TECHNICAL NOTES

How Oil Water Separators Work

Oil Water Separators

What is an Oil Water Separator?

An oil water separator (OWS) is a specialized device that removes free and dispersed oils, grease, and solids from industrial wastewater, stormwater, or process water before discharge or further treatment.

https://www.panamenv.com/oil-water-separators/

Why Use One?

- Prevents oil pollution in rivers, lakes, and sewers
- Ensures compliance with environmental regulations (e.g., EPA limits often <15-100 ppm oil)
- Recovers valuable oil for recycling or disposal
- Protects downstream equipment and biological treatment systems
- Low operating costs — many use gravity only, with minimal maintenance

Common Applications

- Vehicle maintenance facilities
- Fuel depots
- Tank farms
- Airports
- Oil refineries and chemical plants
- Manufacturing and metalworking
- Marine bilge water (ships)
- Vehicle wash racks

The Science Behind It

How It Works

Oil water separators (OWS) rely on the difference in oil and water's specific gravities (density):

Oil is lighter than water (typically 0.8–0.95 SG vs. water's 1.0), so it naturally rises. Solids are heavier and sink.

Step-by-Step Process (Gravity + Coalescing Types)

1. Inlet & Flow Diffusion
   Oily wastewater enters through an inlet pipe. A baffle or diffuser reduces turbulence and velocity, creating smooth, laminar flow.
2. Pre-Separation / Solids Settling
   Heavy solids and sludge drop to the bottom (sludge zone). Large oil droplets quickly rise to the surface.
3. Coalescing (Droplet Merging)
   In advanced ows wastewater flows through coalescing plates (corrugated or parallel packs).
   - Tiny oil droplets attach to the coalescing media plates.

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- They collide, merge into larger globules (coalesce).
- Larger droplets rise faster to the top due to increased buoyancy.

4. Oil Collection
   Separated oil forms a layer on the water surface and is skimmed and drained off for recovery.
5. Clean Water Outlet
   Oil-reduced water exits from the effluent end of the separator and flows to discharge or further treatment.

Key Principle: Stokes' Law

The rise velocity of an oil droplet depends on its size, the density difference between oil and water, and gravity. Larger droplets rise much faster, improving efficiency, which is why coalescence is used to increase the speed of droplet removal from the waste stream.

Types of Oil Water Separators

1. Gravity / API Separators

- Simple baffle-style tanks based on American Petroleum Institute (API) standards.
- Effective for large oil droplets (60-150 micron) and high flows.
- Larger footprint required.
- Typical effluent: ~100 ppm oil.

2. Coalescing Plate Separators (Parallel Plate / CPI / TPI)

- Use packs of inclined plates and/or other media designs to dramatically increase surface area.
- Smaller size for the same flow rate.
- Better removal of smaller droplets (>10–30 microns).
- Typical effluent: <10–15 ppm oil.
- Most common for industrial and refined oils use.

3. Other Types

- Hydrocyclone (centrifugal force for high-pressure systems)
- Filtration or media-based (for emulsified oils)
- Marine bilge OWS (often with two stages + 15 ppm monitor)

Maintenance Tips

- Regularly skim recovered oil
- Remove accumulated sludge
- Inspect plates/baffles for fouling
- Monitor effluent quality

Benefits & Next Steps Benefits of a Well-Designed Oil Water Separator

- High efficiency with low energy use (gravity-based)
- Compact footprint (especially coalescing types)
- Durable construction (steel, fiberglass, concrete)
- Recoverable oil can sometimes be recycled and/or sold to 3rd parties that reuse
- Reduced disposal costs and environmental risk

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