PAN AMERICA ENVIRONMENTAL, INC.

Model FB-S

FB-S

Steel Oil Water Separators
5-5000 GPM Above Grade

The FB Series oil water separators are designed per the American Petroleum Institute (API) separator design guidelines.

Pan America Environmental FB steel Series, steel oil/water separators are high performance, above grade, coalescing Oil water separators with flow rates up to 5000 GPM for removal of free and finely dispersed oil droplets from oily wastestreams. The design follows the American Petroleum Institute's (API) #421 Design & Operation of Oil/Water Separators Manual, February 1990.

FB performance: <10mg/L, 30-micron free, dispersed and non-emulsified oil droplets.

The FB Series steel Coalescing Oil Water Separators are designed for applications where a high performance coalescing oil water separator design is desired using coalescing media. The industrial duty FB design has many features such as adjustable water weir, integral inlet diffuser, A-36 carbon steel or stainless steel construction and many options to provide engineers, system integrators and end users with convenience and flexibility in oil separator system configuration choices.

The FB is installed above grade. It can be customized for flush with or below grade installation.

Features:

- A-36 carbon steel
- Adjustable water weir
- Integral oil reservoir
- Influent diffuser
- Expandable effluent chamber
- Sealed/gasketed covers
- Internal/external epoxy coatings
- Lifting lugs
- Flat Bottom
- Skid mounted
- Multi-section cover

Typical applications:

- Groundwater remediation
- Mobile separation system
- DAF/Clarifier pretreatment
- Power plant water treatment
- Refinery process water
- Aircraft wash racks
- Machining coolant oil removal
- Tank farm tank bottoms
- Vehicle washwater treatment
- R.O. Filter pre-treatment
- Oil spill recovery
- Trench water treatment
- Bilge water treatment
- Hydraulic fluid tank de-watering

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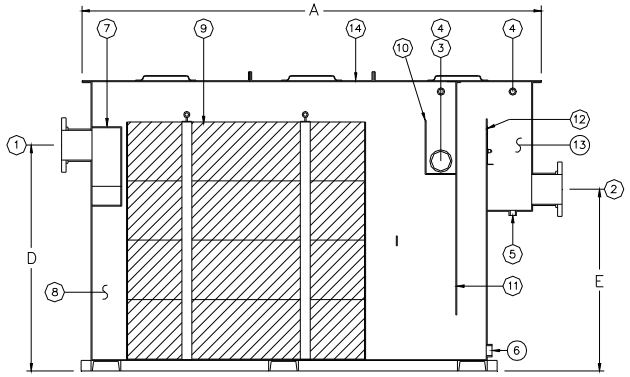

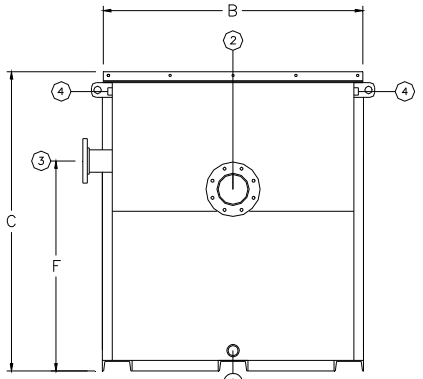

Coalescing Separation

The FB separator separates via coalescing action and the density differential of liquids per Stokes Law, which defines the rise rate of an oil droplet based on its density and size. Typically, the difference between the specific gravity of the oil and water is much closer than the specific gravity of the suspended solids and water. Therefore, the design of the FB separator is based on the difference in the specific gravity of the oil to be separated and the wastewater.

Products Separated:

Motor oils, fuels (vehicle/jet), fuel oils, hydraulic fluids, immiscible machining oils, lube oil, transmission fluid, bunker c, DNAPL, LNAPL, vegetable based oils, crude, air compressor lube & other hydrocarbon based derivatives (BTEX etc.) Model sizing is based on the oil/fuel specific gravity, droplet size removal desired and other parameters of the wastestream.

Options:

- Influent feed system
- Effluent pump out
- Oil pump out
- Mobile push cart
- Mobile trailer system
- Effluent solids filter
- Effluent carbon (GAC) filter
- Effluent AQAM (organoclay) filter
- High level alarms
- High temperature design
- Retpak secondary coalescing media
- Vent VOC absorber
- Elevation stand
- External storage/pre-separation tanks

Model	Length A	Width B	Height C	Inlet D	Outlet E	Oil Outlet F	Oil Spill Vol. Gal.	Oil Chamber Gal.	Inlet Size	Outlet Size	Drain Size	Oil Outlet Size	Empty Weight	Operat. Weight	Flow Rate GPM (Max.)
FB-2	5'-6"	1'-6"	1'-8"	1'-0"	8"	9"	12	1	2"	2"	1"	2"	350	900	5
FB-4	5'-6"	2'-4"	1'-8"	1'-0"	8"	9"	25	2	2"	2"	1"	2"	600	1615	10
FB-8	5'-6"	2'-4"	2'-8"	2'-0"	1'-8"	21"	48	3	2"	2"	1"	2"	720	2290	25
FB-12	5'-6"	3'-4"	2'-8"	2'-0"	1'-8"	21"	72	4	3"	3"	1.5"	3"	1065	3300	35
FB-16	6'-0"	4'-4"	2'-8"	2'-0"	1'-8"	21"	95	6	3"	3"	1.5"	3"	1210	4330	50
FB-24	7'-9"	3'-4"	3'-1"	1'-10"	1'-6"	16"	90	8	4"	4"	2"	3"	1340	4545	70
FB-36	7'-9"	3'-4"	4'-1"	3'-10"	2'-6"	28"	135	12	4"	4"	2"	3"	1425	5520	100
FB-48	7'-9"	3'-4"	5'-1"	3'-10"	3'-6"	40"	180	15	4"	4"	2"	3"	1605	6600	140
FB-64	7'-9"	4'-4"	5'-1"	3'-10"	3'-6"	40"	270	20	6"	6"	2"	4"	1750	9035	190
FB-80	7'-9"	5'-4"	5'-1"	3'-10"	3'-6"	40"	340	25	6"	6"	2"	4"	1930	10800	220
FB-96	7'-9"	6'-4"	5'-1"	3'-10"	3'-6"	40"	400	30	6"	6"	2"	4"	2002	12577	275
FB-128	7'-9"	8'-4"	5'-1"	3'-10"	3'-6"	40"	545	35	6"	6"	3"	4"	2200	14700	350
FB-144	7'-9"	9'-4"	5'-1"	3'-10"	3'-6"	40"	615	35	6"	6"	3"	4"	2635	18700	415
FB-160	14'-1"	5'-10"	5'-5"	4'-0"	2'-10"	2'-8"	640	40	6"	6"	3"	6"	4900	21600	465
FB-192	14'-1"	6'-10"	5'-5"	4'-0"	2'-10"	2'-8"	765	40	8"	8"	3"	6"	5580	25550	550
FB-224	14'-1"	7'-10"	5'-5"	4'-0"	2'-10"	2'-8"	895	40	8"	8"	4"	6"	6215	29500	640
FB-256	14'-1"	8'-10"	5'-5"	4'-0"	2'-10"	2'-8"	1025	40	8"	8"	4"	6"	6990	33460	730
FB-288	14'-1"	9'-10"	5'-5"	4'-0"	2'-10"	2'-8"	1150	40	8"	8"	4"	6"	7800	37600	815
FB-320	16'-9"	5'-10"	9'-3"	7'-10"	6'-7"	5'-10"	1500	50	8"	8"	4"	6"	10050	51000	910
FB-384	16'-9"	6'-10"	9'-3"	7'-10"	6'-7"	5'-10"	1820	50	8"	8"	4"	6"	10800	59300	1050

Item	Qty	Description	Item	Qty	Description	Item	Qty	Description	Item	Qty	Description	Item	Qty	Description
1	1	Inlet	4	4	Vent	7	1	Inlet Diffuser	10	1	Oil Skimmer/Reserv	13	1	Effluent Chamber
2	1	Outlet	5	1	Drain	8	1	Influent Chamber	11	1	Oil Baffle	14	1	Cover
3	1	Oil Outlet	6	1	Drain	9	-	Flopak Media	12	1/2	Water Weir			

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FB Series Steel Oil/Water Separator Engineering Specification FB2 through FB2112

Section 1.0 Oil/Water Separator

Performance
The Pan America Environmental FB Series Oil/Water Separators are designed to produce an effluent concentration of 10 mg/l or less of oil droplets 30 micron and larger of non-emulsified, free and dispersed oils. By virtue of our Flopak coalescing media and tank design, readily settleable solids are also removed.

1.01 Design
The oil/water separator will be designed and fabricated per the following specifications. Rectangular tankage with features as described designed per API #421 Design & Operation of Oil/Water Separators Manual, February 1990 and Stokes Law. The design will incorporate flexible flow rating capability based on application parameters.

1.02 Influent Chamber
Influent flow enters the clog proof influent diffuser pipe and is immediately spread out across the depth and width of the chamber. Any readily settleable solids drop to the bottom of the separation chamber.

1.03 Oil/Water Separation Chamber
The separation chamber is to be packed with Flopak cross-fluted coalescing media. The media pack will be designed to create a quiescent zone, a laminar flow pattern to facilitate the impingement of oil on the media, and will provide numerous droplet impact sites and changes of flow direction. The media shall have a 60-degree cross-flute angle.

1.04 Oil Skimmer
The separator shall be provided with a fixed weir oil skimmer with integral oil reservoir. The skimmer shall be located at the effluent end of the separation chamber.

1.05 Clean Water Effluent Chamber
The cleansed water will flow under the oil retention baffle, over the water weir and into the effluent chamber. This chamber is to have the capability to be expanded at the factory by modifying the standard integral chamber so a greater volume of water is available for pump suction directly from the FB tank.

1.06 Expanded Oil Reservoir (optional)
An integral oil reservoir is to be provided for the temporary storage of separated oils. This chamber is located at the effluent end of the separator. The reservoir will have fittings for pump suction and vent. This reservoir is provided in larger volumes than the standard reservoir.

1.07 Separator Cover
The separator is to have a single piece cover that provides complete closure of the tank. The separator cover will be mounted to the tank via zinc plate hardware and vapor sealed with an industrial grade closed cell, compressible polyethylene gasket.

1.08 Fittings
All fittings are to be FNPT coupling up to 3". Fittings larger to be 150# FF ANSI, B16.5 flange.

1.09 Lifting Lugs & Skid
The FB shall be provided with lifting lugs and a skidded base. The skid shall be provided with bolt holes to allow attachment of the tank to an installation surface.

Section 2.0 Materials of Construction

2.01 Steel Construction
Tank shell, baffles and external structural members shall be constructed of ASTM A-36 carbon steel. Joints are double welded and dye penetrant tested.

2.02 Surface Preparation
Interior surfaces shall be prepared to an SSPC-SP10 near white metal blast. Exterior surfaces shall be prepared to an SSPC-SP6 commercial blast.

2.03 Coatings
Interior coating shall be a self-priming, coal tar epoxy (14-16 mils DFT). Exterior coating shall be primer coat followed by industrial polyurethane coat (6 mils DFT). Color is Green.

2.04 Piping
Internal piping shall be ASTM, A-53 steel.

2.05 Coalescing Media
Cross-fluted, oleophilic Flopak coalescing media shall be provided as manufactured by Pan America Environmental, material of construction to be PVC.

2.06 Cover Gasketing
Closed cell, industrial grade polyethylene vapor sealed cover gasketing shall be provided. No neoprene shall be permitted.

2.07 Manufacturer
The manufacturer of preference shall be: Pan America Environmental

2.08 Warranty
Pan America Environmental warrants its products to be free of defect in materials and workmanship for a period of one year from the date of shipment.

Section 3.0 Freight and Shipping Preparation

3.01 Freight Cost
The quoted freight cost is an actual or estimated cost. This cost is subject to change throughout the life of the quote and any resultant order.

3.02 Palletizing
All equipment prices include palletization except for equipment that is shipped via flat bed.

3.03 Crating
Any crating cost included or itemized includes an export slat crate design. Other crate styles can be provided on request and may incur additional cost.
Export crating is not included in the equipment cost unless indicated in the quote provided to you.

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Oil Water Separator Options Descriptions

Influent Feed System Air operated, diaphragm pump with air controls or progressive cavity pump, sump level switches & Nema 4 control panel, base mounted, 115/230/460V power offered. Electric diaphragm pumps available.

Effluent Pumpout Centrifugal pump with level switches & Nema 4 control panel, base mounted, 115/230/460V power offered. FB Effluent chamber must be expanded to accommodate pumpout or provision of an external pumpout tank.

Oil Pumpout System Air operated, diaphragm pump with air controls, level switches & Nema 4 control panel, base mounted, 115V/1ph/60Hz power req'd. Electric gear or progressive pump systems available. 1 - 100 GPM (larger if required)

Freeze Protection Immersion heaters mounted through tank wall. Each heater has an independent thermocouple well, 0-60 deg. F thermostat and Nema 1 (or optional Nema 4) housing. 230/460V/3ph/60Hz power req'd.

Retpak Secondary Coalescer High surface area, reticulated, secondary coalescing media for polishing flow after standard Flopak media.

Oil Sight Glass Two automatic, brass valves with tempered sight glass and protection rods mounted in oil reservoir. If glass is broken check ball stops outflow from reservoir.

External Sight / Level Glass An externally mounted clear PVC sight tube is provided with multi-point level switch for indication or pump control of oil or water. Switch is removable for cleaning and inspection.

Elevation Stand Epoxy coated steel stand or legs to elevate tank to desired level. Standard deck height is 30". Full platforms & walkways with ladders or stairways can be designed where required or desired.

High Temperature Design Flopak coalescing media and any piping is constructed of a combination of CPVC &/or polypropylene (or other materials) for temperature resistance up to 200° F.

Alternate Media Construction Standard Flopak media is PVC. HPVC, polypropylene, glass-coupled polypropylene and 304/316 stainless media is available. Contact PAE to determine proper media type for your application. Media plate spacing is available in 1/2", 3/4" & 1.2".

External Storage/Feed Tanks A wide variety of tank volumes can be supplied for your water, product and sludge holding needs. Flat bottom and cone bottom designs constructed in polyethylene, fiberglass, steel & stainless steel can be provided.

Effluent Filter Systems Solids filter systems can be provided to remove filterable solids from the separator effluent. Contact Pan America to determine proper filtration needs for your application.

AQAM Filter Systems AQAM (Alkyl Quaternary Ammonium Montmorillonite) filter systems can be provided to remove trace hydrocarbons, sheens, DNAPLs, slightly soluble chlorinated hydrocarbons and high molecular weight organics from the separator effluent. Contact Pan America to determine proper filtration needs for your application.
Can be used to protect and increase GAC lifespan.

Carbon Filtration Systems (GAC) GAC carbon filters can be provided to remove contaminants after the separator. Contact Pan America to determine proper system needs for your application.

Emulsion Cracking Systems Emulsion cracking systems can be provided to remove oil-in-water emulsions prior to the separator. Contact Pan America to determine proper system needs for your application.

pH Adjustment Systems pH adjustment systems can be provided to maintain pH levels prior to or after the separator. Contact Pan America to determine proper system needs for your application.

System Containerization FB separators with any options can be installed in a 20 or 40' shipping container(s) to simplify system provision and field implementation. System would include the complete mounting, piping and wiring of the system in one or more container as required by the project.

Trailer Mounting FB separators can be mounted on a trailer for system mobilization. Trailer design generally includes corner leveling jacks, bubble levels, walkway, toolbox, electric or hydraulic brakes, piping and wiring of options.

Field Skid Mounting FB separator system can be mounted to a mobile skid with leveling for quick field mobilization.

Skid Mounted System FB separators can be combined with our other treatment equipment and options into a fully integrated, custom designed system completely mounted, plumbed and wired to a system skid. To simplify your need to do the wiring and plumbing on site, reducing your time frames and on site costs, we design around your requirements.

Vent Scrubber Separator vapors can be extracted and scrubbed prior to discharge to atmosphere to remove VOC content.

Level Sensors Level sensors can be provided to detect water and oil/fuels. One or more sensor points can be provided to perform various functions such as high level, low level, pump on/off based on liquid levels and level detection for DCS controls or other functions based on your needs.

Class 1 Div 1 & 2 Systems can be designed for use in a class 1 div 1 or 2 environment. Controls, components and wiring are changed to meet the needs of these environments. Intrinsically safe relays are also used for level sensors.

Oil Monitor An oil detection system can be provided to monitor effluent oil content and provide various actions based on the oil alarm setpoint. Actions might include: audible/visual alarm, redirection of influent or effluent via actuated valve, shutdown of influent pump or your custom action.

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Oil Water Separation Theory

Coalescing Oil Water Separators: Coalescing Oil Water Separators are passive, physical separation systems designed for removal of oils, fuels, hydraulic fluids, LNAPL and DNAPL products from water. Pan America Environmental designed performance can be described by a combination of Stokes Law and current coalescing plate theory, wherein, the oil droplet rise rate and other parameters dictate the surface area required for gravity & coalescent separation.

Separation Process: The water/oil mixture enters the separator and is spreadout horizontally, distributed through an energy and turbulence-diffusing device. The mixture enters the Flopak media where laminar and sinusoidal flow is established and the oils impinge on the media surface. As oils accumulate they coalesce into larger droplets, rising upward through the pack corrugations until they reach the top of the pack, where they detach and rise to the water's surface. At the same time solids encounter the media and slide down the corrugations, falling into the v-hopper under the Flopak media.

Stokes Law: This equation relates the terminal settling or rise velocity of a smooth, rigid sphere in a viscous fluid of known density and viscosity to the diameter of the sphere when subjected to a known force field (gravity). The equation is:

$V = (2gr^2)(d1-d2)/9\mu$
where
V = velocity of rise (cm sec^{-1}),
g = acceleration of gravity (cm sec^{-2}),
r = "equivalent" radius of particle (cm),
dl = density of particle (g cm^{-3}),
d2 = density of medium (g cm^{-3}), and
μ = viscosity of medium (dyne sec cm^{-2}).

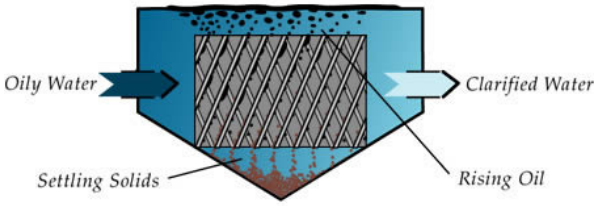
Coalescence: Gravity separation utilizes the difference in specific gravity between the oil and water. Oil separates from a fluid at a rate explained by Stokes Law. The formula predicts how fast an oil droplet will rise or settle through water based on the density and size of the oil droplet size and the distance the object must travel. Our separators are built to exploit both variables of Stokes Law.

With the use of our Flopak media oil only need rise a short distance before encountering the oleophilic, coalescing media plates inside the separation chamber as opposed to rising a great distance in gravity separation. Upon impinging on the plates the oils coalesce (gather) into larger droplets until the droplet buoyancy is sufficient to pull away from the media and rise to the water's surface. The design will meet particular design criteria as indicated below:

- The hydraulic distribution of the influent flow must assure full usage of the cross-sectional area of the media to fully utilize the plate pack's surface area.
- Flow control and direction must be determined to prevent hydraulic short circuiting around, under or over the media pack.
- A laminar flow condition must be maintained (Reynolds "Re" number less than 500) in order to assist droplets to rise. Per the American Petroleum Institute's (API) Publication 421 of February 1990.
- Horizontal flow through velocities in the separator must not exceed 3 feet per minute or 15 times the rate of rise of the droplets which ever is smaller.
- The media containment chamber design, plate design/angle and spacing sufficient to facilitate removal of accumulating solids. Plates are to be smooth surfaced and angled at 60 deg.

Flopak Coalescing Media Design

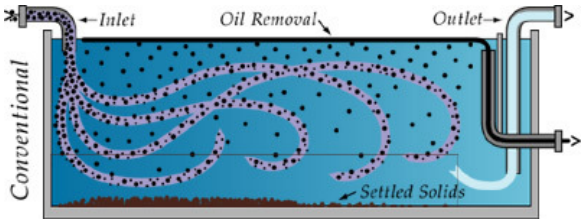
Pan America's Flopak coalescing media provides a laminar flow path that creates a quiescent zone to facilitate the impact with and attachment of oils to the media surface by reducing wastestream turbulence and velocity. This control of the wastestream creates a more ideal environment for oil removal. By virtue of our Flopak media design, solids will also collide with the media and settle to the separator bottom to some degree.Due to oil typically being lighter than water, they (oil) will rise up the coalescing plate. As the oil droplets rise up the plate they will coalesce or come together with other droplets, creating progressively larger droplets. Once the droplet size is sufficient or the droplet reaches the top of the media plate the droplet pulls away from the plate and rises to the water surface. To some degree, the solids replicate this process in reverse (settling).

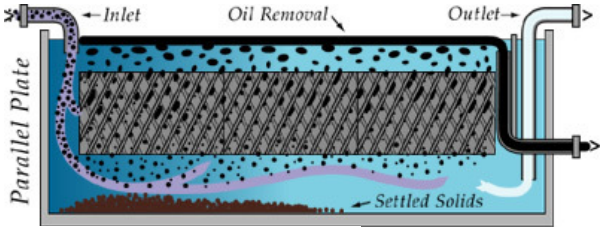


Gravity Separation vs. Coalescing Plates

Two types of oil water separator exist today in varying types of design, but all are dependent on these two types of design.
The first and oldest type is gravity or conventional separation, simple separation via gravity (density differential between two immiscible liquids leads to one of them rising above the other). This design, when designed properly (or even improperly) provides a certain tank length, width and depth that provides a wide, quiet spot in the pipeline to give oils time to rise. This design (also known as an API separator) generally provides a discharge oil concentration of 100 ppm based on a 150 micron droplet size. The API type design relies on a large water volume. This correlates to a tank size that can be 5 times the size of an equally sized coalescing separator.

The coalescing design is known by many names ie. parallel plate, corrugated plate, slant rib coalescer so on and so forth. However, the concept, operation and design are generally the same. The coalescing concept is based on having a large surface area in contact with the wastestream (coalescing plates). The more surface area provided, the more enhanced the separation process will typically be. By using the coalescing media, the size of the tank is reduced and a higher performance is attained than by gravity separation. Pan America's Flopak coalescing design provides a discharge oil concentration of 10 ppm or less with an oil droplet size of 30 or as small as a 20 micron oil droplet.





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