



## **Installation and Operating Manual**

### **Mohr Separations Research Model MSR-11 Oil Water Separator**

#### **Background and Introduction:**

The MSR Model MSR-11 Oil-Water Separator is a passive gravity-flow system for the separation of oil from oil-water mixtures. The design utilizes the difference in specific gravities between oil and water (buoyancy force) enhanced by the use of Mohr Separations Research International modular coalescing system. The separator is designed to receive oily water by gravity flow and to process it on a once-through basis. It may also be utilized in pumped flow at a reduced flow rate. Please contact MSR if it is desired to operate in pumped condition. The separator vessel is constructed of pure polypropylene plastic, utilizing all welded construction. The coalescing plates are manufactured of an oleophilic ("oil-loving") polypropylene.

The oil-water mixture enters the separator through the inlet pipe into the pre-separation chamber, proceeds through the plate inlet chamber, and makes a 180 degree turn to enter the coalescing plate packs. The oil in this mixture is usually in the form of droplets of various sizes. As the oil-water mixture flows through the plates, the oil droplets rise within the water due to their buoyancy. As the droplets rise, they come in contact with the underside of the plates and coalesce, forming a thin film of oil on the underside of the plates. This film flows upward along the plate surface until it reaches the plate peaks. Oil accumulates in a thicker oil layer on the underside of the plates until it disengages and moves up through the module. Holes have been provided in the module plates at the peaks so that the oil collected in this manner may percolate through the holes and eventually come to the water surface in the separator.

The separated oil that comes to the top flows out over the "vee-notch" skimmers into the oil holding tank, located on the side opposite the inlet chamber. The clean processed water is discharged via the outlet underflow/overflow into the customer's downstream piping system. The water underflow/overflows are provided with adjustable collars used to set the flowing water level.

### *Internal Configuration:*

A cross-sectional flow schematic of the separator is provided below. The separator consists of a pre-separation chamber with baffle, a coalescing module inlet chamber directly upstream of the module, a coalescing module section, oil removal skimmers with an oil storage tank, and an outlet underflow/overflow section. Both water overflows are adjustable so that water levels can be set exactly.

The oil-water mixture enters the separator through an inlet distributor pipe, turned downward. This inlet pipe is cut at an acute angle. This dissipates energy of the incoming fluid in the pre-separation chamber. Oil separated ahead of the packs will rise directly to the top of the vessel, and the remainder of the mixture will flow into the coalescing module.

The coalescing module provided in the MSR-11 unit consists of special polypropylene coalescing modules held together with plastic retainer pins. Spacing between the plates in the module is maintained by pin and socket arrangements molded into the plates. The purpose of these plates is to enhance the coalescing of small droplets. As the oil-water mixture passes through the module, small droplets are coalesced into larger ones which rise to the surface of the liquid in the tank. The oil then forms a layer in the tank, which overflows the skimmers into the oil holding tank on the side of the pack.

### *Initial Installation Requirements and Setup*

Dimensions of the separator and connections are shown on the drawing provided in the Appendix. No external piping or valves are provided by Mohr Separations Research Inc.

INLET PIPING (TO BE PROVIDED BY THE USER) MUST BE AT LEAST AS LARGE AS THE INLET CONNECTION FOR 10 PIPE DIAMETERS UPSTREAM OF THE UNIT TO AVOID EXCESS TURBULENCE IN THE INLET PIPING. Smaller piping could cause emulsification of the oil in the water and could have a negative impact on separator performance. The inlet valve, if provided, should also be at least 10 pipe diameters upstream. It is preferred that the piping directly at the separator be straight, without valves or fittings.

### *Safety and Environmental Considerations*

- All normal safety precautions should be taken with this equipment to prevent accidents and fires.
- Normal fire prevention measures must be taken to prevent fire danger from the separated oil.
- Care should be taken to keep the area around the separator clean to prevent accidents.

- Dispose of the separated oil properly, preferably by recycling.
- SAFETY AND ENVIRONMENTAL PROTECTION ARE THE RESPONSIBILITY OF THE USER. MOHR SEPARATIONS RESEARCH ASSUMES NO LIABILITY FOR MISUSE OF THIS SEPARATOR OR FOR USE OUTSIDE THE PARAMETERS FOR WHICH IT IS DESIGNED.

*Initial installation requirements:*

The inlet flow to the separator must be by gravity flow, without a centrifugal pump upstream. Centrifugal pumps greatly agitate the oil and water and tend to make a very stable emulsion that is very difficult if not impossible to separate by gravity settling or enhanced gravity settling such as is used in the separator.

System flow should be controlled upstream to ensure even steady flow and stable conditions in the separator. Unstable flows tend to reduce efficiency and may cause spills. The separator tank is atmospheric in design, vented to atmosphere around the cover. It is recommended that if a pump is used to introduce the water/oil mixture into the separator that it be a positive displacement type such as a progressive cavity pump. This will minimize further emulsification of the mixture so as to minimize the effect on separator performance.

To achieve the desired flow, excessive throttling of the input must be avoided as this will also cause emulsification of the oil, adversely affecting separator performance. Especially avoid the use of globe type or other valves with high pressure drops.

The separator must be installed as level as possible, preferably within 1/16" per foot. Excessive slope of the unit may adversely affect performance. It is highly recommended that the water effluent line and the oil skimmer lines be gravity flow. The pressure loss for the water effluent pipe and oil skimmer line shall not exceed the drop in elevation of the customer lines. External piping should be separately supported. The separator is not designed to support long runs of piping.

To install the separator, follow these steps: (Please refer to attached cross-sectional flow schematic)

- Ensure that the unit is installed in a level position and check inlet and outlet connection to ensure that they are properly made and leak tight. Be careful to avoid damage to the plastic threads in the connections.
- Ensure that the source of the water to be treated is properly regulated and not provided with a centrifugal pump or other device which will cause emulsification such as a high pressure drop valve.
- Provide a mounting pad or other mounting arrangements to ensure that the separator is level.

- Connect the oil-water inlet piping to separator inlet connection (please see attached cross-sectional flow schematic).
- Avoid excessive throttling of the flow.
- Connect oil outlet piping to the separator oil outlet connection.
- Connect the water outlet piping to the water outlet connection. Ensure proper fall in the outlet piping so that the line will drain by gravity.
- It is recommended that drain valves and piping be installed to the drains to avoid possible spills when emptying the tank.

### *Initial Check*

Before putting the MSR-11 unit in service initially or after maintenance, the following startup-check procedures should be performed.

- Ensure that the unit is installed in a level position and check inlet and outlet connection to ensure that they are properly made and leak tight. Be careful to avoid damage to the plastic threads in the connections.
- Remove wing nuts securing the cover and set the cover aside. The cover retaining bolts are intended to remain in the separator and are not to be removed.
- Check to ensure that the module has not moved out of place. The module should be positioned so that it is correctly in position as shown on the drawing.
- Ensure that the flat and corrugated plastic pressure plates are correctly installed. It is important that both of these should be flush against the bottom of the separator. A small piece of wood such can be a convenient way to push down on the top of the corrugated plate to get it to the bottom of the separator without damaging the corrugations. A detail showing this installation is provided on the flow diagram.
- The water outlet weirs are preset at the factory so that the water level under flowing conditions in the plate area is approximately 3/8" (10 mm) below the bottom of the "vee-notch" oil overflow weirs. The settings of the water weirs should be checked against the installation drawing to ensure that they have not shifted during shipment. You can check this setting by inserting a ruler down through the overflow weirs to meet the bottom of the separator. The top of the weirs should meet the dimension shown on the drawing. After checking the factory settings, it will still be necessary to check them under flowing conditions as discussed below.

### *Initial start-up:*

This procedure is to be followed after the installation of the separator or after the separator has been drained and is ready to be restarted.

- Before starting the flow to the unit, remove the cover and ensure that the coalescing module has not shifted and that the flat and corrugated plastic

- are in place. The separator should contain one coalescing module, one flat plastic sheet in the space between the plate pack and the inlet baffle and a corrugated plastic sheet between the flat sheet and the inlet baffle.
- Plug the drain connections and oil removal connections if they have not been provided with valves. Mohr Separations Research recommends that these be provided with valves. If valves are installed, close the valves.
  - Ensure that there are no obstructions in the water outlet piping and that adequate oil disposal facilities are provided.
  - Fill the tank with clean water to avoid contaminating the downstream end of the separator with oil.
  - Open the user supplied valve to allow the oil-water mixture into the tank.
  - Adjust for the desired flow rate and allow unit to stabilize for a few minutes.
  - Check to ensure that the stabilized water level is approximately 3/8" (10 mm) below the "vee-notch" oil skimmers. The stabilized water level is shown on the drawing as the dynamic water level and the static water level is the level at no flow - essentially the top of the water weirs.
  - Adjust water overflows if necessary.
  - Check for leaks, both external and internal and remedy any found.
  - Check to ensure that oil is building up on the surface of the water. If oil buildup is very slow, ensure that there is no oil in the outlet water flow. If the outlet water is clean, wait for oil to build up on the surface. If the outlet flowing water contains oil, check for emulsification of oil and upstream conditions. Ensure that emulsifying detergents are not being used in the inlet water.
  - After oil begins flowing into skimmers, ensure that the oil disposal arrangements are taken care of and that the oil is being disposed of properly.
  - Replace the cover after flow is stabilized and oil is being removed to disposal.

Note: it is possible that the oil will build up only over a period of days, or perhaps weeks, depending on how much oil is present in the inlet water. If no oil appears quickly, check again after some time in service.

#### *Normal Operation:*

Carefully maintain flow at the rate set when flow was established. The oil flow into the skimmers, once a sufficient quantity of oil has accumulated in the separator, varies with the concentration of oil in the incoming water. Only oil will be removed since the skimmer has been set above the water level. Some traces of water will exist in the oil because some will become entrained in the oil going over the weir. This is not a problem as long as it is not too great because the oil should be recycled. If excessive water is found, check the water weir adjustment. NOTE: An oil layer will always remain on the surface when the weirs are adjusted properly.

### *Maintenance:*

1. After approximately 250 hours of operation, the inlet area of the separator should be checked to determine if an excessive amount of solids have accumulated. If this happens, a settling tank should be installed upstream of the separator to remove the solids. Otherwise, the solids may accumulate enough to plug the lower part of the module. In this case, efficiency will be reduced and hydrocarbons in the outlet water may exceed allowable limits.
2. After approximately the first 1,000 hours of operation, the inlet area should be cleaned as follows:
  - a. Stop flow to the unit and close valves.
  - b. Remove cover.
  - c. Raise the water weirs to force accumulated oil over the “vee-notch” weirs to the oil tank. Because the inlet water is not flowing, it will be necessary to use a hose to provide the water to float the oil over into the oil tank.
  - d. Drain the water from the vessel.
  - e. Remove the coalescing module and clean it. The module can be cleaned using a standard garden hose at normal domestic pressure. **DO NOT USE DETERGENTS OR SOAPS. DO NOT DISASSEMBLE MODULE.** It is not necessary to return the module to as-new condition or to remove all of the oil, only to remove the solid particles that may be present in the module. Some oil on the plates will not cause deterioration of performance.
  - f. Use a hose to flush the tank and sweep all sediment out of the drain connections.
  - g. Inspect water weirs for damage and replace if necessary.
  - h. To restart unit, reinstall modules and seals. To reinstall modules, use the following steps:
    - i. Install module, being careful to install the module with the textured sides of the plates **DOWN**. Move the module to the side of the module area next to the oil holding tank.
    - ii. Install the flat plastic sheet in the space between the module and the inlet baffle. Install the corrugated plastic sheet between the flat sheet and the inlet baffle.
    - iii. For start-up, follow instructions listed in *Initial Start-up* above.

Note: The quantity of sludge found in the inlet section should be used as a basis for determining the next interval before cleaning. If the sludge level is very low, the interval can be extended. If it is more than 1/3 up the plate packs the interval should be shortened.

*Troubleshooting:*

Problem	Possible Cause	Diagnostic Technique	Corrective Action
No Oil Discharged (1)	Water Weirs too low (2)	Check oil layer thickness	Raise water weirs to appropriate level
Processed water effluent contains oil	Flow too great for separator	Check Flow Rate	Reduce flow rate
	Module plates blocked	Remove module and inspect	Clean system per instructions above and reinstall
	Seal flat and corrugated plates not installed or incorrectly installed	Inspect for correct installation	Install correctly
	Surfactants in use upstream of separator	Determine if soaps or detergents are in use	Eliminate use of Soaps and / or detergents
Tank overflowing	Outlet line restricted or blocked (3)	Check flow	Remove restriction and / or clean line

For other problems or advice, please consult the factory at telephone: 918-299-9290.

Notes:

1. For oil flow, the oil layer on top of the water in the main separator area must be about ½" (12 mm) thick. This constitutes about 1/8" (3mm) above the bottom of the "vee-notch" weirs.
2. Although it is possible that there is little or no oil in the incoming water, incorrect adjustment of the water weirs is more likely.
3. Outlet line must be at least as large as outlet nozzle unless unit is operated at very low flows.

