OTO Oil and Gas Technology Co,.Ltd

To develop high efficient separation technologies

Provide our customers with quality products and services

Create value and become the preferred partner of our customers

OTO Oil & Gas Technology Co., Ltd

OTO Oil and Gas Technology Co., Ltd is committed to develop efficient and reliable separation equipment for the oil, gas and processing industries. We provide our valued customers with quality products, cutting edge technology and technical services.

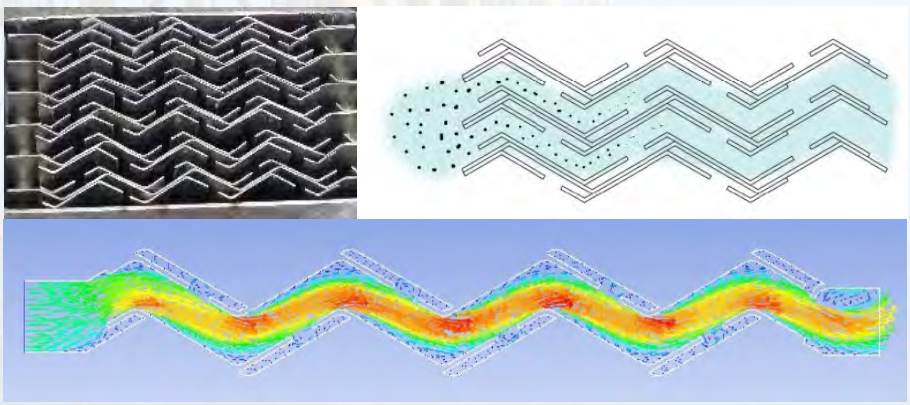
- Compact and efficient separators for multi-phase separation of oil, gas, water and sand
- Inline separation for gas and liquid, oil and water, and sand with gas and liquid.
- Online instrument to provide real-time measurement of particle sizes for oil droplets, gas bubbles and solid particles.
- Computational fluid dynamic analysis (CFD) for multiphase flow inside piping and separation equipment.

1. PRODUCT

The company's products include conventional separation products, compact Inline separation products and complete sets of equipment. Mainly include gas and liquid, gas and solid, liquid and liquid, liquid and solid separation. Compact Inline separation is a promotional product independently developed by our company.

1.1 Vanepack Demister

Vanepack demister consists of a batch of metal sheets which are formed into a certain shape and assembled together to form a series of zig-zag gas flow channels. When the gas enters the demistering element, it is divided into many parallel streams. Gas flow direction is changed by flowing through the zig-zag channels. With the help of inertia force generated by changes of flow direction, the heavier liquid droplets are drawn out of the gas main flow and collide against the surface of the metal sheets of vanepack elements by surface tension. The liquid attached to metal sheets are then drained and discharged from the bottom of vanepack by gravity. Double pocket vane elements are used to prevent liquid re-entrainment for high gas flow.



Vanepack element and its CFD analysis

Performance Characteristics

- Higher gas capacity
- 100% Removal of liquid droplets of 8 micron and larger. Liquid droplets down to 4 micron can be removed with upstream meshpad coalescing element.
- Low pressure drop
- Good resistance to corrosion and scaling
- Suitable to liquid droplets with high viscosity

1.2 Minicyclone Demister

The minicyclone demister is widely used to remove both solid particles and droplets in gas stream. Gas carrying solid particles and liquid enters the minicyclone by two symmetrical tangential entrances. Stable cyclonic flow is generated inside the minicyclone. Solid particles and liquid droplets are moved to internal wall of minicyclone by strong centrifugal force of swirl gas flow. The collected solid particles and liquid droplets are discharged from bottom of minicyclone. Clean gas flows upward through the central tube.

- Stable and strong swirl flow generaged by double tangential entrances for increased separation performance
- Suitable for occasions where droplets and solid particles need to be removed from the gas stream. Separation performance can be increased with upstream coalescing element, such as meshpad and hookless vanepack.
- High separation efficiency, 100% removal of droplets and solid particles for 8μm and larger
- Very good for resistant wearing, blockage and scaling
- Minicyclone made of ceramic materials is used for sands removal with extended life.

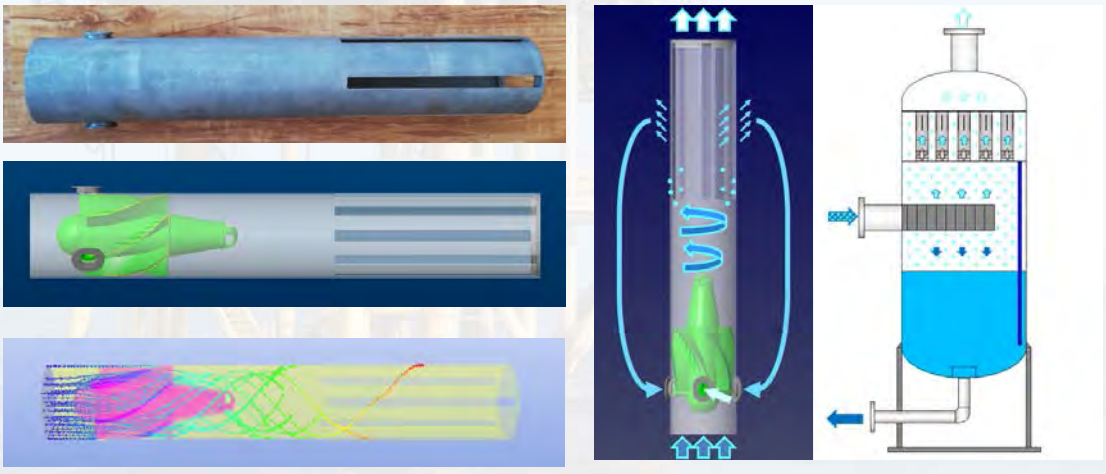
Minicyclones – element and separator

1.3 Axial Flow Cyclone

Axial flow cyclone demister is the most cutting-edge technology for gas-liquid separation. It utilizes very high centrifugal force generated by swirl flow inside the cyclone to remove liquid droplet from gas by density difference between gas and liquid droplet. Axial flow cyclone demister is suitable for high operating pressure, high separation efficiency and low pressure drop. This demister features significant improvements to the cyclone design using the special advanced aeronautical technology to optimize the vane blade's aerodynamical shape to achieve an even better pressure to velocity conversion. This leads to good pressure drop characteristics and lower shear stresses between the gas and liquid within the cyclone. These two parameters potentially allow an improved gas flow rate per cyclone tube. In addition to this, the cyclones liquid handling capacity has been improved compared to other mist eliminating cyclones.

Wet gas enters the cyclone with high velocity. Strong swirl flow is generated inside the cyclone by guided vanes. Gas flows in both axial and circumferential (rotating) direction. High centrifugal force induced by rotating flow will enforce liquid droplets to move toward and attached to the internal wall of cyclone. The liquid flows along the cyclone wall as thin liquid film and discharged out of the cyclone through slots. Dry gas will flow out of the cyclone. A small portion of gas (less than 10%) will flow through the slots together with liquid. This gas stream will enter the cyclone again by suction from bottom channel by low pressure generated by cyclonic flow (gas recycling).

- Designed with advanced aeronautical technology
- Improved liquid droplet separation from gas
- Good performance in fouling service
- Less pressure drop
- Smaller separator vessel required
- No maintenance due to robust design
- Easily replace existing older mist eliminating equipment for better performance



Axial flow cyclone – element and separator

1.4 Compact Oil-Water Separator

Our cutting-edge technology for l-liquid compact (in-line) separation is developed based on current cyclonic separation. They feature high separation efficiency, flexibility and providing a solution with compact installation without sacrificing separation performance.

The compact separation technologies consist of Dewaterer (Bulk Separation Cyclone, BC), Hydrocyclone (HC). Both of them adopt the principle of axial flow cyclone. These technologies provide a full separation coverage from oil well to produced water treatment.

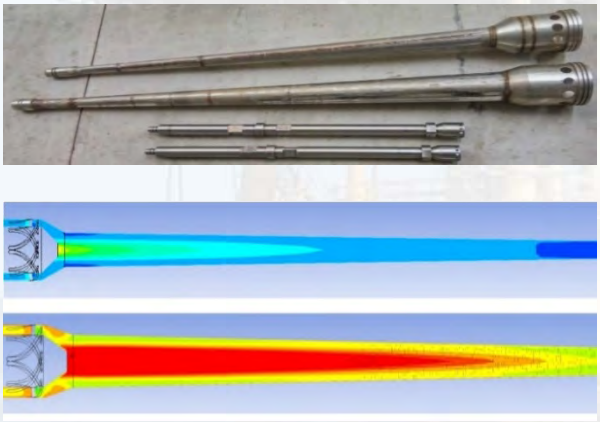
Dewaterer is suitable for separation applications for inlet oil content less than 50%. Hydrocyclone is used for applications where the inlet oil content is <10,000ppm. Based on specific operation conditions, both Dewaterer and Hydrocyclone can be adjusted with their geometric parameters for optimized performance.

The compact (inline) oil-water separator mainly uses the principle of centrifugal separation. The liquid enters the cyclone (axial swirl) from the inlet flow channel axially, and forms a stable swirl flow to generate high centrifugal force (more than 100g) through the vane (special optimized design), so that the oil and water are separated in the cyclone. The compact separators features very short residence time (less than 10s). Their separation efficiencies are over 90%. In depth CFD simulations and site tests have been carried out for separartion optimization and verification.

The product can be applied to the production stream at wellhead, central process facility (CPF), refinery and chemical plant. Some typical process schemes are presented in the section of Compact Separation Solution.

Performance:

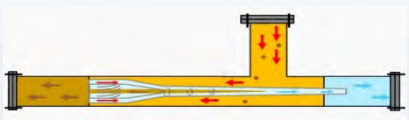
- Dewaterer: water outlet pressure drop <1bar, oil in water <1000ppm
- Hydrocyclone HC: water outlet pressure drop < 3bar. Separation efficiency is 90% for oil droplet of 10 microns and larger.
- Flexibility: two or three stage compact separators can be combined to form different process solutions
- Typical performance



Cyclone liner and CFD analysis

Liner assembly in vessel

Principle of operation



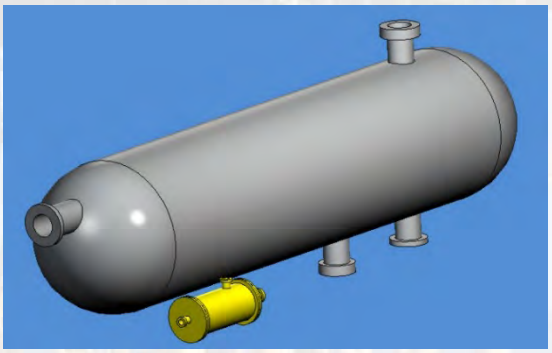
Inline separation

Dewaterer			
Stage	Single		
Density kg/m3	870		
Temperature ℃	>50		
Gas Content %	<5%		
UnderFlow DP bar	<=1.2bar		
Inlet O/W %	FlowSplit %	UnderFlow O/W ppm	W/L
5%	10%	<2000	50%
5%	15%	<1000	67%
5%	20%	<700	75%
10%	15%	<2000	33%
10%	20%	<1000	50%
20%	30%	<1500	33%
20%	40%	<1000	50%

HydroCyclone		
Stage	Single	
Density kg/m3	870	
Temperature ℃	>50	
Gas Content %	0%	
UnderFlow DP bar	<2.7bar	
Particle Diameter um	>12um	
Inlet O/W ppm	DownFlow O/W ppm	Efficiency %
<1000	<100	90%
<500	<80	85%
<200	<40	80%
<100	<30	70%

Product Advantages:

- Very compact in size and small footprint. The single-stage residence time is <10s, and the three-stages residence time is <30s. Suitable for new installation and retrofitting of exist equipment that require better performance or higher capacity.
- Small pressure drop. The pressure drop of Dewaterer (BC) at water outlet is less than <1bar.
- High separation efficiency. For feed with 30% oil, oil in water (OIW) will be less than <1000ppm with Dewaterer (efficiency > 99%). The separation efficiency of combined separation train of Dewater and hydrocyclones will be achieve 99.9%, such as from 30% oil content to <50ppm OIW.
- Liquid weight, low investment costs
- Modular skid equipment, easy to install
- Simple design, less operation and maintenance cost
- A variety of solution options to adapt to different site conditions. See the **Compact Separation Solution** for details.



Capacity：150m3/h
Conventional separator：
ID > 3m, length > 12m

Compact separator：
ID < 0.9m, length <1.5m

Conventional separator vs Compact separator

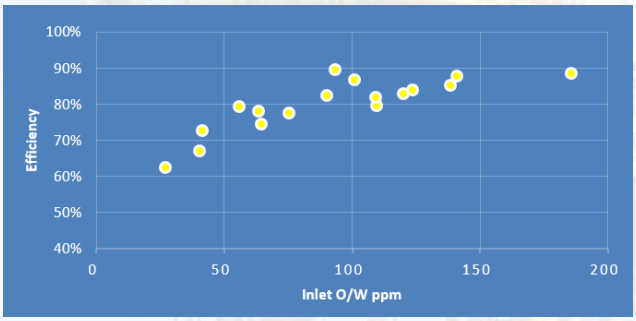
1.5 Compact Floatation Unit (CFU)

A new gas flotation device has been developed by to combine the advantages of gas flotation and cyclone technology to achieve high efficiency and compact design. The new floatation device utilizes a microbubble generating device to generate microbubbles (average bubble size is 20-40 μm). The gas bubbles will attach to the tiny oil and solids contaminants in the special swirling field of the device. The oil and solids with bubbles exhibit small density and bigger particle size so that flotation efficiency is improved.

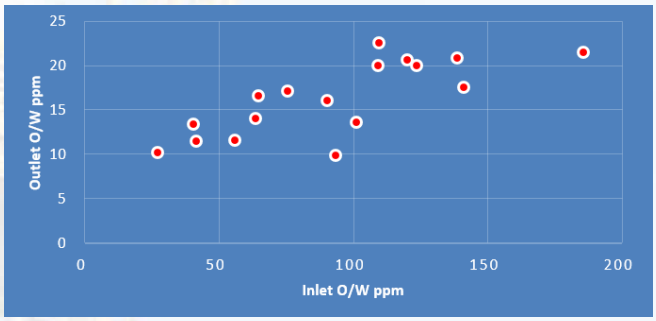
Compact Floatation Unit（CFU）can be applied to oilfield wellheads, central process facility (CPF), refineries, chemical plants. A highly efficient and compact produced water treatment solution can be provided with combination of hydrocyclone and CFU.

Product Advantage

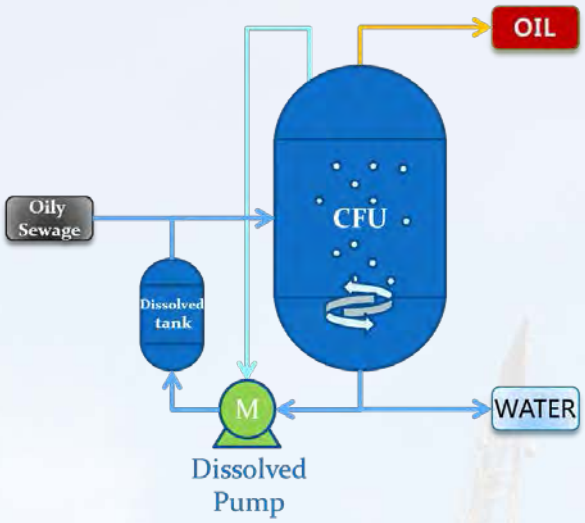
- High oil removal efficiency
- Small footprint (1/10 of the volume of traditional equipment), residence time is about 3minutes only
- No or small amount of chemicals required
- Modular skid construction, low transportation costs
- Stable performance and wide operation envelope
- Low CAPEX and OPEX
- Compact solution together with hydrocyclone for produced water treatment



Inlet Oil vs. Oil removal efficiency



Inlet oil content vs. Outlet

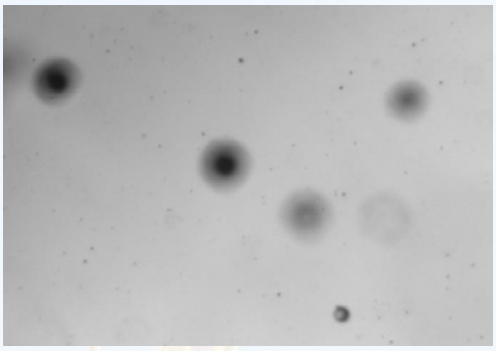


CFU Configuration

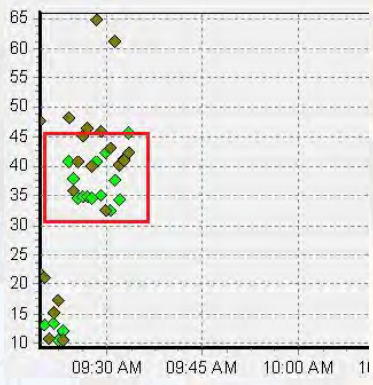
CFU		
Stage	Single	
Density kg/m3	870	
Temperature ℃	>50	
Down outlet pressure drop bar	<1bar	
Inlet O/W ppm	Water Out O/W ppm	Efficiency %
<200	<25	88%
<100	<20	80%
<50	<15	70%
<30	<10	67%

CFU performance

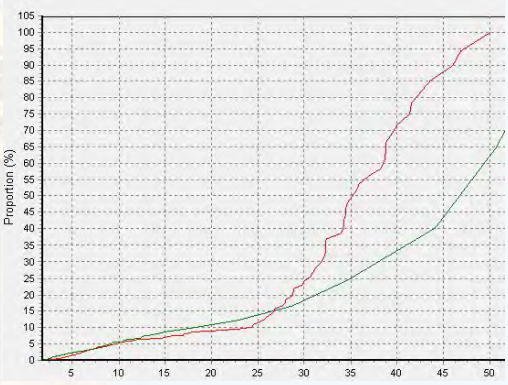
CFU Feed with bubbles



Gas bubble photo



Average bubble size：30-40μm



Bubble size distribution

2. COMPACT SEPARATION SOLUTION

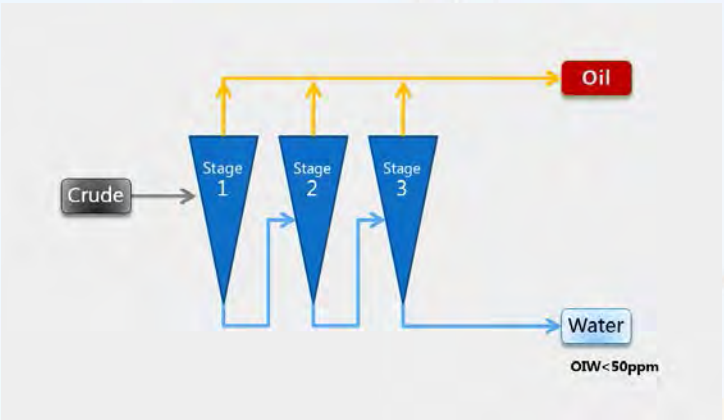
The Compact Separation (**CS**) Solution is dedicated for produced fluid with a high water content (oil content <50%). The produced fluid processed by compact separation equipment will meet separation requirements specified by customers.

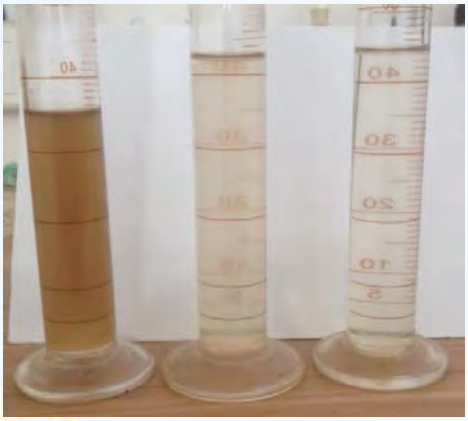
There are many possible integrated solutions with combination of Dewaterer, Hydrycoclone and CFU. The particular design condition will determine the selection of most separation process based on our experience to take the best advantage of each kind of equipment.

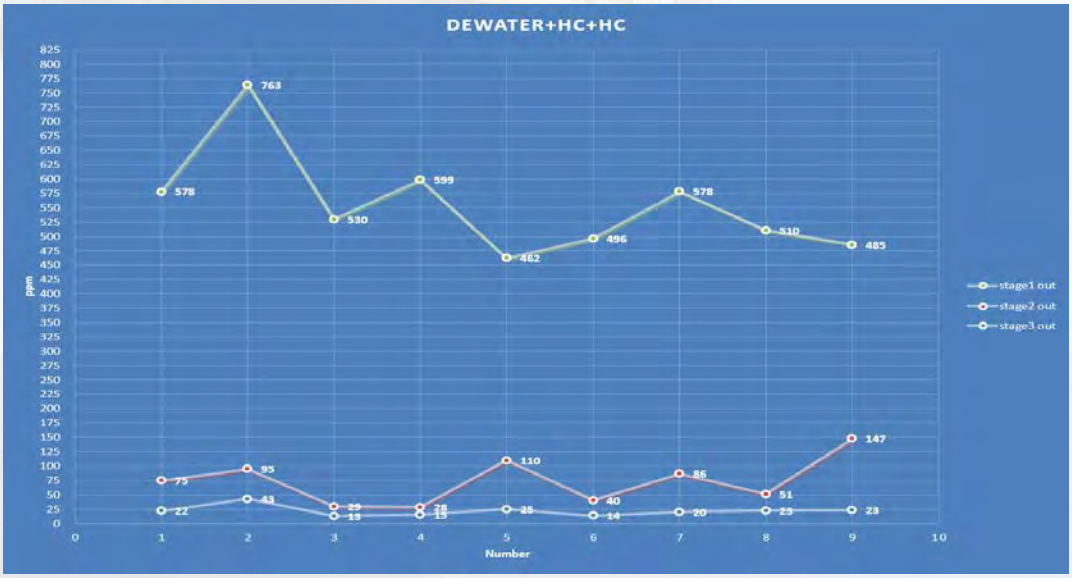
A few typical solutions are presented for better understanding of OTO compact separation technology.

2.1 Compact Separation Solution -1

Three stage separation (BC+HC1+HC2) is arranged in series. HC1 and HC2 are both hydrocyclone but with different separation purposes. After three stages of separation, 80%~95% of the water in the feed stream is removed. The oil content in water of the final stage will be less than 50ppm. Total pressure drop the system is about 6 bar.



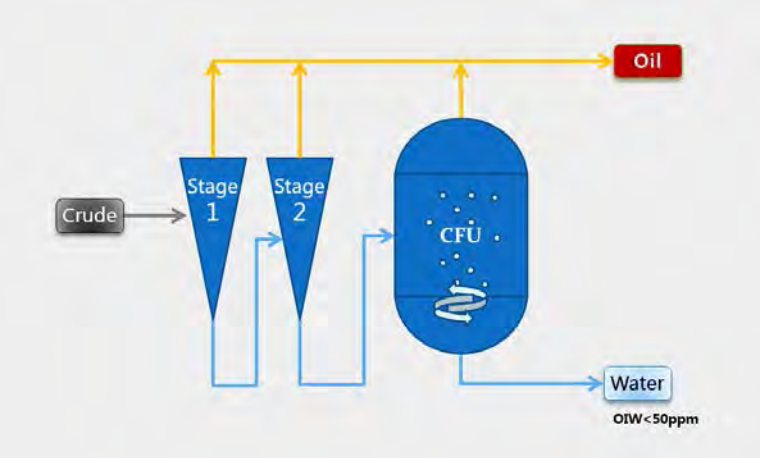


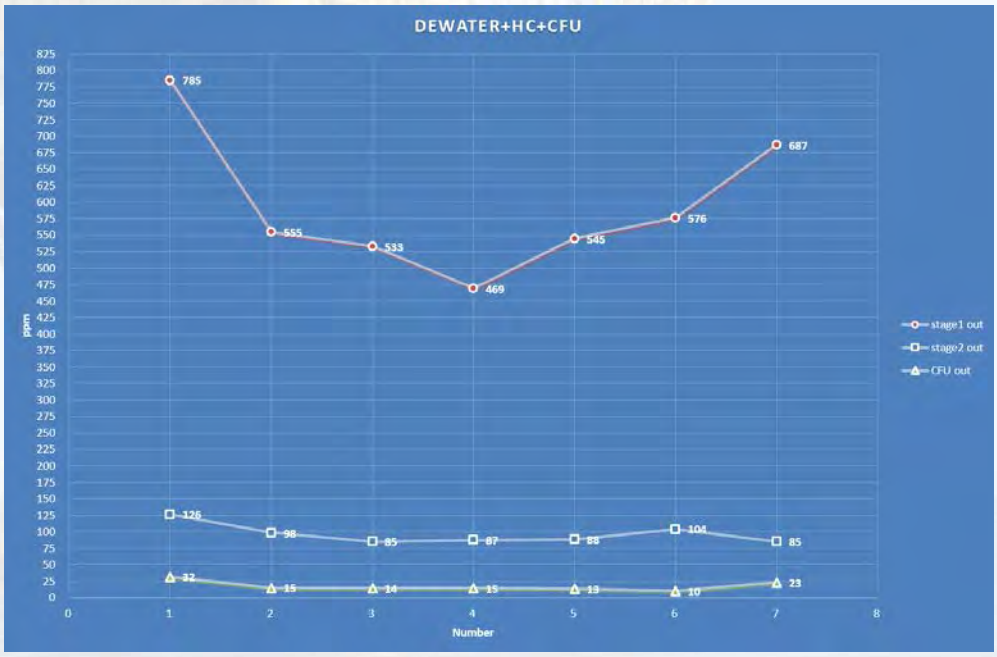


2.2 Compact Separation Solution -2

Three-stage in series of BC+HC+CFU. The inlet contains <30% oil. After three stages of separation, 80%~95% of the water in the produced liquid is removed. The final water outlet contains will be <50ppm oil and suspended solids will be <50ppm.

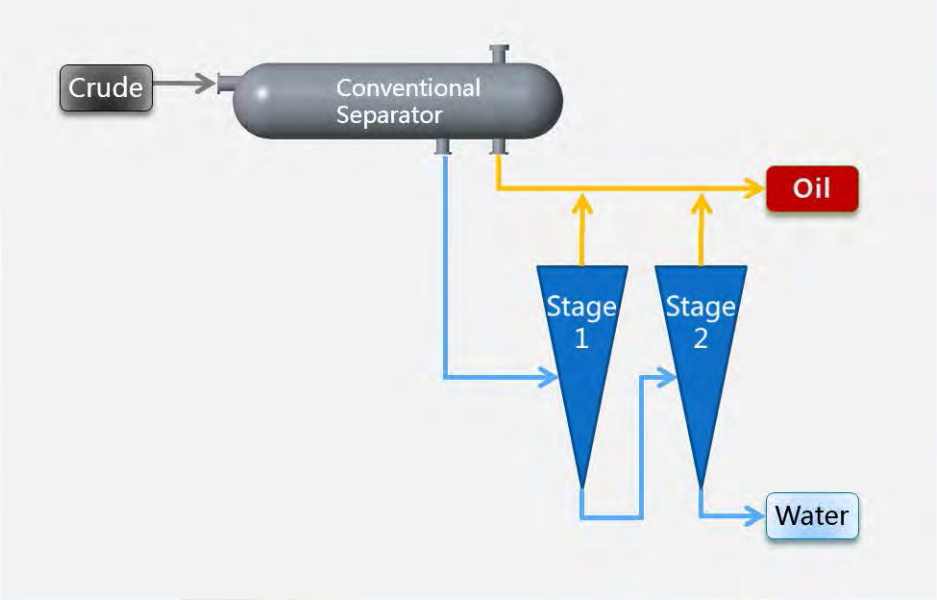
The pictures below demonstrate the separation performance of CS-2. The feed liquid contains 5%-10% of oil. The oil contents in water outlet of first-stage Dewaterer is about 500ppm. The oil content in water outlet of second-stage hydrocyclone is 50-100ppm. The water from CFU achieve 15-30ppm. The oil outlet is about 30-40% oil. Under standard operation condition, the pressure drop of each stage is 1bar, 2.7 bar, and <1bar respectively. In special cases, the pressure drop can be increased or decreased according to customer operation requirements. This solution is a very suitable choice for on-site re-injection of produced water.





2.3 Compact Separation Solution -3

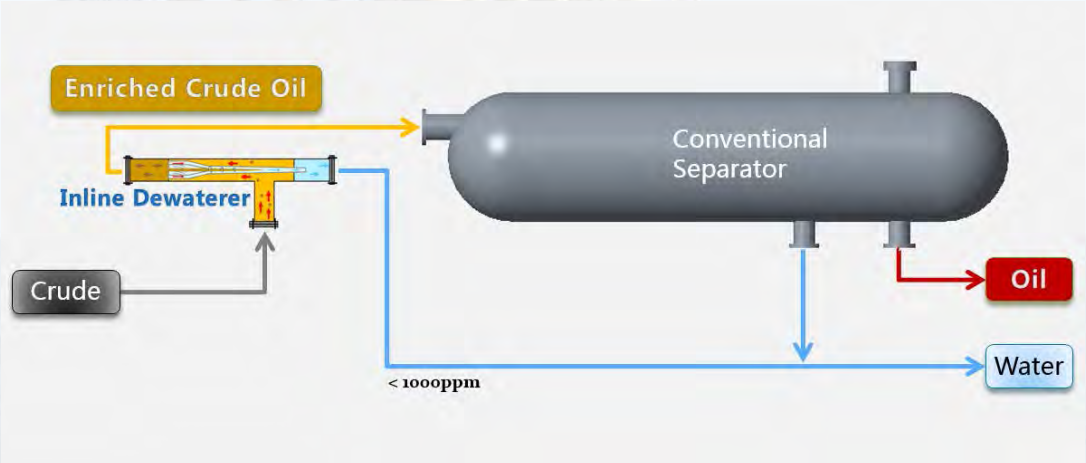
The two stage hydrocyclone are operated in series to process water stream from upstream separator. The oil content in water from separator is <1500pp. The discharge water of second stage hydrocyclone will be less than 50ppm oil.



2.4 Compact Separation Solution -4

The Dewaterer is installed upstream conventional separator. Partial water is separated from feed stream before entering separator. The oil content in water stream from Dewaterer will be less than 1000 ppm. Water from Dewater will combine together for further water treatment.

This solution will increase process capacity of separator. It can be used for new installation and retrofitting of existing equipment.

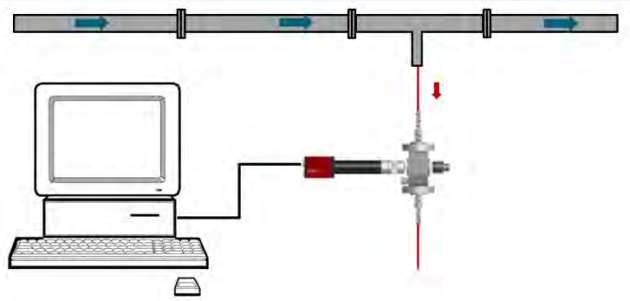


3. SERVICES

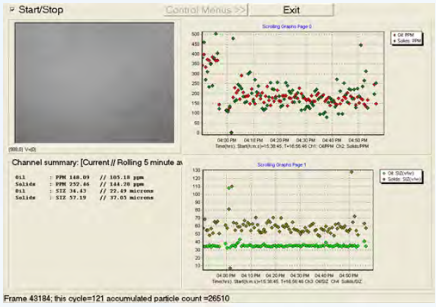
3.1 Particles Online Real-time Measurement and Monitoring

OTO provide online analyzing of oil droplets, solid particles and gas bubbles in pipe flow lines. The instrument uses high-speed microscopic photography technology to automatically identify oil droplets, solid particles and tiny bubbles. Particle size distribution will be provided with its software.

The measurement is accurate and fast, and the result data is comprehensive. The measurement does not use additional equipment and chemicals. Operation of the instrument is simple and easy. Measurement of gas bubbles and oil droplet is not possible with conventional sampling method.



Equipment Configuration of real-time measurement



Online Real-time Monitor

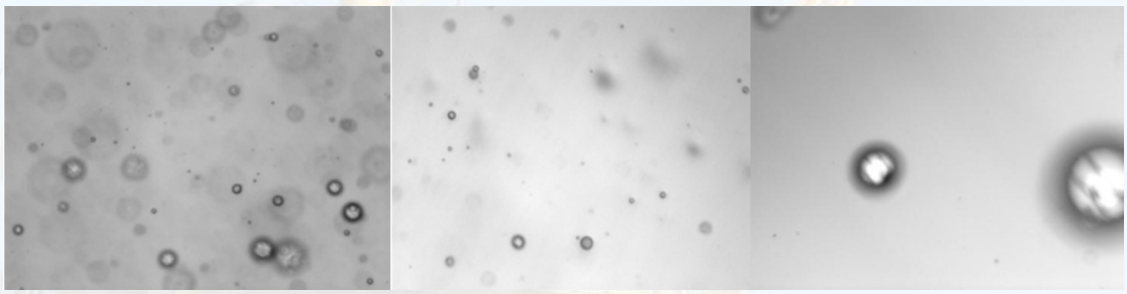
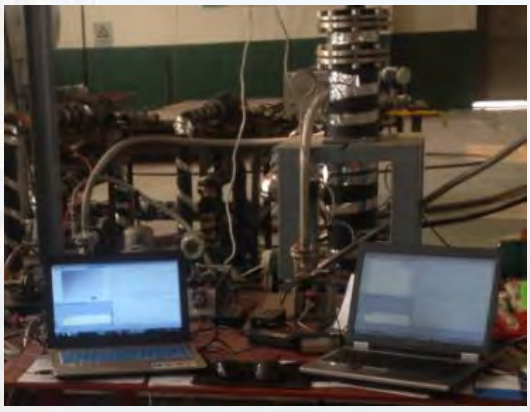


Photo of micro Particles

Single instrument measurement

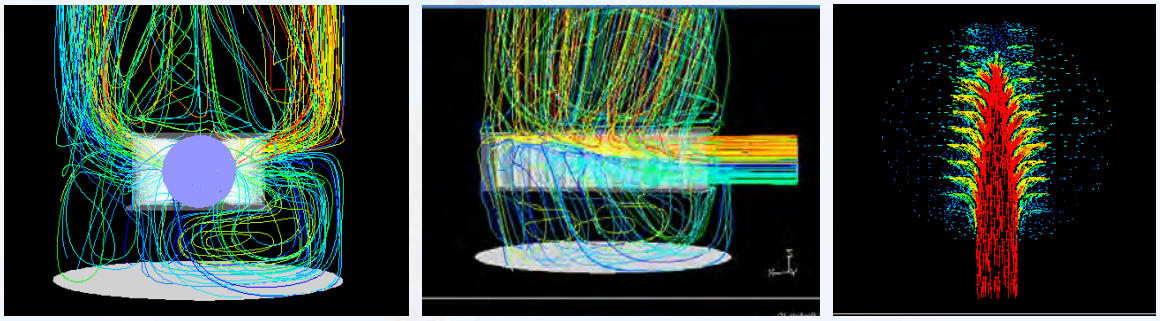


Due instruments measuring two location simultaneously

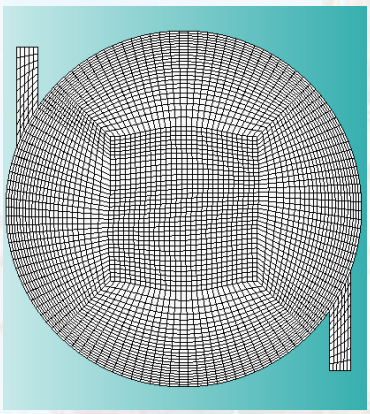
3.2 Computational Fluid Dynamics

Computational Fluid Dynamics (CFD) is a commonly used research tool. CFD is extensively used by OTO for product development, project design. Multiphase flow is comprehensively simulated for better understanding of flow characteristics, separation performance and optimization.

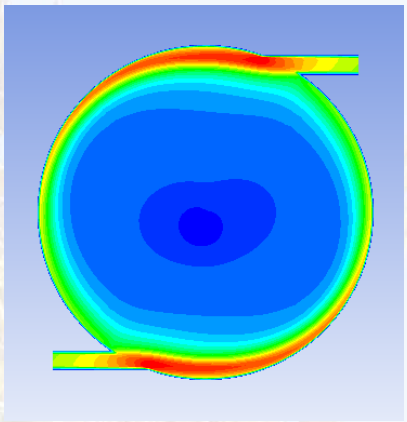
The following pictures and part of our CFD analysis illustrations for projects and product development.



Flow streamline and vector distribution of separator inlet device

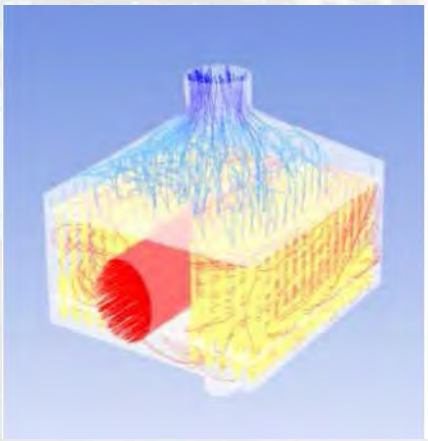


CFD Meshing



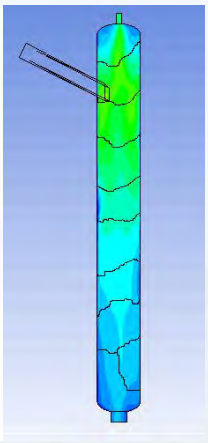
Tangential velocity contour in cyclone

Streamlines in cyclone



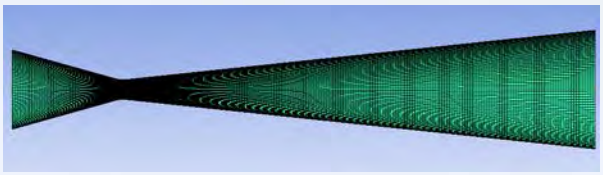
Flow streamline and pressure distribution

Hydrocyclone analysis

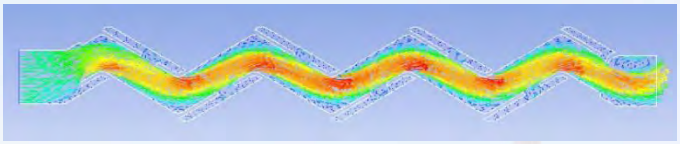


GLCC Analysis

Cyclone liner analysis



Ejector meshing



Flow vector and velocity in Vanepack

Ejector CFD

4. CONTACT INFORMATION

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