Industrial Oily Wastewater Pretreatment

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Pretreatment of Oily Wastewater – Why is it Important?

Oils, fats and greases can cause significant long term harm to the environment if discharged untreated.

Certain types of fats and greases can also plug and foul sewer systems, causing significant maintenance problems if they are not removed from wastewater.

Oil, fats and greases can also have a detrimental impact on subsequent wastewater treatment processes if not properly controlled.
Pretreatment of Oily Wastewater – Understand the Application

Not all oily wastewater is the same.

Understanding the source, nature and characteristics of oily wastewater is key to understanding how to treat it.

Once the characteristics of the oily wastewater is understood, the proper oil/water separation technology can be selected.
Pretreatment of Oily Wastewater – Understand the Application

Oily wastewater varies greatly.

- Petroleum Production
- Petroleum Refining
- Petrochemicals
- Steel Manufacturing
- Automotive
- Railroad Maintenance
- Power Plants
- Poultry Processing
- Meat Processing

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Once you know the source of the oily wastewater, understand the characteristics of the oil and other constituents in the wastewater. These may include:

- Specific gravity of the oil or grease to be separated.
- Viscosity of the oil or grease.
- Free oil and grease concentration in the raw wastewater.
- Total oil and grease concentration in the raw wastewater.

But these are just the basic factors. Other characteristics, such as these, can impact the selection and design of oil/water separation equipment.

- Temperature of the wastewater.
- pH of the wastewater.
- Total Suspended Solids concentration.
- Specific gravity of the wastewater.
Understand the variability of the wastewater. This can impact equipment selection or the need for equalization.
Wastewater Discharge
Requirements/Limitations

The selection of oil/water separation equipment for the treatment of oily wastewater can be dependent on more than just treatment requirements for oil and grease. The following treatment requirements can also impact the selection of equipment.

- BOD5
- COD
- Total Suspended Solids (TSS)
- TKN
- Ammonia

The requirement to remove TSS or the requirement for biological treatment can impact oil/water separation equipment selection.
Oil/Water Separation Equipment
Product Categories

Oily Wastewater

- < 50 mg/l Oil & Grease

Oily Wastewater

- 50 – 500 mg/l Oil & Grease

Oily Wastewater

- > 500 mg/l Oil & Grease

Primary Oil/Water Separator
- Decant Equalization Tanks
- API Separators
- CPI Separators
- Hydrocyclone Separator
- Gravity Grease Separator
- Traveling Bridge Collector

Secondary Oil/Water Separator
- DAF/DGF Separators
- IAF/IGF Separators

Tertiary Oil/Water Separator
- Walnut Shell Filter
- Media Filter

Treated Effluent

1 – 10 mg/l Oil & Grease
API Separator

Typical Applications and Operating Conditions

- Typically used in petroleum refineries, petrochemicals, primary metals and railroad maintenance facilities.

- Influent Oil: 300 ppm to 10,000 ppm.

- Influent TSS: 300 ppm to 10,000 ppm.

- Effluent: 50 to 200 ppm oil and TSS.
Advantages

- Ability to process wastewater with high TSS concentrations, up to 20,000 PPM.
- Non-metallic collector component resist corrosion and are easy to install.
- Concentrated oil removal.
- Responsive to variations in flow and load.

Disadvantages

- Large area required.
- Higher costs.
Typical Applications and Operating Conditions

- Normally used in oil production, petrochemical and power plants with low TSS wastewater.
- Influent oil: 200 to 10,000 ppm.
- Influent TSS: Less than 100 to 200 ppm, dependent upon type of oil present.
Advantages

- Very small space requirements.
- Low capital costs.
- Easy to cover for VOC and odor control.

Disadvantages

- Not recommended for TSS concentrations above 100 to 200 ppm.
- Not tolerant to variations in flow and load.
Typical Applications and Operating Conditions

- Typically used in petroleum production with some applications in refineries and petrochemical facilities.

- Influent Oil: 300 ppm to 5,000 ppm.

- Effluent Oil: 100 to 300 ppm.
Advantages
- Lower cost.
- Concentrated oil removal.
- Small space requirements.

Disadvantages
- Very poor response to variation in flow and load.
- Separate hydrocyclones required for oil and TSS removal.
- Requires a minimum 35 psi feed pressure.
Gravity Grease Separator

Typical Applications and Operating Conditions

- Typically used in the food industry for removal of heavy floating grease and fat.
- Influent Oil: 500 ppm to 10,000 ppm.
- Influent TSS: Up to 20,000 ppm.
- Effluent: 100 to 300 ppm oil and TSS.
Gravity Grease Separator

Advantages

- Ability to process wastewater with high TSS concentrations, up to 20,000 PPM.
- Non-metallic collector component resist corrosion and are easy to install.
- Concentrated grease removal.
- Responsive to variations in flow and load.

Disadvantages

- Large area required.
- Higher maintenance costs.
Typical Applications and Operating Conditions

- Limited to steel mill applications.
- Influent Oil: 500 ppm to 10,000 ppm.
- Influent TSS: Up to 20,000 ppm.
- Effluent: 100 to 300 ppm oil and TSS.
Advantages

- Well suited for removal of large amounts of floating oil and heavy solids load. Primary used in steel mills.
- Concentrated oil removal.
- Responsive to variations in flow and load.

Disadvantages

- High maintenance and capital costs.
- Large area requirements.
Typical Applications and Operating Conditions

- Most common method of oil and TSS removal. Used in most industrial applications.
- Influent oil and TSS concentrations up to 500 ppm.
- Up to 95% removal of oil and TSS
Advantages

- Tolerant of changes in wastewater strength and flow.
- Integral chemical conditioning provides good removal of oil emulsions.
- Low sludge production, 0.1 to 0.5% of forward flow.
- Consider non-metallic collector components for corrosion resistance.

Disadvantages

- Higher cost and larger footprint compared to other technologies.
IAF/IGF Separators

Typical Applications and Operating Conditions

- Typically used in oil production with some minor applications in refineries and petrochemical plants.
- Works best on applications with consistent wastewater characteristics and no oil emulsions.
- Influent oil concentrations less than 300 ppm.
- 50 to 90% removal of oil.
- Not designed to remove TSS (TSS less than 100 ppm).
IAF/IGF Separators

Advantages

- Small footprint.
- Lower costs.

Disadvantages

- Higher sludge production, 2 to 10% of the forward flow.
- Less tolerant of flow and load variations.
- Poor removal of oil emulsions.
- Limited TSS removal efficiency.
Typical Applications and Operating Conditions

- Typically used in facilities with strict oil discharge requirements, that do not have downstream treatment processes, such as biological treatment.

- Sometimes used with systems that have downstream membrane processes such as MBR.

- Influent oil concentrations less than 100 ppm.

- Effluent oil less than 5 ppm.
Walnut Shell Filters

Advantages

- Can achieve very low effluent oil concentrations, 1 to 5 ppm.

Disadvantages

- Not a good TSS removal device.
- High capital cost.
Media Filters

Typical Applications and Operating Conditions

- Filtration of:
  - Suspended solids

- Inlet parameters
  - Solids $< 30$ mg/L
  - Turbidity $< 30$ NTU
  - Particles $> 10$ micron

- Outlet parameters
  - Solids $< 5-10$ mg/L
  - Turbidity $< 1$ NTU
  - Particles 2 - 5 micron
    - 98% removal
  - Requires coagulant or flocculent feed
Media Filters

Advantages

- Can operate at very high rates approaching 10 gpm/ft².
- Very good turbidity control.

Disadvantages

- Not recommended for oil removal. High oil concentrations can plug and foul media to the point it needs to be replaced.
## Oil/Water Separator Selection Guide

<table>
<thead>
<tr>
<th>Equipment/Product</th>
<th>Influent Oil Concentration</th>
<th>Effluent Oil Concentration</th>
<th>Primary Applications</th>
<th>Secondary Applications</th>
<th>Ability to Process TSS</th>
<th>Special Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decant/EQ Tanks</td>
<td>500-20,000 mg/l</td>
<td>100-300 mg/l</td>
<td>Food</td>
<td>None</td>
<td>Influent TSS up to 20,000 mg/l</td>
<td>Requires manual removal of accumulated oil and TSS. Used for lower flow applications.</td>
</tr>
<tr>
<td>API Separators</td>
<td>500-20,000 mg/l</td>
<td>100-300 mg/l</td>
<td>Refining Petrochemicals</td>
<td>Oil Production Power</td>
<td>Influent TSS up to 20,000 mg/l</td>
<td></td>
</tr>
<tr>
<td>CPI Separators</td>
<td>500-10,000 mg/l</td>
<td>100-300 mg/l</td>
<td>Oil Production</td>
<td>Refining Petrochemicals</td>
<td>Influent TSS &lt; 150 mg/l</td>
<td>Plate packs prone to plugging in high influent TSS conditions.</td>
</tr>
<tr>
<td>Hydrocyclone Separators</td>
<td>500-5,000 mg/l</td>
<td>100-300 mg/l</td>
<td>Oil Production</td>
<td>None</td>
<td>None. A separate hydrocyclone required for TSS removal.</td>
<td>Requires pressurized feed &gt; 35 psi.</td>
</tr>
<tr>
<td>Gravity Grease Separators</td>
<td>500-10,000 mg/l</td>
<td>100-300 mg/l</td>
<td>Food</td>
<td>None</td>
<td>Influent TSS up to 20,000 mg/l</td>
<td>Designed to remove heavy floating grease from wastewater.</td>
</tr>
<tr>
<td>Traveling Bridge Collector</td>
<td>500-10,000 mg/l</td>
<td>100-300 mg/l</td>
<td>Primary Metals</td>
<td>None</td>
<td>Influent TSS up to 20,000 mg/l</td>
<td>Older technology. No longer commonly used.</td>
</tr>
<tr>
<td>DAF/DGF Separators</td>
<td>&lt;500 mg/l</td>
<td>10-30 mg/l</td>
<td>Refining Petrochemicals</td>
<td>Oil Production</td>
<td>Influent TSS &lt; 500 mg/l, with effluent TSS &lt; 25 mg/l.</td>
<td>Sludge and float volume is 0.1 to 0.5% of forward flow. Extremely responsive to flow and load changes.</td>
</tr>
<tr>
<td>IAF/IGF Separators</td>
<td>&lt;300 mg/l</td>
<td>20-75 mg/l</td>
<td>Oil Production</td>
<td>Refining Petrochemicals</td>
<td>Influent TSS &lt; 100 mg/l</td>
<td>Float volume is 1 to 10% of the forward flow.</td>
</tr>
<tr>
<td>Walnut Shell Filters</td>
<td>&lt;100 mg/l</td>
<td>&lt;5 mg/l</td>
<td>Oil Production</td>
<td>Refining Petrochemicals</td>
<td>Influent &lt; 100 mg/l. Not designed for TSS removal.</td>
<td>Backwash is 1% of the forward flow.</td>
</tr>
<tr>
<td>Media Filters</td>
<td>&lt;50 mg/l</td>
<td>&lt;20 mg/l</td>
<td>None</td>
<td>All Other Markets</td>
<td>Influent TSS &lt; 50 to 100 mg/l</td>
<td>Typically not used as an oil removal device.</td>
</tr>
</tbody>
</table>
Thank you very much for your attention.