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OCTOBER 2003 MEETING THE ENVIRONMENTAL CONCERNS FOR AIR, WATER AND WASTE

A Clean Sweep

By Tom Hobson

Figure 1

Belt skimmer removing grease from a waste water sump

When properly selected and applied, oil skimmers are a highly economical solution for separating oil from water to allow its reuse or safe disposal.

How Oil Skimmers Work

Oil skimmers are simple, dependable and effective tools for removing oil, grease and other hydrocarbons from water and can pay for themselves within a few months.

All oil skimmers rely on the fluid properties of specific gravity and surface tension although designs may vary. Most use a moving medium to remove floating oil from a liquid surface as shown above (see **figure 1**). Floating oil and grease cling to skimming media more readily than the water. This allows media (in the shape of a belt, disk, drum, etc.) to pass through the fluid surface to pick up floating oil and grease while leaving most of the water behind. The oily material is subsequently removed from the media with wiper blades or pinch rollers.

Grease skimming involves higher viscosity hydrocarbons. These skimmers must be operated at higher temperatures to keep the grease fluid. This may require heating elements in the reservoir and skimmer unit to keep the grease in a liquid state for easier pick-up and discharge. If floating grease forms solid clumps or mats in the reservoir, a spray bar, aerator or other mechanical apparatus can be used to break up the grease and facilitate skimming.

Often, a skimmer by itself can achieve the required level of water purity. For more demanding situations, skimming is a cost-effective pretreatment before more complicated and costly treatments, such as coalescers, membrane filters and chemical processes are employed.

Typical applications for industrial oil skimmers

Wastewater sumps - Removing floating hydrocarbons can reduce the cost of disposal and lower the contingent liabilities of wastewater discharge.

Coolants and cutting fluids - Skimming tramp oils extends coolant life, improves the quality of machined parts, reduces irritating smoke that forms during machining, lessens the chance of dermatitis, and helps prevent the fluid from developing a "rotten egg" odor.

Heat treating - Quench oils must be removed from heat treated parts, and can be captured with a skimmer for re-use or disposal. This reduces oil purchases, prolongs wash water life and lowers disposal costs.

Parts washers - Removing floating oils from a wash tank prevents re-contamination of the parts as they are removed from the fluid and extends fluid life.

Food processing facilities - The removal of vegetable oils, greases, and animal fats from a plant's wastewater stream reduces processing and disposal costs.

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,

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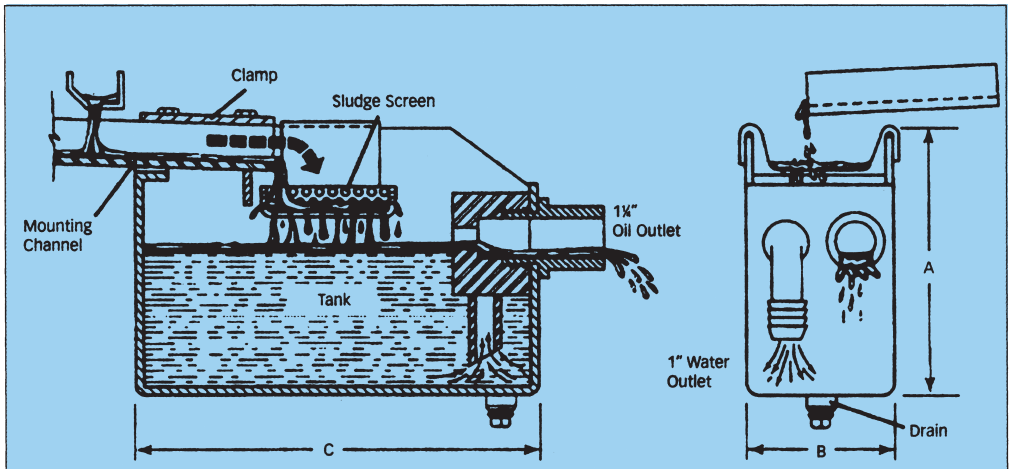

Figure 2 *A concentrator or decanter can reduce the water content of skimmed oil.*

reducing environmental problems.

Recovery/monitoring wells - A belt skimmer can be used instead of a down well pump to remove oil, fuel and other hydrocarbons from monitoring and recovery wells. Generally, this is more cost-effective and reduces maintenance headaches. Skimmers can reach depths of 200 feet or more and remove floating product despite fluctuating water tables.

Choosing the right skimmer

There are several types of industrial oil skimmers. Choosing one best suited for an application will maximize oil removal while minimizing capital expense and operating costs. Define the application in terms of the following characteristics:

Operating conditions - The performance and life of the pick-up medium, wiper blades, pulleys, etc. are affected by operating conditions. These 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. (See Note 2 under Table 1 for an exception.) If the oil congeals or solidifies at ambient temperatures, the reservoir and/or skimmer will require heaters to maintain fluid flow.

Removal rate - Skimmer removal rates, expressed in gallons per hour (gph), vary with oil viscosity. Typically, manufacturers rate skimmers using SAE 30 weight motor oil at 65 °F (18 °C). It is wise to ask for test data, especially if the application involves a much different viscosity. Skimmer selection should be based on the maximum amount of oil removed within the shortest available time. For instance, suppose total oil influx is 200 gallons a day. The calculated average would be 200/24 = 8.3 gph. However, if most of it comes during a single eight-hour plant shift, the application probably needs a removal rate three times that average, especially if it's necessary to prevent the discharge of contaminated water to a sewer system. As a rule of thumb, it's best to specify approximately twice the maximum capacity otherwise anticipated for normal conditions.

Skimmed water content - All oil skimmers pick up some water with the oil. Suction skimmers pick up more water than other types. High water content increases oil recycling and disposal costs. The ratio of water-to-oil usually decreases with thicker films of floating oil and slower moving pick-up media. A concentrator or decanter (see **figure 2**) installed at the skimmer discharge port provides secondary oil/water separation that can reduce water content to nearly zero.

Residual oil - A skimmer removes oil as long as it is 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 further reduction is required, a secondary removal stage such as membrane filtration may be added.

Portability - A portable skimmer can sometimes service multiple machines, sumps or wells in plants, mobile equipment service shops or at remediation sites.

Tank or sump characteristics - The

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Figure 3

Various pulley assembly designs help improve oil removal by stabilizing a skimmer belt in turbulent fluid.

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 emulsions. Although skimmers do not cause emulsions, they may 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 the tank or sump has 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 - Ask questions about the physical location and characteristics of the tank and collection container. 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? Total skimmer system cost may involve additional components, tank modifications, and skimmer maintenance.

Types of oil skimmers

For industrial oil skimming, there are six basic designs commonly used in moving media skimmers. Suction skimmers are excluded, as they are suitable only for relatively thick (1/4 inch) layers of oil. Otherwise they tend to collect too much water.

Belt skimmers - Belt-type skimmers use an endless belt of stainless steel, elastomer or polymer medium that is lowered into the tank or vessel to be skimmed. The belt passes through the fluid and then through the skimmer's resilient wiper blades where the oil is removed from both sides of the skimmer medium. Removal rate is not affected by belt length, which is chosen to assure contact with the liquid at its lowest level. The belt length should also allow easy mounting of the skimmer where oil discharge is convenient and assure easy access for routine service. Lengths of 100 feet or more are possible.

Different belt materials are available for various application conditions (see **table 1**). Corrosion-resistant stainless steel is for applications with high temperatures and harsh chemicals. Elastomer is used where abrasive particles are present or when physical abuse of the belt is likely. Various engineered polymers can also be used for resistance to high temperatures and many chemical types. Fuzzy (raised nap)

Application criteria for typical belt materials.

Application Variable	Stainless Steel	Elastomer	Standard Polymer	Extended Temp. Polymer	High Temp. Polymer	Fuzzy Polymer Fabric
Temp range	<220 °F (104°C)	<120°F (49°C)	140°F (60°C)	<180°F (82°C)	<220°F (104°C)	<160°F (71°C)
pH range 2-13[1]	Yes	Yes	Yes	Yes	Yes	Yes
Operates in the presence of grit fines and other suspended particles	No	Yes	Yes	Yes	Yes	No
Removes certain DNAPLs[2] and some emulsified oils	No	No	Yes	No	No	Yes
Effective for very light oils	No	No	No	No	No	Yes

Table 1

1 At ambient temperatures

2 Dense Non-Aqueous Phase Liquids – These can be skimmed if the polymer belt reaches to the bottom of the tank where material has settled.

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polymers can pick up low viscosity hydrocarbons, such as fuel oils, gasoline and diesel fuel.

Wiper blades made of standard nitrile material (also called Buna-N) are suitable for about 80 percent of all applications. Other wiper materials, such as ceramic hybrid types, are designed for harsh operating conditions.

Mop skimmers - These skimmers use an endless medium shaped like a rope that utilize mop-like tendrils to pick up oil. As the medium leaves the liquid and enters the drive unit, it is pressed and wrung with pinch rollers. For higher viscosity oils, this medium tends to mat and lose effectiveness. A decantation system is usually used with these units as water pickup can be high. Also, replacement mops tend to be more expensive than belt type media.

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 fluid surface area for proper operation. Length considerations are the same as for belt skimmers with a typical tube diameter of one inch.

Mini tube skimmers - These are very similar to the larger tube units, but typically have either a 3/16-inch or a 5/16-inch diameter tube. The 5/16-inch diameter is preferable as it has enough stiffness to not drag on the housing and prematurely wipe off oil when drawn into the unit. Pickup rates vary from one quart per hour to 1.5 gph, depending on diameter

Table 2 *Typical oil skimmer removal rates[1].*

Skimmer Type	Nominal Removal Rates
Disk Skimmer	Up to 1.0 gph
Compact Tube Skimmer	Up to 1.5 gph
Stationary Belt Skimmers, 1" to 2" wide belts	2 to 6 gph
Portable Belt Skimmers, 1" to 4" wide belts	6 to 20 gph
Stationary 4" Belt Skimmer	20 to 40 gph
Stationary 8" Belt Skimmer	40 to 80 gph
Multiple 8" Belt Skimmers (2 to 5 Belts)	80 to 200 gph
Grease Skimmer With 8" Wide Belt	120 to 160 gph[2]

1 Based on typical product specifications and SAE 30W oil at 65°F (18°C)
2 Grease skimmer capacity is based on tests with Brooks Technology Plexelene 725 grease.

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and speed. These units can be used where space is limited. Units that have a motor mounted underneath reduce the amount of space required over the rim of the tank to nearly zero.

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. When specifying disk diameter, it is important to consider reach, the portion of the disk that actually gets immersed. Less disk area in the fluid results in less oil removed. Obviously, fluctuating fluid levels can be a problem.

Also, it is important to look at how much of the disk the wipers are actually wiping. If it only wipes two inches from the edge, then any reach into the fluid beyond two inches 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.

The principal criterion in skimmer selection is removal rate. Typical rates for different moving media skimmers are listed at right (see **table 2**).

properly selected and applied, oil skimmers are a highly economical solution

Motors and optional features

Motor types - All mobile media skimmers use motors to move the belt, tube, disk, etc. Many are designed with standard, industrially rated, continuous duty motors and may also use fully enclosed speed reducing drives. Some can be specified with the following motor options:

- Any common voltage or electrical requirement
- Explosion proof
- Drip proof
- Tropicalized
- Dirty conditions duty
- Food service duty
- Water wash-down duty.

Optional equipment - Accessories allow for systems to be customized to their specific application, easing installation and optimizing performance. Some of the more common options are listed below.

Special drive components – Tail pulleys can help improve removal rates by stabilizing belt assemblies in the fluid (see **figure 3**). Yoke-and-tether assemblies help prevent pulley loss due to human error or belt breakage.

Mounting stands and adapters – These include pre-engineered mounting stands for easier installation. Models are also available for pits, walls and free-standing units.

Shelters/ enclosures – Reinforced poly-shelters, and below-grade enclosures provide protection from the elements.

Controls/accessories – A float switch and warning light can be used to monitor fluid level in the oil collection drum, which helps prevent overflow. Other options include a timer, control panel, variable speed drive and power packs.

Concentrator – (see "skimmed water content" earlier in the article.)

Heaters – Many skimmers can be ordered with heating devices to keep skimmed product fluid in cold environments.

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