is no relative velocity between the oil, the moving plane, and the hydrodynamic streamlines, the oil layer moves down the plane undisturbed. This is important in order to minimize emulsification of the oil. Further development and testing found a practical upper limit of 3 knots, while still maintaining 100% recovery, was achieved at a belt angle of 23 degrees.

Since 1971, the oil collection method of the Dynamic Inclined Plane has been incorporated into over 190 JBF skimmers and vessels. JBF has available numerous test reports, actual spill reports and customer/user references.