foto: US Navy

OIL SKIMMERS

OIL AND WATER DON'T MIX

The relationship between oil and water in a mixture is well-known and governed by two physical properties.

Specific Gravity – Most hydrocarbons have a lower specific gravity than water. Without agitation, oil separates from the water and floats to the surface. These oils are known as LNAPL's, Light Non-Aqueous Phase Liquid. Oils (and other compounds) that sink in water have a higher specific gravity and are known as DNAPL's, Dense Non-Aqueous Phase Liquid. Surface Tension and Affinity – Normally, oil bonds more tightly to itself and other materials than to water. This affinity, and differences in surface tension between oil and water, cause oils to adhere to a skimming medium.

Although designs vary, all oil skimmers rely on specific gravity, surface tension and a moving medium to remove floating oil from a fluid's surface.
Floating oil and grease cling to skimming media more readily than water, and water has little affinity for the media. This allows skimming media in the shape of a belt, disk, drum, etc. to pass through a fluid surface to pick up floating oil and grease with very little water. This oily material is subsequently removed from the media with wiper blades or pinch rollers.
Oil skimmers are simple, dependable and effective tools for removing oil, grease and other hydrocarbons from water. Often, a skimmer by itself can achieve the desired level of water purity. In more demanding situations, skimming is a cost-effective means of removing most of the oil before using more complicated and costly treatments such as coalescers, membrane filters and chemical processes.
Grease skimming involves higher viscosity hydrocarbons. Skimmers must be equipped with heaters powerful enough to keep grease fluid for discharge. If the floating grease has formed into solid clumps or mats, a spray bar, aerator or mechanical apparatus can be used to break up grease mats and facilitate removal.

Typical applications for industrial oil skimmers

Wastewater Sumps
Most manufacturing or processing facilities have circulating water systems. This water collects in a central tank or sump. Removing floating hydrocarbon contamination with little water content can reduce the cost of disposal and lower the contingent liabilities of wastewater discharge.

Coolants and Cutting Fluids
When machine coolants become contaminated with tramp oils, four things usually occur: 1.) coolant life is reduced; 2.) quality of machined parts is reduced; 3.) in many cases, a smoke will begin to appear in the shop, causing irritation to the workers on the job; and 4.) the fluid takes on a "rotten egg" odor. Skimmers that remove tramp oils solve these problems and typically pay for themselves within a few months.

Heat Treating
Quench oils that must be removed from heat treated parts can be captured for re-use or disposal. The results are lower quench oil costs, prolonged wash water life and lower disposal costs.
Parts Washers
Floating oils re-contaminate parts as they are removed from a wash tank. Oil skimmers can remove this oil. The benefits of using an oil skimmer are oil-free parts and extended fluid life.

Food Processing Facilities
Removal of vegetable oils, greases, and animal fats from a plant's wastewater stream reduces the costs of processing and disposal.

Parking Lots, Garages and Service Facilities
Waste oil from leaks, spills and other sources must be retrieved from sumps before water can be discharged to storm or sanitary sewers.

Outdoor Ponds, Lakes, Basins, Etc.
Where floating oils are present, skimmers provide inexpensive and effective removal, solving a serious environmental problem.

Recovery/Monitoring Wells
Removing oil, fuel and other hydrocarbon liquid from wells can be more cost-effective using a belt skimmer instead of a down well pump. Skimmers don't have nearly the maintenance issues and can reach depths of 100 feet or more, removing product despite fluctuating water tables. Skimmers can handle very thick fluids effortlessly and some (like the Abanaki PetroXtractor®) can separate some DNAPL's such as coal tar and creosote from water.

Choosing an appropriate skimmer

There are several types of industrial oil skimmers. Choosing one best suited for your application will maximize oil removal while minimizing capital outlay and skimmer operating costs. First, define the application in terms of the following characteristics:

Operating Conditions
All skimmers have a moving medium, and possibly other parts, immersed in the liquid. The performance and life of the pick-up medium, wiper blades, pulleys, etc. are affected by different conditions. These conditions include temperatures in and out of the liquid, pH of the solution, and the presence of solvents or other reactive chemicals.

Hazardous Materials
Applications involving flammable materials or explosive vapors require the use of explosion proof (or air driven) motors and controls.

Temperature/Viscosity
All skimmers require floating oil to be in a liquid, free-flowing state. If the oil congeals or solidifies at ambient temperatures, the tank and/or skimmer will require heaters to maintain fluid flow. This is especially true at temperatures low enough to freeze water. A heater option is a must if a skimmer is to be used outdoors in freezing temperatures.

Removal capacity

Rating
Skimmers usually have an oil removal rate expressed in gallons per hour. The rate varies with oil viscosity, so Abanaki and most manufacturers rate skimmers using SAE 30 weight motor oil at 65°F (18°C). If a manufacturer doesn't specify the test oil for its rating, or your application involves a much different viscosity, it is wise to ask for additional test data. When specifying removal capacity, it is better to err on the high side to allow for peaks in the oil influx. (See "Comparing Different Types of Oil Skimmers.")

Water Content
All oil skimmers pick up some water with the oil they remove. Some designs, particularly suction skimmers, pick up more water than others. High water content increases oil recycling and disposal costs. Generally, the ratio of water-to-oil decreases with thicker films of floating oil and slower moving pick-up media. An Oil Concentrator® or decanter installed at the skimmer discharge port provides secondary oil/water separation that can reduce water content to nearly zero.

Residual Oil
A skimmer continues to remove oils as long as they are present. Depending on oil influx rate and the skimmer's removal rate, residual oil in the water may be as low as a few parts per million. When residual oil reaches this level and further reduction is required, it may be more practical to use a secondary removal method following skimming, such as membrane filtration.

Portability
Skimmer portability is a plus in some applications. For example, in plants, mobile equipment service shops, and at remediation sites, a portable skimmer can sometimes service multiple machines, sumps, or wells.

Tank or sump characteristics

The location, shape, and capacity of a tank or water impoundment are major factors in choosing the right skimmer. Also consider fluctuations in water level, turbulence and possible

Crewmembers on board the Coast Guard Buoy Tender Harry Claiborne lower an oil skimmer into the water during a pollution response drill in Galveston Bay. The oil skimmer is a part of the Coast Guard's Vessel of Opportunity Skimming System (VOSS), along with containment boom, an inflatable oil recovery barge, and pumps and compressors to operate them. When deployed, the VOSS equipment uses containment boom to collect oil into a small area to make it easier for the skimmer to remove the oil from the surface of the water. (U.S. Coast Guard Photo)

The NCOIC of liquid fuels maintenance untangles a discharge hose before connecting it to a drum skimmer in preparation for a oil and light fuels spill water contamination clean-up. (U.S Air Force Photo)

emulsions. Although skimmers do not cause emulsions, they can have trouble removing certain types.

Size/Design
Oil and water can emulsify when subjected to turbulence and other mechanical agitation. Avoid this by having water return to the tank below the liquid surface at as low a velocity as practical. Make sure your tank or sump provides quiet areas, weirs, and sufficient volume to allow adequate time for oil/water separation.

Shape
Tanks without nooks and crannies for oil to accumulate in are best. If you have an irregular shape, put the skimmer where the largest amount of oil accumulates. Consider a means of directing oil towards the skimmer such as a floating boom or baffle plate.

Location/Installation
The physical location and characteristics of the tank and collection container are important. Does skimmed material need to be pumped from the skimmer to the container? Will skimmer access for periodic maintenance be a problem? How much mounting space is available? Are tank or container modifications required? Cheap systems quickly lose appeal when costs for additional components, increased maintenance and expensive tank modifications are involved.

Different types of oil skimmers

For industrial oil skimming, there are six basic designs commonly used:
Belt Skimmers
Belt-type skimmers use an endless belt of stainless steel, elastomer or poly medium, which is lowered into the tank or vessel to be skimmed. The belt passes through resilient wiper blades where the oil is removed from both sides of the medium.

Disk Skimmers
These skimmers rotate a disk shaped medium through the liquid. Oil is wiped off and discharged into a collection container in a manner similar to belt skimmers. It is important to consider reach, the portion of the disk that actually gets immersed, when looking at a disk skimmer. Less disk in the fluid, means less oil removed. Obviously, fluctuating fluids can be a real problem for disk skimmers. Also, it is important to look at how much of the disk the wipers are actually wiping. If the wipers only wipe 2″ from the edge, then any reach into the fluid beyond 2″ is wasted. As a result, removal capacities for disks can be relatively low.

Drum/Barrel Styles
These are similar to the disk type, but use a rotating drum shaped medium. Compared to disk types, they are usually more rugged and have higher removal capacity. These units can also be rendered ineffective by fluctuating fluid levels.

Mop Skimmers
These skimmers use an endless medium shaped like a rope and having mop-like tendrils that pick up the oil. As the medium leaves the liquid and enters the drive unit, it is pressed and wrung out with pinch rollers. For higher viscosity oils, the medium tends to mat down and lose effectiveness. A decant system is a must for these units, as water pickup can be very high. Also, replacement mops can be very expensive, so check prices on replacements before purchasing.

Large Tube Skimmers
Tube skimmers use a floating plastic hose that snakes out over the surface of the liquid and is then drawn back through the drive unit where oil is removed. This design requires a relatively large amount of surface area for proper operation.

Mini Tube Skimmers
Very similar to the large tube units, but use either a 3/16″ or a 5/16″ tube instead of 1″. The pickup rate varies from 1 quart/hour to 1.5 gph depending on the diameter of the tube. These units are fairly compact, and can fit in tight spots. The better units will have the motor mounted underneath, to bring room required over the lip of the tank down to near zero. The 5/16″ diameter is preferable as it has enough stiffness to not drag on the housing and prematurely wipe off oil when being drawn into the unit.

Floating Suction Skimmers
These come in several forms, but all have a floating intake. They are most suitable for relatively thick layers of oil (1/4 inch), otherwise they tend to ingest large amounts of water. Some machines will actually emulsify oil due to churning as it passes through the suction pump. This type of skimmer requires a coalescing or at least a decanting unit to be at all effective. <<