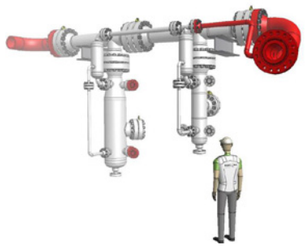
SULZER

Upstream Systems for Gas, Oil, Produced Water and Sand Processing

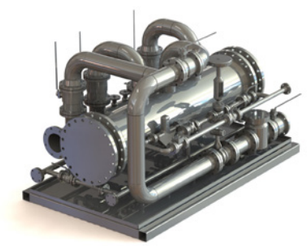
Upstream Systems for Gas, Oil, Produced Water and Sand Separation & Processing

Offering innovative cost-saving solutions for the complete upstream processing train, both for optimized greenfield projects and brownfield modifications of existing facilities.

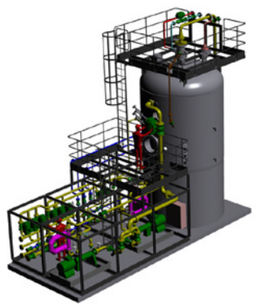
Compact inline gas/liquid separators

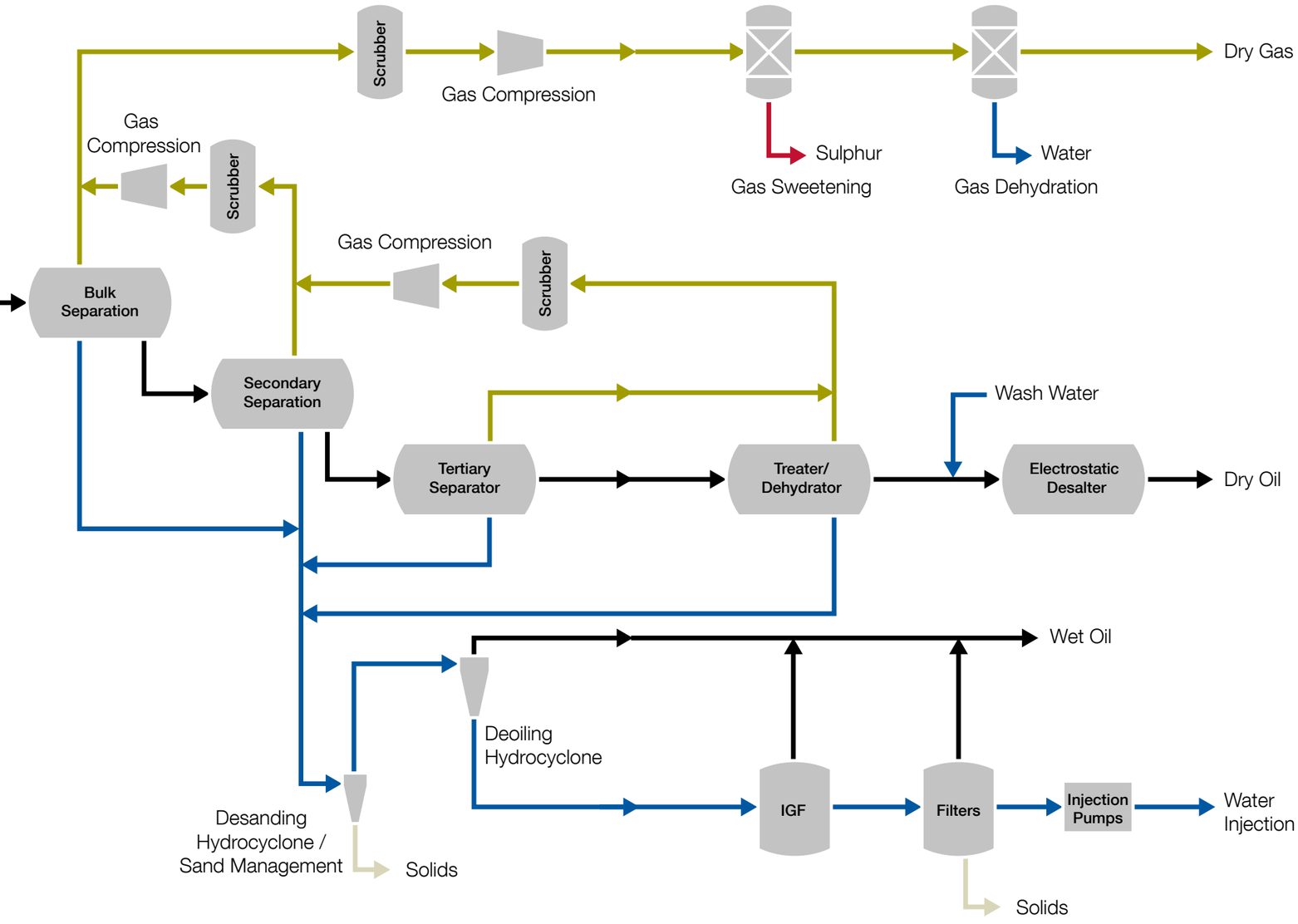


Novel MixedFlow technology Deoiler Hydrocyclones



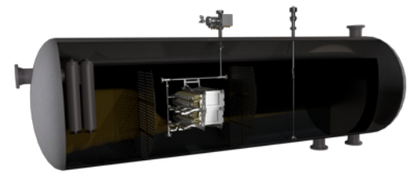
Sand separation, processing & handling



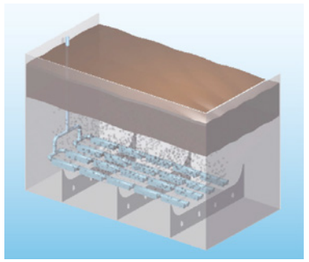


Compact Mass transfer and Inline Separation

Integrated separator & Vessel Internal Electrostatic Coalescer (VIEC)

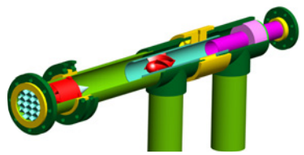


Wash Tank Distributor



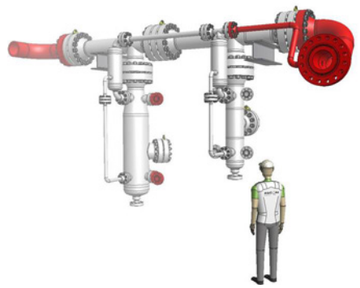
HiPer™ TwinLine™ Separator and Degasser

A patented compact inline separator designed to remove liquid from gas or gas from liquid in two stages, across the widest range of feed fluid characteristics and operating conditions.



Background

While conventional inline separators have a distinct operating window, the HiPer TwinLine™ has the potential to cover a much wider set of operating conditions expanding the current operating range of inline separators to higher fractions of dispersed phase, making it at the same time more resistant to higher fluctuations in gas and liquid feed flow rate, operating pressure and flow regime, without losing control of the quality of the separated phases.



Technology

The Sulzer HiPer TwinLine™ is a patented compact inline separator designed for removing liquid from gas (separator/scrubber design) or gas from liquid (degasser design) in two stages. It can be used as stand-alone unit or in combination with conventional separators and scrubbers as a hybrid design and also with other inline products like HiPer™ Deoiler and HiPer™ Desander.

Application and client benefits

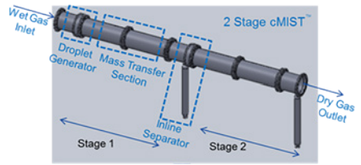
Standalone units can be applied when performance meets clients' requirements. Pre- or post-separation units - upstream or downstream of conventional horizontal separators and vertical scrubbers - can be applied when performance boosting is required. For less demanding services, the single stage HiPer™ MonoLine Separator and HiPer™ MonoLine Degasser are available.

The advantages of the HiPer TwinLine™ designs can be summarized as follows:

- Debottlenecking existing separators
- Compact design-minimizing space and weight requirements
- Achieving high separation efficiencies across the widest range of feed fluid characteristics and operating conditions
- Providing a more robust control in handling fluctuating operating conditions, including turndown
- Typically designed and constructed according to standard process piping specifications, and eliminating the need for a pressure safety valve (subject to client acceptance)

cMIST™ Compact Mass transfer and Inline Separation

Advanced Inline natural gas dehydration technology representing a step-change in operational efficiency and significant reduction in footprint.



Background

cMIST™, developed by ExxonMobil Upstream Research Company and licensed to Sulzer for onshore and offshore gas dehydration applications, is a novel and compact system for efficiently removing water vapor present during the production of natural gas. This inline technology reduces the size, weight, footprint and cost of the gas dehydration system. A testing campaign on a 2-stage demonstration unit located at an XTO compressor station (onshore USA) was successfully completed in February 2016 and demonstrated the performance and robustness of the design.

The system consists of a combination of an ExxonMobil-design droplet generator creating well dispersed small droplets of glycol with a high surface area for the water absorption from the natural gas, followed by a Sulzer-design HiPer™ inline separator for efficiency separating the rich glycol from the natural gas.

Technology

Removing water vapor through the use of dehydration technology — typically accomplished by using large dehydration towers — reduces corrosion and possibilities of hydrate formation. This helps ensure the efficient transport of natural gas through the supply infrastructure and ultimately to consumers.

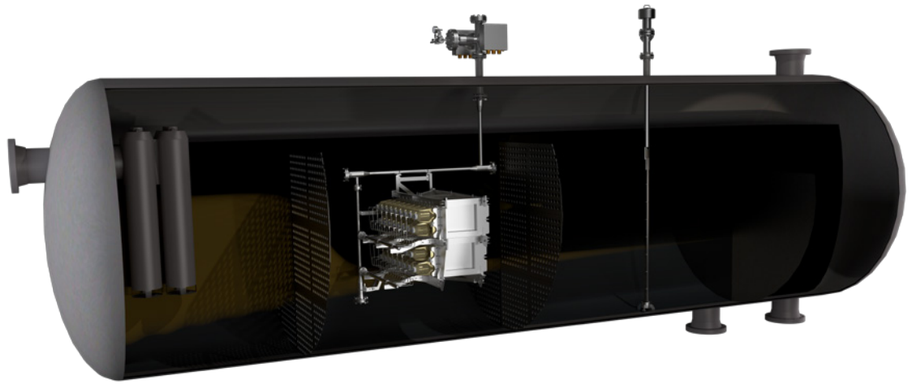
Application and client benefits

Being applicable in both greenfield facilities and brownfield modifications for capacity enhancements and debottlenecking, cMIST™ provides the following benefits:

- Especially advantageous for offshore, floating, remote and urban applications
- Reduction of complexity, size, weight, footprint and CAPEX
- Constructed to pipe specification
- Modular, scalable and flexible design, in horizontal and vertical configuration
- Not influenced by tower motion (for floating facilities) and feed stream foaming

VIEC™ Vessel Internal Electrostatic Coalescer iPhase™ Interface Level & Oil in Water Profiler

VIEC™, Vessel Internal Electrostatic Coalescer, is a technology using alternating high voltage electrical fields for enhancing liquid-liquid separation and thereby helping oil companies increase production capacity on existing assets as well as reducing investment cost for new assets. iPhase™, Interface Level and Oil in Water Profiler, is based on electrical conductance for vessel control.



Background

VIEC™ is a recently acquired technology and filed proven solution for substantial increase of oil-water separation efficiency, improving production capacity, eliminating emulsion issues, reducing heating and chemical dosage demand as well as space and weight requirements.

Technology

The separation is achieved by using alternating high voltage electrical fields. It is a modular construction consisting of several electrodes, where each electrode is electrically insulated and has its own dedicated transformer for transforming a low voltage feed to high voltage.

Tolerates 100% water and 100% gas without short circuiting or arcing, making it ideally suited for use in any three-phase separator to speed up separation of water dispersed in oil and/or to resolve stable oil continuous emulsions.

The VIEC™ can be installed in new separators or retrofitted into existing three-phase separators with no hot work required.

Pairs of energized electrodes are supplied by a low voltage feed from dedicated external VIEC™ frequency cards, giving excellent reliability and robustness.

Applications and client benefits

The VIEC™ technology offers a wide range of applications for optimizing and/or de-bottlenecking oil separation trains, depending on the process scenarios and client requirements. Typical applications include the following:

Tie-ins/capacity increase: The enhanced separation effect offered by the VIEC™ reduces the required retention time in the separator to achieve specification.

Thus, by retrofitting the VIEC™ into existing production separators, the throughput can be significantly increased without compromising oil quality.

Heavy oil: Conventional processes for heavy crudes require higher temperatures than medium and light crudes due to higher viscosity. With VIEC™, heavy crudes can be separated at significantly higher viscosities since the positive effect of enhanced droplet growth outweighs the negative effect of high viscosity. This allows for a significant reduction in process temperatures. The benefits can be substantial energy savings and a reduction in the operational complexity of the process.

Desalting: Conventional desalting is performed using conventional two-phase electro-coalescers in the final stage, after all the gas has been removed and the water content reduced sufficiently. Using VIEC™ technology, desalting can start earlier in the process train at higher water cuts with gas present. By achieving low water contents in the oil stream early in the process, the number of required desalters downstream could be reduced in process schemes where a conventional approach calls for two or more desalters. Additionally, the required injection rate of wash water could be reduced significantly.

Light oil: For light oils, the VIEC™ can contribute to a more compact process with savings in both process equipment, weight and space. Due to lower viscosities, export quality can be achieved with less electrostatic treatment time than for heavier crudes. Since VIEC™ technology can be applied in any three-phase separator where there is gas present and high water contents, final separation of the crude can be performed further upstream with VIEC™ technology than in a conventional process. This could potentially remove the need for a conventional dehydrator downstream, providing a more compact separation scheme.

Pre-treatment skid: VIEC™ technology can be used in pre-treatment skids upstream of existing process facilities to ensure that the existing facilities are not overloaded as the rate of produced water and/or crude increases. This allows for a minimally invasive intervention that minimizes the interruption to the existing facilities, while at the same time increasing its capacity for processing crude.

Emulsion breaking/de-bottlenecking: The presence of, for example, surfactants, a high viscosity or the mixing of incompatible well streams could lead to stable emulsions that severely limit the capacity of separators.

Electro-coalescence is a well proven principle for breaking stable emulsions. Thus, by installing VIEC™ technology at the appropriate stage in the separation train, troublesome emulsion can be resolved, which ensures the optimal operation and performance of the separation facilities.

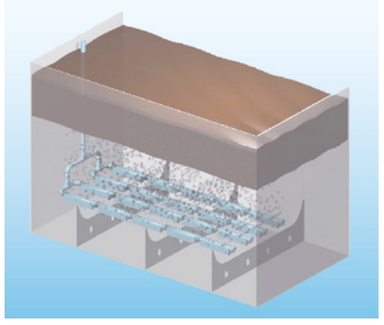
All major operators have utilized our expertise when optimizing the design in their assets. Today, over 40 separation vessels, worldwide, are enhanced with the VIEC™ technology.

iPhase™ interface level and oil in water profiler

- The iPhase™ profiler is based on electrical conductance to provide the user the means to operate a production separator more efficiently by giving an accurate position of the oil/water interface as well as the oil in water profile below the interface level
- The iPhase™ can also measure the level of sand build-up in the separator, allowing for planned intervention or indicating when to use sand-jetting systems
- The inductive measurement principle utilized in the iPhase™ provides a volume based measurement, giving a high tolerance to deposits
- The iPhase™ profiler measures the electrical conductivity of the water/oil mixture surrounding each sensor. The conductivity is measured by setting up an electric field and measure the current flowing

Wash Tank Distributor

Sulzer's patented distributor technology to be applied in hulls of FPSO vessels for processing high saline crude oil and removing contaminants benefiting the operations as well as the environment.

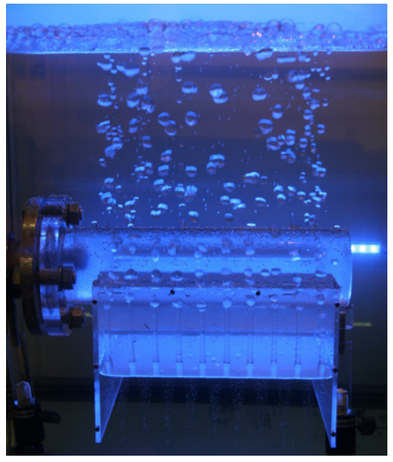


Background

Research co-operation between Sulzer and Total has led to a new phase inversion technology where water-in-oil dispersions are converted to oil-in-water. The oil-cleaning process achieves commercial oil specifications with processing tanks integrated into the hull of the FPSO vessel. Water and salt are removed from the oil in the wash and desalting tanks. This technology uses Sulzer designed innovative static mixers and inlet distributors.

Technology

'Double emulsions' can be created where very small droplets of water are carried in oil droplets which are themselves dispersed within a continuous water phase - known as a 'water leg'. Water droplets, along with salts and other contaminants, can be removed from the oil by contacting the oil droplets with the continuous water phase. The Sulzer Wash Tank Distributor VROL is used at the bottom of the water leg and has been developed to create optimal droplets of oil and removes solids, even when subjected to motion.



In conjunction with Total, the technology is being applied in wash and desalting tanks in the hulls of FPSO vessels for removing entrained water, salts and contaminants from crude oil. The distributor system substantially improves the separation performance and concentrations of <0.5 % vol. BS&W (basic sediment and water) in the oil outlet can be obtained.

For the development of other innovative wash separator processes, small and large scale test rigs have been developed which enable us to investigate detailed coalescence phenomena as well as the whole separation process. CFD is used to simulate the wash tank process particularly taking into account the motion of the tank.

Application and client benefits

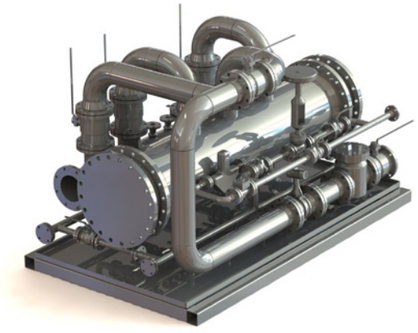
There are two main advantages with this wash tank technology:

- The weight of and the amount of equipment on the platform are reduced as the oil is cleaned on the FPSO and not on the platform itself, thereby saving money and equipment.
- Process does not result in environmental discharges as the processed water that remains after the oil has passed through the wash tanks, is returned to the reservoir near the oil recovery site.

This technology has been in operation for multiple years on the USAN, PAZFLOR and CLOV FPSO's, as well as on the recently started MOHO Nord / LIKOUF FPU. The MARTIN LINGE FSO and the EGINA FPSO are also equipped with this technology and will start up in the near future. All these assets are operated by Total.

HiPer™ Bulk Deoiler Hydrocyclones and HiPer™ Deoiler Hydrocyclone

Produced water deoiling technology providing high separation efficiency.



Background

Conventional deoiling hydrocyclones with tangential inlet ports have long been part of produced water treatment facilities. With environmental legislation around the world increasingly sharpening the allowable oil-in-water content to maximum 20 ppm or even below, the conventional designs are often not adequate to meet these stringent regulations.

The HiPer™ (Bulk) Deoiler Hydrocyclones are based on a novel swirl generation method called MixedFlow. Available in multiple sizes and geometries, they are designed to meet performance requirements across a wide inlet oil concentration range, from percentage down to low double digit ppm levels.

Technology

Contrary to tangential or axial inlet hydrocyclones, the operating principle of these MixedFlow types, with multiple inlet ports positioned at the periphery of each individual cyclone liner, results in a stabilizing and coalescing effect on the water/oil flow. Most available pressure energy is converted in to a rotating motion within the cyclone. This results in the generation of maximum G-force that will be responsible for an adequate and stable oil-from-water separation, combination with minimum pressure drop.

As part of qualification programs for subsea separation systems, a 2-stage version of this system design has been extensively tested in low pressure and high pressure multiphase flow loops under realistic oil & gas field conditions, with varying feed conditions and oil characteristics.

Application

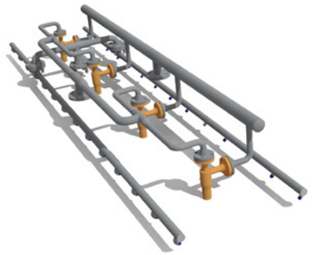
New vessels are minimized in size for a given pressure drop, thereby resulting in CAPEX savings.

Existing vessels with conventional liner types can be retrofitted with HiPer™ Deoiler Hydrocyclones to allow for more flow capacity at a given pressure drop or operation at the same flow rate with a resulting lower pressure drop.

The mechanical design of each liner, with its removable top swirl section, allows for easy dis-assembly and cleaning.

HiPer™ Sand Removal Cyclones and Sand Jetting Systems

Robust vessel-based sand removal with high efficiency.



Background

Produced sand and solid particles not separated from process fluids by HiPer™ Desanders and HiPer™ Desander Hydrocyclones may accumulate in separators and other processing equipment. In order to remove these settled particles, our HiPer™ Sand Removal Cyclones can be applied as stand-alone or in combination with our Sand Jetting System internals. The separated particles are typically routed to an external system for accumulation, cleaning and disposal.

Technology

The operating principle of the HiPer™ Sand Removal Cyclones is based on the fluidization of the settled particles by means of a motive fluid introduced into the individual cyclone heads. In this manner, a low pressure zone is created by centrifugal forces, which acts as active slurry extraction zone.

Subject to the availability of motive fluid (typically produced water) and the area of settled solids which needs to be covered, one or more sections with multiple cyclones can be installed. A minimum distance is kept between the cyclones for the circulating fluid flow around each cyclone not to interfere with one another.

As a result of the geometry and operating performance of the HiPer™ Sand Removal Cyclones, they are less prone to fouling / plugging and consume less motive fluid and pressure drop than the nozzle-based Sand Jetting System.

The operating principle of the Sand Jetting Systems is based on the fluidization of the settled particles by means of a motive fluid introduced into a distributor pipe system with multiple jet nozzles and a sand pan at the center. After fluidizing the particles, the drain nozzles located at the vessel bottom are opened and the slurry freely drains out by gravity.

The outlet slurry streams are typically fed to a sand handling, cleaning and disposal system, on a periodic basis resulting from the use of these units during regular intervals.

Application and client benefits

In view of the low motive water requirement and the ability to fluidize considerable amounts of solids within a reasonable period of time, the HiPer™ Sand Removal Cyclones form an important part of our vessel-based solids handling approach. They can be installed in new vessels but also retrofitted into existing separators not originally designed to house these internals. Such retrofits can typically be executed without welding to the vessel shell, but require a minimum number of nozzles available on the pressure vessel which can be used to feed the motive fluid and extract the slurry.

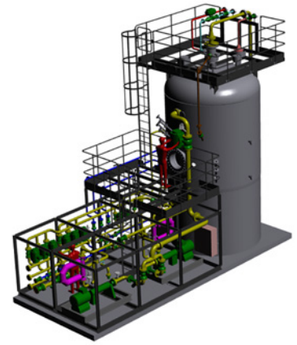
Besides removing solids from separators or other processing equipment, these cyclones can also be deployed to cycle slurry streams across accumulators for cleaning as well as transport accumulated solids over extended distances to a disposal station

The design is considered very robust and reliable, to such extend that the technology has been qualified for use in subsea separators by a major IOC.

For the sand jetting system, depending on the diameter and length of the separator section to be cleaned, multiple sand jetting sections generating an optimized spraying patterns can be installed and operated in sequence to ensure proper sand removal.

HiPer™ Desander and HiPer™ Desander Hydrocyclone Sand/Solid Handling Systems

Cyclone-based continuous removal of sand and solids to protect downstream equipment of erosion. Sand/Solid Handling systems to transport the separated particles for accumulation or disposal.



Background

HiPer™ Desanders and HiPer™ Desander Hydrocyclones can be used to remove sand and solids at several stages in the typical oil & gas processing facility, for instance upstream of main production separators or at the entry to produced water treatment system HiPer™ deoiling hydrocyclones.

Technology

Solids separation in a cyclone is driven by g-forces induced by the position of the inlet or a swirl element. Various cyclone-based technologies, both conventional and advanced, have been developed to remove sand/solids from well streams, multi phase and single phase process streams. Sand/solids slurry streams from HiPer™ Desander, HiPer™ Desander Hydrocyclones or separator-based internals such as sand jetting systems or HiPer™ Sand removal cyclones, can be fed to a sand handling system in a continuous or batch process. This system typically allow for accumulation, recycling, cleaning and disposal of the separated sand/solids.

Customs designs are available to meet client demands, based on specific site operating conditions and performance requirements.

Systems are typically designed as skid-mounted units, including all main separation and processing components as well as auxiliaries like pumps, valves, instruments and controls, to allow for proper performance and robust operation.

Application and client benefits

The compact HiPer™ Desander can achieve bulk separation of larger particles at a much lower flow pressure drop than typically found on existing desanding equipment. Due to its compactness, the HiPer Desander can be installed in existing processing systems when limited space is available.

Various locations can be identified where the solids/sludge can be removed from the production process. The locations identified are listed below:

- Downstream of well head
- Upstream of separator
- Oil outlet line separator
- Water outlet line separator
- Sandjetting system drain line
- Upstream of Produced Water Treatment System

The additional benefit of compactness is that the overall hardware and installation costs are very attractive compared to conventional solutions. These inline separators are typically constructed according to standard process piping specifications, minimizing weight and space requirements.

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