

Multiphase Boosting & Wetgas Compression



Sustainability around The Globe



Green Oil & Gas production by using Bornemann Multiphase Technology

Bornemann designs and manufactures tailor-made Twin Screw Multiphase Systems that help the oil industry eliminate methane flaring when processing Multiphase mixtures of liquids and gases. This benefits customers by improving production efficiency, reducing emissions and helping them comply with government regulations.



**More than 600 proven references of installed
Bornemann Multiphase Boosting Systems.**

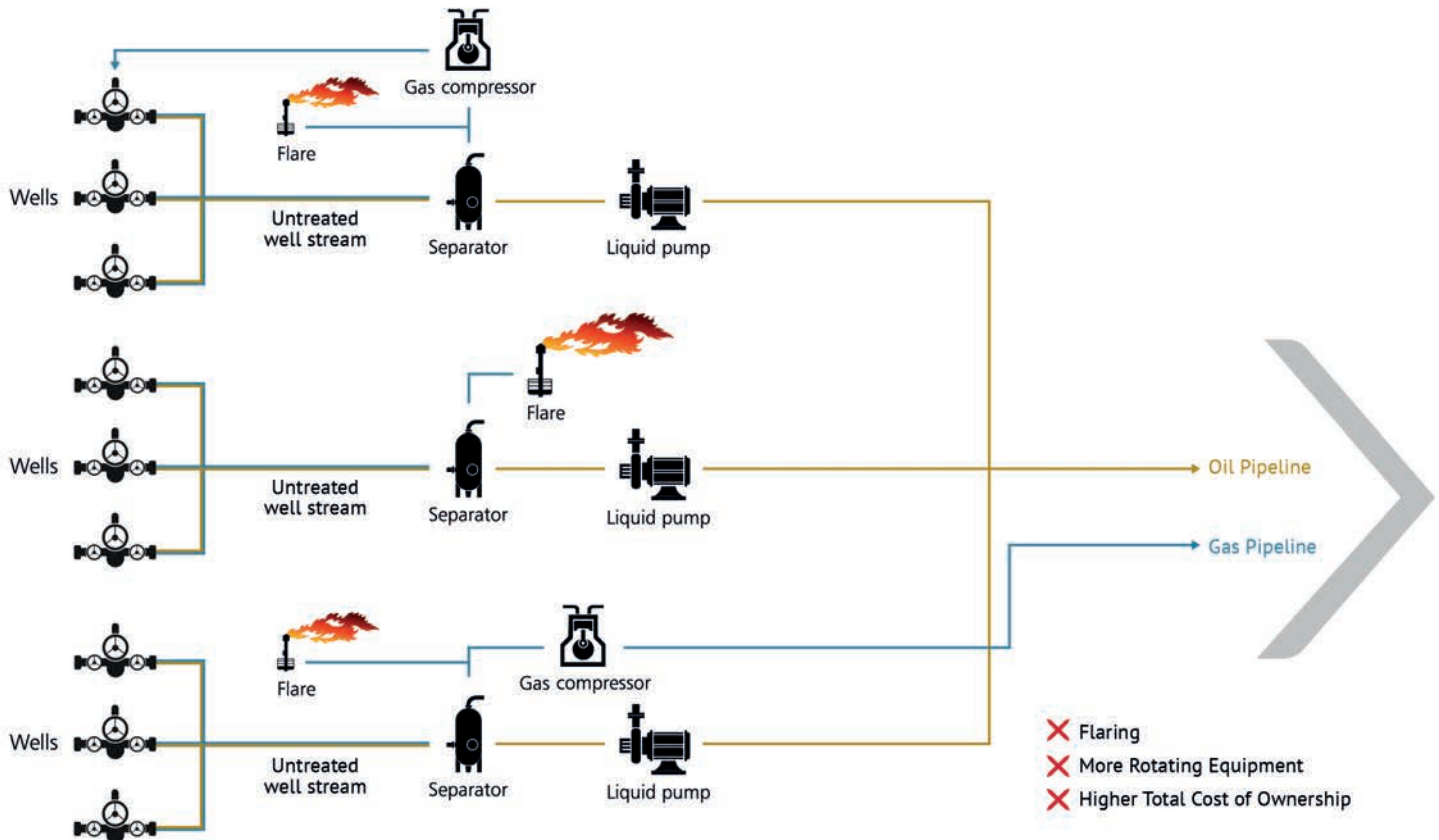
www.bornemann.com

Economical and Sustainability Approach:

- Zero flaring - Zero CO₂ - Zero environmental pollution
- Commercial usage of the gas as energy resource
- Footprint reduced to a minimum
- Clean Production
- Less equipment - Less Total Cost of Ownership
- Prolonged lifecycle of the oil well by Multiphase wellhead pressure control

No Separation, Zero Flaring

Conventional Technology



Multiphase Technology and Customer Benefits

Unpredictable Flow

The focus is on unpredictable flows, previously considered as unprofitable. Twin Screw Multiphase Pumps handle these with ease and at a fraction of the conventional costs.

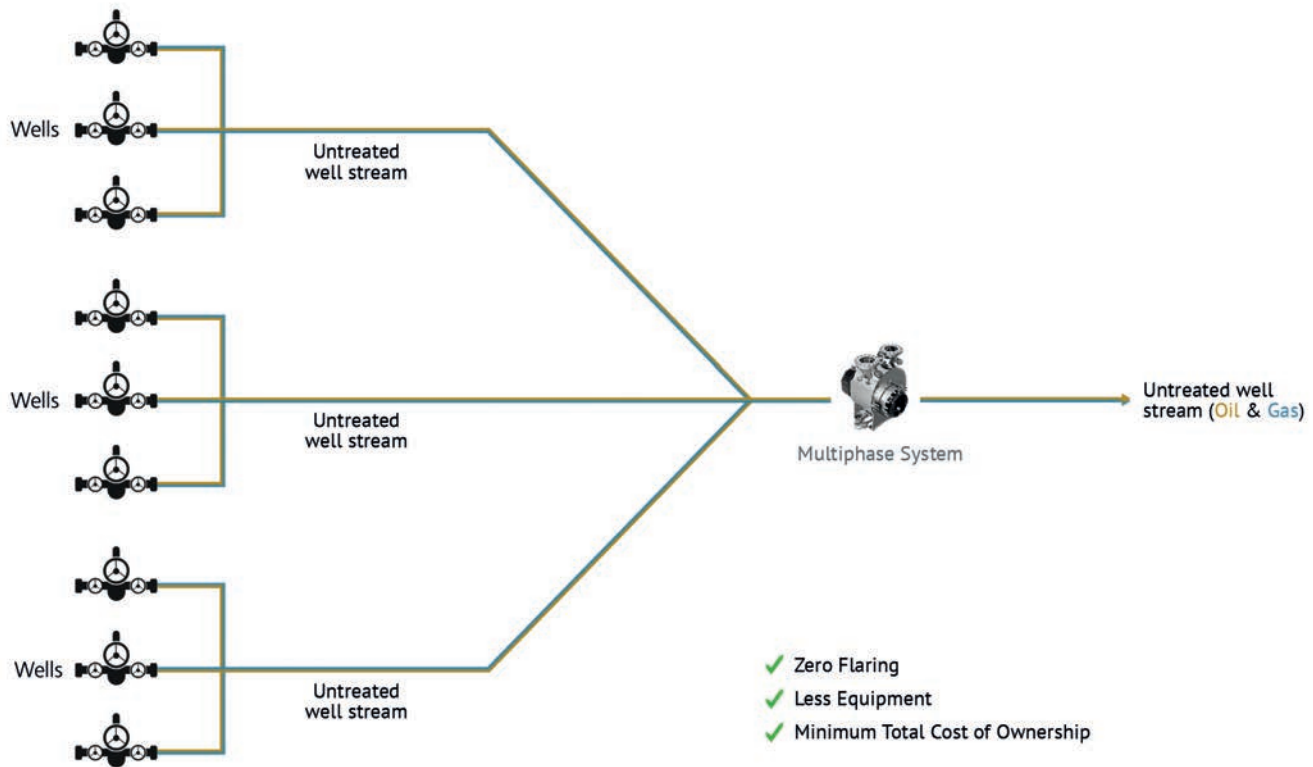
Untreated Stream

Twin Screw Multiphase Pumps offer a reliable solution to suit a whole range of potential flows. Untreated products ranging from wet - gas to heavy crude are reliably pumped in any situation, off-shore, thermal or conventional. In addition flaring can be avoided making this byproduct available for profitable use.

Prologned Production

Exploiting oilfields in harsh or inaccessible environments and extending the lifecycle of oil wells is the perfect opportunity to generate a sizeable profit. A comparatively low investment and impressively reduced Total Cost of Ownership are the commercial benefits.

Bornemann Multiphase Technology



Multiphase Technology and Customer Benefits

Process Flexibility

Untreated stream and unpredictable flow can be handled by using Twin Screw Multiphase Pumps to guarantee highest process flexibility. Multiphase fluids with Gas Volume Fraction up to 100 % can be handled. Using Twin Screw Multiphase Pumps, there is no risk of plugging caused by Wax or Paraffin.

Less Complexity

No separation in the oil field during the pumping process makes wellhead separators and associated equipment obsolete. A simplified system layout results in less footprint.

Fast Payback

Using Twin Screw Multiphase technology leads to a reduced back pressure, resulting in an increased flow and a shorter return on investment.

End-users can expect longer production cycles from existing fields.

A simplified layout and less installed equipment reduce capital and operation costs.

Multiphase Pump Series



MSL

- Single well applications
- ≤ 99 % GVF
- Differential Pressure up to 22 bar (319 psi)
- Flow from 5 m³/h (755 BPD) up to 250 m³/h (37,736 BPD)
- 300# rating



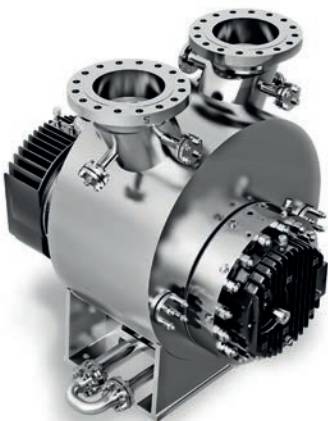
MW

- Standard applications
- ≤ 97 % GVF
- Differential Pressure up to 50 bar (725 psi)
- Flow from 50 m³/h (7,547 BPD) up to 5500 m³/h (830,189 BPD)
- 300# rating



MPC HD / MPC HD-S

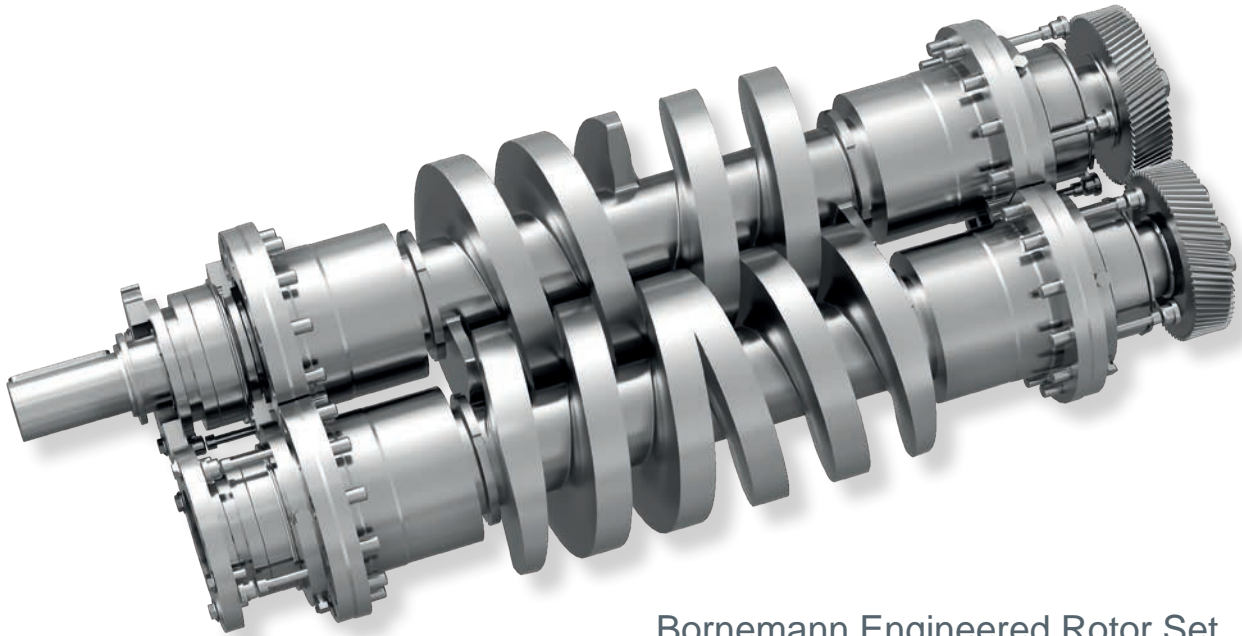
- High differential pressure applications
- ≤ 100 % GVF (MPC HD) / ≤ 99 % GVF (MPC HD-S)
- Differential Pressure up to 120 bar (1,740 psi)
- Flow from 50 m³/h (7,457 BPD) up to 5000 m³/h (754,717 BPD)
- 300#, 600# and 900# rating



MPC HC / MPC HC-S

- High capacity applications
- ≤ 100 % GVF (MPC HC) / ≤ 99 % GVF (MPC HC-S)
- Differential Pressure up to 50 bar (725 psi)
- Flow from 50 m³/h (7,457 BPD) up to 8000 m³/h (1,207,547 BPD)
- 300#, 600# and 900# rating

Unique Screw Design



Bornemann Engineered Rotor Set

Standard Screw

The unique rotor design enables Bornemann to maintain a short bearing span and a compact pump design. The best suitable material selection for the feed screws and shafts in respect to bending and corrosion resistance.



Degrassive Screw

Screws with a decreasing pitch. Reliable manufacturing process for screws with decreasing pitch. Proven increase in efficiency for Multiphase service. Substantial decrease in Total Cost of Ownership by smaller drive train and lower power consumption.

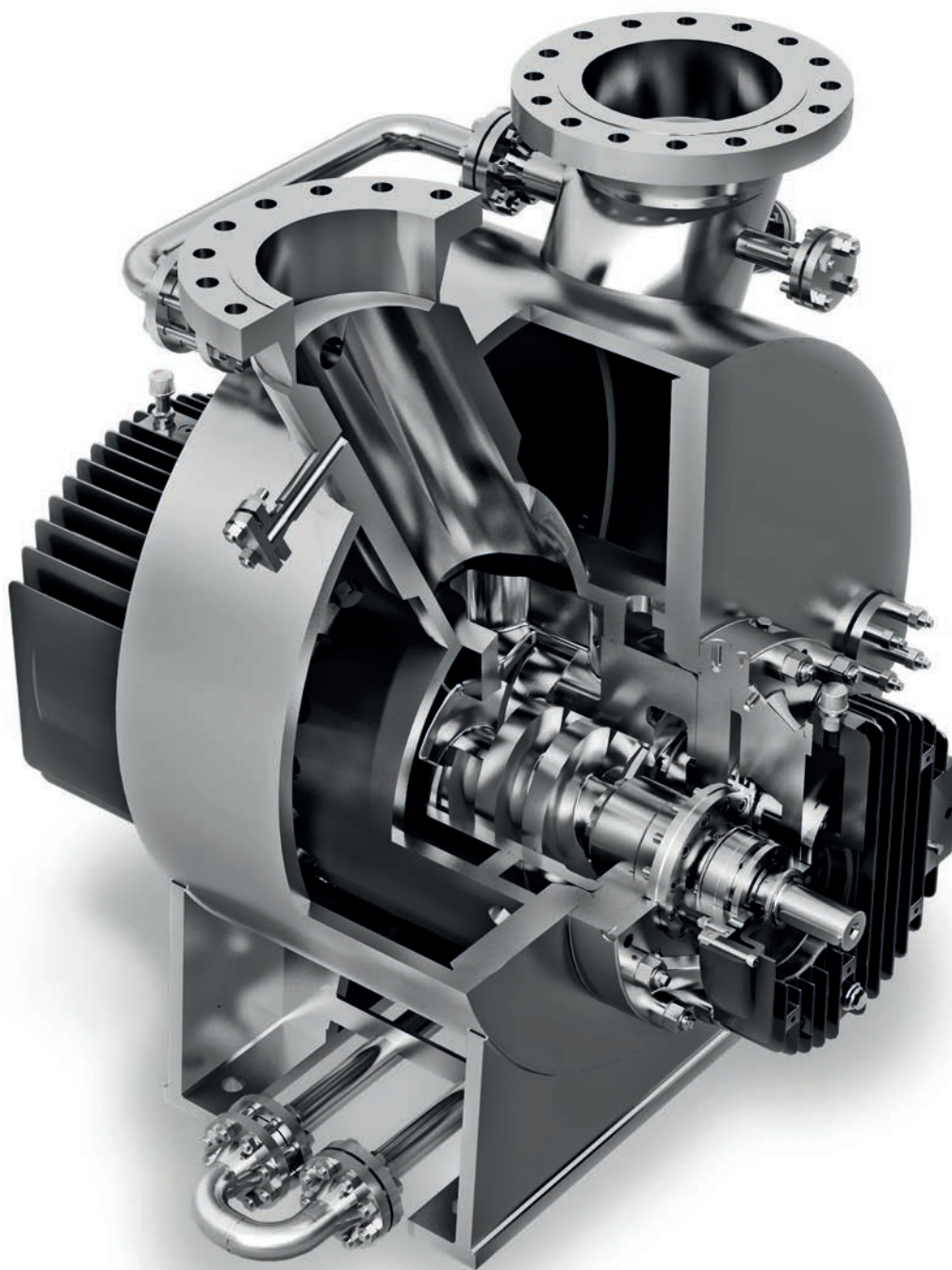


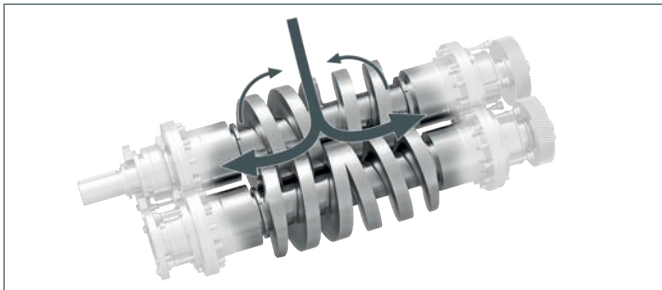
Unique Design Features

The heart of each Multiphase System is the Bornemann Multiphase Pump.

More than 80 years' experience in Twin Screw Pump Technology and above 30 years' experience in Multiphase Boosting Technology with more than 600 references of installed Multiphase Boosting Systems demonstrate Bornemann's worldwide leadership.

Systematic research and development are leading to innovative solutions for the future.





Designed as a Multiphase Pump with internal liquid recirculation

- less system complexity
- higher reliability
- enlarged separating casing for liquid hold-up
- up to 100 % dry run capability



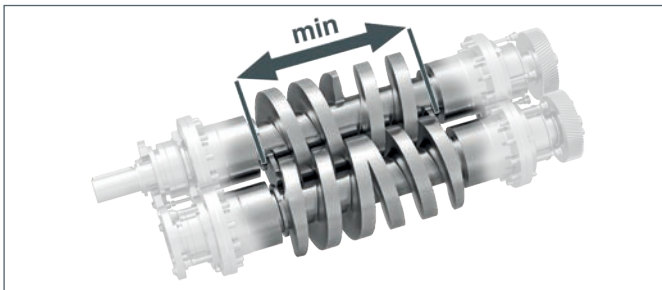
Engineered Rotor Set

- superior material selected to purpose
- higher mechanical core strength
- reduced spare part cost



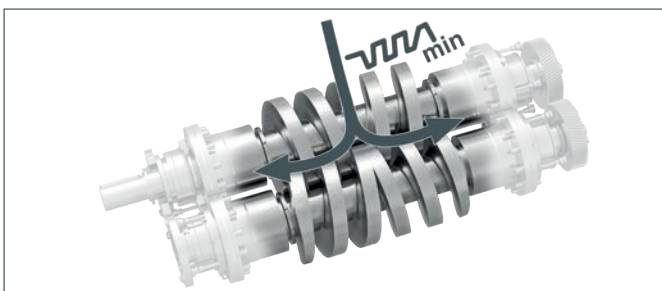
Customized Screw Profile

- long service life
- high efficiency
- customized to process



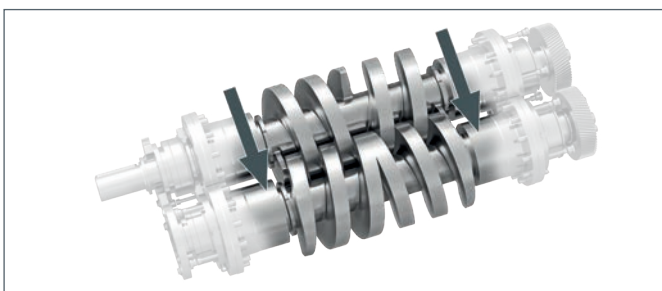
Compact Design

- short bearing span
- minimized shaft deflection
- high efficiency



Low Pulsation

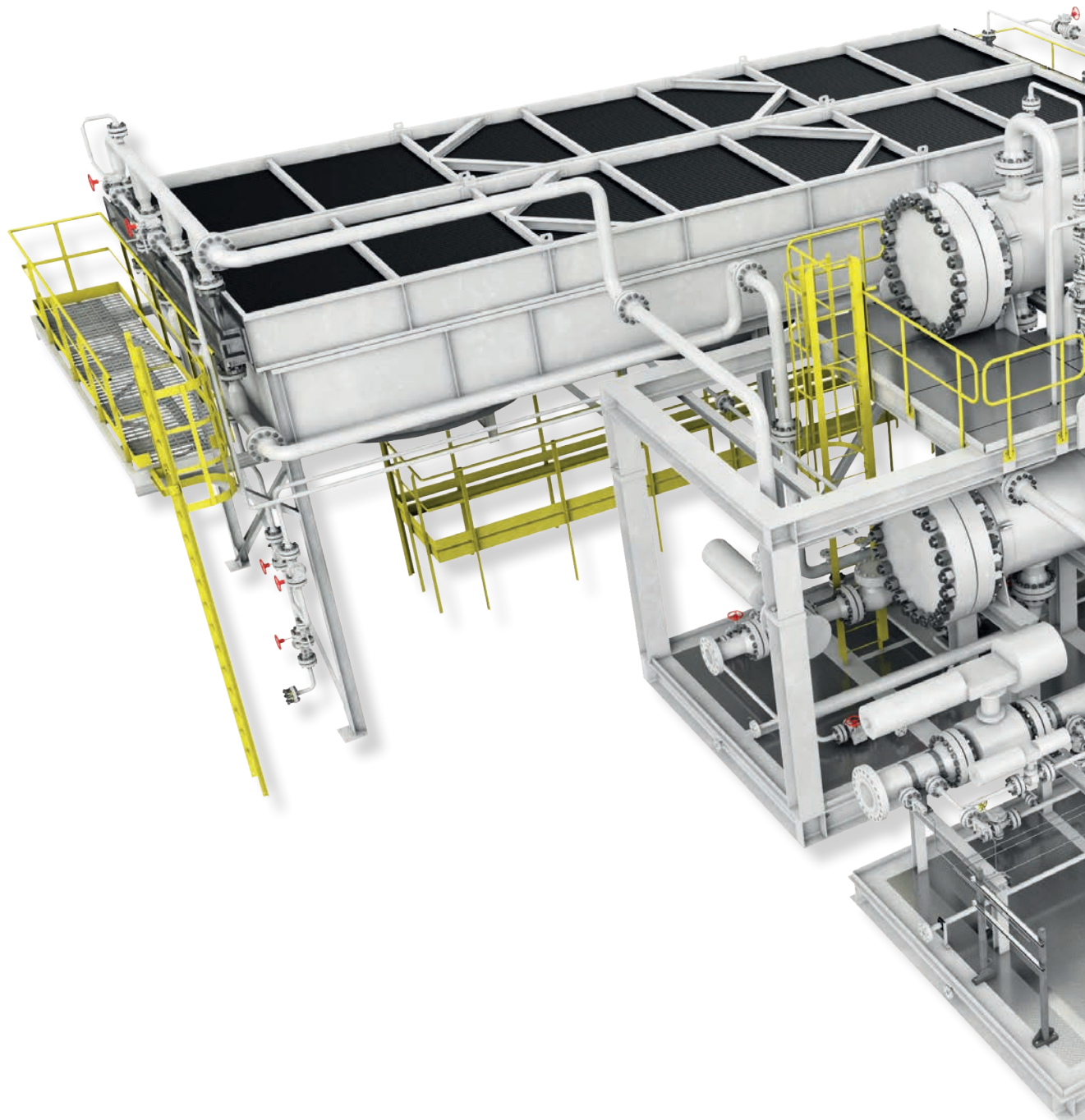
- less vibration
- long service life



Constant Conditions on Mechanical Seal

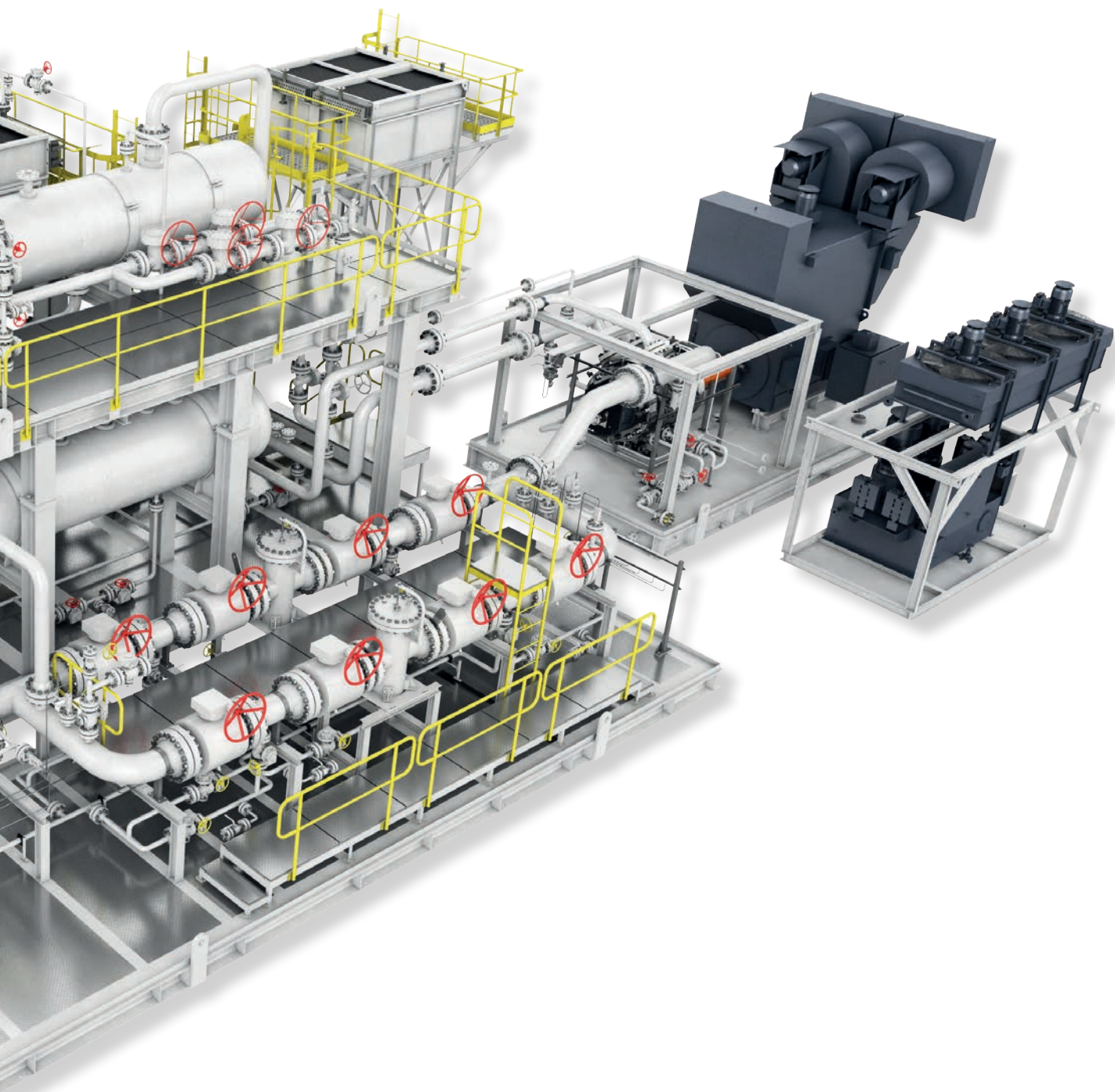
- extended service life
- mechanical seals rated for fully designed system pressure
- designed for Multiphase conditions

Tailormade Multiphase System Solutions



Complete Multiphase Boosting Systems

With an extensive experience in research & development, engineering, production and commissioning all over the world Bornemann is able to supply complete system solutions – for a wide range of performance conditions and harsh ambient environmental conditions.



Safety first

The Bornemann system guarantees full safety and automatic operation under all circumstances.

- Fail and fire safe ball valves isolate the Multiphase Pump System inlet and outlet
- Automatic shut down in case of out of range measuring value
- Hard wired emergency chains
- Constantly monitored Multiphase process

Plug and Pump

The skid-mounted Multiphase Pump is equipped with all necessary instrumentation and safety devices. Bornemann supplies complete Multiphase Systems including electrical drive system with motor, variable frequency converter and all required electrical / mechanical auxiliaries. Prior to shipment, the complete Multiphase System will undergo a complete system factory acceptance test.

Conventional Multiphase Boosting

In the future, one of the most important sources of oil will be reserves that have already been discovered but have not yet been recovered.

Even though the performance of individual fields varies widely, and advancing technology is improving recovery, still more than half of the world's oil found to date remains in declining and abandoned fields. Bornemann Multiphase Boosting recovers more of this oil and extends field life by reducing wellhead pressure.

The rate at which oil flows from a reservoir to the production tubing depends heavily on the pressure loss across perforations, a screen, a gravel pack and other elements of the completion. Inflow also depends on pressure losses in the tubing and in surface production equipment.

Application Challenges

Reducing wellhead pressure is an important way to boost production throughout the life of a field. Minimizing wellhead pressure is especially critical as reservoir energy declines, in economically marginal fields, and where an enhanced recovery method is being used. Flow restriction caused by surface back pressure on the reservoir can be eliminated by installing a Bornemann Multiphase Boosting System at the wellhead or at a manifold that combines production from several wells. Multiphase Boosting can also eliminate the need for field separators, and provide other advantages in remote or restricted areas where more traditional approaches to field development are not possible.

In a wide range of oil and gas production applications, Bornemann Multiphase Boosting is capable of:

- Inlet pressure as low as 0.1 barg (1.5 psig)
- Differential pressure as high as 120 bar (1,740 psi) with a single pump
- Operation in combination with a down hole pump or gas lift system
- Operation either in parallel (for high volume or redundancy) or in series (for high differential pressure)
- Unmanned, remote-controlled operation



The Solution

The core of the Bornemann Multiphase Boosting System is a Twin Screw positive displacement pump. Patented features allow it to handle all fluid mixtures, even pure gas at the pump inlet. Among other advantages, the ability to handle a range of fluid mixtures helps to prevent the formation of emulsions. Inlet pressure – wellhead pressure – is kept constant by adjusting the rotational speed. As an integrated part of each Bornemann Multiphase Boosting System, the control system is able to operate the system on a constant inlet pressure by speed adjustment.

A Bornemann Multiphase Boosting System consists of a Twin Screw pump and a driver (usually an electric motor) which are installed on a common base plate to minimize the unit's footprint.

Remotely operated, fail-safe ball valves on both inlet and discharge isolate the pump in case of unexpected operating conditions.

An inlet strainer and a discharge check valve, along with the necessary instrumentation complete the system. This gives the Multiphase Boosting System the versatility to safely operate in a variety of applications and conditions including offshore platforms, remote locations and environmentally sensitive locations, just to name a few.

Advantages

A Bornemann Multiphase Boosting System helps to reduce back pressure, which results in increased flow and a shorter return on investment.

The system also offers:

- Reduced capital and operating cost as a result of simplified field layouts and streamlined maintenance
- Elimination of field separation and flaring, reducing environmental impact
- Safe and continuous operation, even when remotely operated
- Single vendor sourcing with complete engineering and operating responsibility



Design Features

Bornemann Multiphase Pumps feature:

- A patented enlarged pump casing that provides an internal liquid hold-up chamber and a recirculation valve, to allow for a “dry running” condition (100 % GVF)
- Field-replaceable pump internals
- High strength rotor designed for harsh operating conditions and changing flow requirements

- Short bearing span with reduced mechanical seal diameter for improved reliability and a more compact unit
- Simple, reliable oil bath lubrication also in Multiphase System arrangements where external Lube Oil Systems are required
- Designs tailored to each application that complies with major international quality and safety standards

References

In early 2000, a Bornemann Multiphase Boosting System was installed in the Midway Sunset Oil Field in California, USA. The Multiphase Boosting System reduced the back pressure on rod pumps, well stuffing boxes, and flow lines resulting in a significant boost in production from diatomite wells.

The client recognized the environmental benefits of operating a Multiphase Boosting System instead of conventional facilities realizing the following benefits:

- Improved project cycle time by reduced regulatory permitting requirements.
- Reduced spill potential by eliminating tanks, fin fans, and lowering pressure on the flow lines and stuffing boxes.
- Smaller footprint which disturbs the natural habitat less and lowers location construction costs.

By using Bornemann Multiphase Boosting Systems, the pump suction pressure fell from about 200 psi to as low as 20 psi and production rates increased threefold from about 1,000 BPD to 3,000 BPD.



Heavy Crude Oil Multiphase Boosting

Global reserves of heavy crude are significant. To date, the contribution of heavy oil to world supply has been modest, but as lighter crudes become harder to find, the demand for heavy oil will significantly increase.

Bornemann Multiphase Boosting is capable of handling the special challenges faced by heavy oil producers. Heavy oil reserves exist in several areas of the world and often involve severe operating environments.

Bornemann has extensive experience in Heavy Crude Oil Multiphase Boosting environments.

For example, in Venezuela's Orinoco Belt, where oil viscosity is 8°-12° API, Bornemann has a proven track record in the application of Heavy Crude Oil Multiphase Boosting.

Application Challenges

In addition to high viscosity, the use of Multiphase Pumps in boosting heavy oil, faces other unique challenges such as:

- The crude may be diluted with light crude or naphtha
- Gas Volume Fraction is typically low during early production, then increases
- Very heavy liquid slugs can enter the pump, requiring the pump system to adjust the speed to changed process requirements
- Water cut may gradually increase at any moment during production
- Production may be intermittent and artificial lift systems may be overloaded
- Very high sand content may apply, which has to be boosted together with the production



Multiphase Pump Boosting Station
MW 10 Multiphase Pumps

The Solution

Bornemann's heavy crude oil Multiphase Boosting Pumps are equipped with a special internal recirculation valve that reduces pressure peaks to minimize vibrations caused by slugging because well stream fluid phases can change quickly.

The very high viscosity of the fluid also requires that the operating speed be reduced. Pumps selected for heavy crude applications run at moderate speeds and the pump screws have a larger-than-normal pitch. The lower speed and larger pitch ensure that the chambers of the pump are filled to minimize noise and vibration.

Many Multiphase Boosting applications in heavy crude oil service are in newly developed fields. In Venezuela's oil fields, Multiphase Boosting Systems are supplied as a complete package, specially designed for Heavy Crude Oil Multiphase Boosting.

Advantages

Bornemann's robust Twin Screw Multiphase Pump for heavy crude oil service helps increase production and reduce capital and operating expenses. A Twin Screw Multiphase Pump operates on the positive displacement principle which offers the following key advantages:

- Not sensitive to phase changes
- Able to handle any combination of oil, water and gas.
- Easily adapt to changing capacity requirements by speed control
- Can handle hard particles
- Special coating developed for heavy sand loaded fields

Design Features

Bornemann Multiphase Pumps for heavy oil service feature a patented large pump casing with an internal separation chamber for liquid hold-up.

Rotor materials and pitch are specially engineered for each application.

For high sand loaded well streams, which are typical in heavy crude oil applications, Bornemann has developed special coatings for the Multiphase Pump internals which have been successfully tested and approved in several applications.

Multiphase boosting systems can be relocated, and if capacity requirements at the new location are different, screws can be changed and the Multiphase System can easily adapt to new process conditions.

High gas content may cause the pump temperature to exceed specified limits. To avoid a shutdown, the inlet side of the boosting can be connected to a diluent supply system that can inject diluent for cooling. In heavy crude oil services, diluent is available in the oil fields via a separate pipeline infrastructure.

Check valves and automatic shutdown valves also protect the boosting from "back spin."



Multiphase Boosting System in high sand loaded Multiphase application

References

In Venezuela's Orinoco Belt, heavy oil fields are typically located about 20 km from the gathering station. Production must be diluted with light crude or naphtha before entering the pipeline.

The many installations in the Orinoco Belt have made it possible to standardize multiphase boosting systems for the fields in this heavy oil region. Operating experience in Orinoco has also provided much of the information needed to further advance the multiphase boosting technology.

In the Petrozuata oil fields, desanders were taken out from the process before central processing to keep the installation simple and centralized. Bornemann Multiphase Boosting Systems are designed with specially engineered and coated pump internals that have been demonstrated to handle the high sand loaded well stream without any significant increase in wear.

The first Bornemann Multiphase Systems, in Venezuela, were installed more than 20 years ago and are still in continuous operation within their designed range. Over this period of time, the Multiphase Boosting Systems were able to successfully adapt to the varying field operating conditions, including the usage of the different artificial lifting methods.

The installed Bornemann Multiphase Boosting Systems are all remotely operated



Multiphase Boosting System installed in Petrozuata Oil Field

Multiphase Boosting In Thermal Operations

Canada's heavy oil reserves, estimated at 1.7 to 2.5 trillion bbl of oil, are an increasingly important source of supply, in part due to technology advances that have significantly reduced production costs and increased recovery. Bornemann Multiphase Boosting Systems have been used successfully to help meet these goals by collecting gas from the wellbore annulus to reduce back pressure and provide additional revenue.

Steam injection processes are used as both primary and secondary recovery methods for heavy oil deposits around the world. The most common methods are Steam Assisted Gravity Drainage (SAGD) and Cyclic Steam Stimulation (CSS). Both processes subject equipment to high temperatures, acid gases and steam.

Application Challenges

SAGD wells are drilled in pairs and use continuous steam injection to mobilize bitumen. As steam is injected into the upper well, it mobilizes the oil above it which then drains down to the lower production well due to gravity. The producer well typically has an electrical submersible pump (ESP) installed and requires control of the liquid column to maintain efficient pumping. This is achieved by controlling the annulus gas pressure in the well bore.

Cyclic Steam wells are usually horizontal wells drilled into tight heavy or extra heavy oil formations. In the initial phase, high pressure steam is injected into the well for a period followed by a "soak" time to allow the oil to mobilize and flow to the downhole pump inlet.

During the production phase Bornemann Multiphase Systems are used to reduce pressure of the hot annulus gas and effectively control positive suction pressure on the rod pumps. The Bornemann Multiphase Boosting Systems have a unique ability to handle the high temperature wet gas at high compression ratios.

The Solution

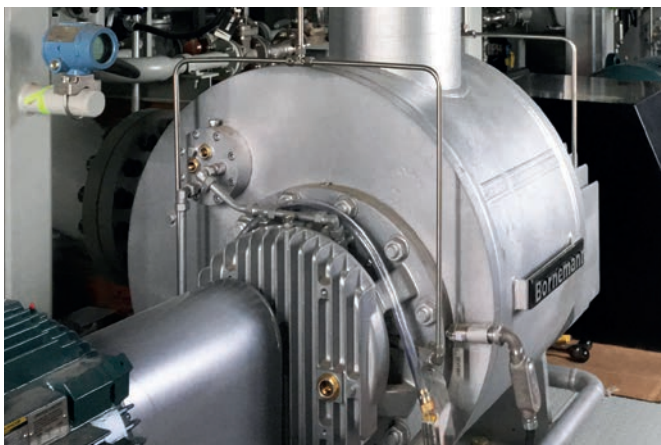
Bornemann Multiphase Boosting Systems are perfectly suited to handle the high temperature wet gas mixtures that are found in the annulus while providing the highest operational availability. Using a Bornemann Multiphase Pump in these applications will greatly lower capital cost associated with traditional compression and pumping systems and completely eliminate the need for well pad flares and inlet scrubbers. Bornemann Multiphase Boosting Systems have been providing greater than 97% reliability in these very demanding applications for more than twenty years.

In both processes, the typical well stream includes saturated steam and condensate water, small amounts of bitumen, and gas including methane, CO₂ and H₂S.

When Multiphase Pumps are used in SAGD and CSS applications:

- Gas composition can shift from an 80/20 CO₂ methane ratio to a ratio of 20/80
- Inlet temperature is near that of saturated steam, about 130°C
- 20-30 wells are drilled from a single pad, and total gas production from the pad may reach 30,000 sm³/d (1 MMscf/d)
- A Multiphase Boosting System can also be used to transfer total production from the pad

The design of a Bornemann Multiphase Boosting System for a well stream with an average gas volume fraction of more than 98 % and few liquid slugs - essentially a "wet gas compressor" - is similar to the design of conventional Bornemann Multiphase Boosting Systems. However, in Thermal Operations, Bornemann Multiphase Systems are designed with an additional external liquid recirculation and cooling system to guarantee a stable process while handling very high temperature wet gas.



Also, the ability to handle thermal expansion and quick temperature changes is especially important for wet gas compression service. A Twin Screw Multiphase Pump has two pairs of intermeshing screws that rotate within a housing, forming cavities between them and between the screws and the housing. Fluid is conveyed from inlet to discharge along both sides of the housing, ensuring that axial forces are always fully balanced.

Since there is no metal-to-metal contact, the pump clearances are sealed by liquid. When handling a gas stream that contains a small amount of liquid, sealing and cooling liquid is stored in the pump housing and flows through a separate cooling circuit. In Thermal Operations, liquid storage is often combined with external separation.



Advantages

Bornemann Multiphase Boosting Systems offer these advantages in annulus vapor recovery service:

- Simple, compact installation reduces footprint and environmental impact
- Control of annulus gas pressure and the height of the liquid column in the casing optimizes production
- Gas that would have been wasted could be used to generate process steam, lowering the production costs
- Greater than 99 % up time ensures constant peak production
- Low maintenance costs improve operating margins
- Elimination of flares meets obligations under the Kyoto protocol and local air quality standards

Design Features

These features of Bornemann multiphase boosting systems make them well suited for annulus vapor recovery:

- Seals in MW based Multiphase Systems operate at suction pressure
- A thermo-siphon as an integrated part of the MW Multiphase Pump circulates atmospheric buffer fluid for seal protection at high gas volume fractions
- Seals in MPC based Multiphase Systems often used in high pressure SAGD applications run at discharge pressure to avoid instable conditions at the mechanical seal
- Alloy overlay in O-ring areas mitigates CO₂ corrosion
- Speed of the variable frequency drive is controlled by suction pressure



References

Bornemann, with the ability to provide complete turnkey systems, has the world's largest installed base of Multiphase Boosting applications in Thermal Operations, including:

- Systems installed at Imperial Oil Canada's Cold lake facility
- Systems installed in Canadian Natural Resources Ltd's Primrose field
- Installations for Deer Creek Energy, Husky, Statoil and other major producers operating in Canada

Wet Gas Compression

As exploitation of global natural gas resources has become more important, major gas producers have expressed growing interest in utilizing Multiphase Boosting as wet gas compressors to enhance production. In response to this trend, Bornemann has developed reliable and cost effective Multiphase Boosting packages for this service.

When a well stream has a high gas volume fraction and only contains small amounts of liquid, Multiphase Pumps operate as “wet gas compressors.” These well streams are often found in marginally economic fields where optimizing production and minimizing cost are critical goals.

Application Challenges

The same guidelines are used to design a Multiphase Boosting system for wet gas compression service. However special attention must be given to ensure that the wet gas compression unit is capable of handling thermal expansion and quick temperature changes.

Applications of Multiphase Boosting Systems operating as wet gas compressors typically involve:

- Gas volume fractions greater than 98 %
- Low amounts of low viscosity fluids
- Heat generated by compression
- Installation either onshore or offshore

The Solution

Wet gas compression generates heat that is removed from the pump either by re-circulating liquid from the well stream or by injecting liquid from a reservoir. In a liquid cooling configuration, temperature in the casing is reduced by a cooler connected directly to the liquid reservoir of the multiphase pump.

A large internal chamber stores water inside the pump housing. Water can be used to cool and lubricate the mechanical seals and pump internals, and to seal the clearances between the screws where metal-to-metal contact is not allowed.



In case thermodynamic calculations require a larger external separator to collect water from the well stream, Bornemann uses an external recirculation system to ensure enough liquid is available for cooling and sealing purposes. A high pressure cooler integrated in the liquid recycle allows for an unlimited run time.

The flushing effect when recirculating hydrocarbons is calculated by the use of process simulation software.

Advantages

In most cases, however, the key benefit is an increase in gas production, whether installed onshore or on an offshore platform.

The low maintenance expense and lower capital cost of Bornemann Multiphase Boosting Systems have a significant positive impact on project economics.

Design Features

In a typical application, a Bornemann Multiphase Pump together with its components is mounted on a common base plate to minimize the footprint of the skid.

A typical wet gas compression system includes:

- Multiphase pump
- Electric motor with variable frequency drive
- Piping and valves
- Instrumentation for safety and control
- Emergency shut down valves

References

At an existing gas facility in the Netherlands with one gas well six km away, the pressure was too low to meet system requirements and production often had to be shut down. To boost the pressure, Bornemann designed a wet gas compression system for the following conditions:

Capacity:	125,000 sm ³ /d
Gas vol. fraction:	99.9 %
Inlet pressure:	5 to 25 barg
Outlet pressure:	25 to 30 barg
Pressure ratio:	2 to 6
Inlet temperature:	10 to 60°C
Outlet temperature:	80°C

Since initial startup in October 2002, the wet gas compression system has operated continuously with an up time of 99.8 %. Gas production has been accelerated and an increase in ultimate recovery from 90 to 95 % was achieved.



Offshore Multiphase Boosting

Space and weight are limited on remote offshore platforms with high costs of construction, maintenance, and lost production.

As distances between satellite platforms and central facilities increase, and deep water tiebacks become longer, boosting pressure and avoiding the cost of multiple submarine pipelines are also critical. Efficient and reliable Bornemann Multiphase Boosting Systems are a perfect solution to meet these special challenges.

Key offshore oil and gas production facilities include Central Processing Platforms (CPP) and satellite Wellhead Platforms (WHP), which are usually unmanned and located up to 100 km from the CPP.

In deep water, smaller discoveries may be developed with subsea completions and gathering stations that are tied back to a central platform. As distances increase, back pressure in the submarine pipeline to the CPP can be high compared to topside Multiphase Boosting applications. Processing equipment on the platform adds more back pressure at the wellhead and lowers production. Bornemann Multiphase Boosting Systems helps eliminate back pressure and increase production by efficiently transporting all three phases of a typical well stream – liquid, gas and solid – without separation.

Multiphase Boosting provides an efficient and reliable way to maintain the performance of declining fields by:

- Upgrading low pressure streams to system pressure
- Reducing well head pressure to increase production
- Boosting untreated well streams without the need for separation equipment, as space on offshore platforms is limited



Application Challenges

A well stream will flow naturally to a platform as long as the wellhead pressure is higher than the pipeline pressure. As the wells age, reservoir and wellhead pressures will decline respectively. In gas fields, liquid production will increase over the lifetime of a well and gas production will decrease. In oil wells, the opposite may occur, resulting in a well stream with an increasing gas volume fraction.

The Solution

A Bornemann Multiphase Boosting System is an economical solution to transport untreated production to a Central Processing Platform (CPP) or an export pipeline.

Multiphase Boosting Systems are able to deal with changing flow conditions throughout the lifetime of a well, as well as short term transient conditions such as gas and liquid slugs. The positive displacement screw pump, with patented Bornemann features, can handle 100 % gas flow for limited periods and continuous 100 % liquid flow.

This feature eliminates the need for separation which will substantially save the cost of an additional submarine pipeline.

Designed to offshore platform standards, the Multiphase System can be driven by an electrical motor, gas or diesel engine, and a SCADA system that transmits all operating data to the central platform. Full automation allows unmanned operation. A skid-mounted unit can easily be relocated to another wellhead platform. The rotor can be changed if the new location's capacity requirements are significantly different.

Advantages

Bornemann Multiphase Boosting systems installed on offshore platforms offer:

- A several-fold increase in production
- Rapid return of investment
- Reduced capital and operating cost
- No shut downs due to changing fluid conditions
- Elimination of flares
- Advanced technology
- Enhanced production control



Design Features

Each Bornemann system is configured for a specific installation. Customized pump casings can be pressure rated to ANSI 900 PSI, a differential pressure rating up to 120 bar is possible. Parallel and serial Multiphase Boosting System configurations can be tailored in accordance to customer needs.

Replaceable liners simplify pump maintenance and engineered rotors are designed to minimize shaft deflection. Flooded rotating elements allow "dry running" for a limited period of time and special trims are available for severe service conditions.



References

With more than 20 installations in Offshore Multiphase Boosting System environments, Bornemann demonstrates a long history of invaluable experience and know how in handling these challenging applications, through individually tailored solutions to meet the end-user specifications and requirements.

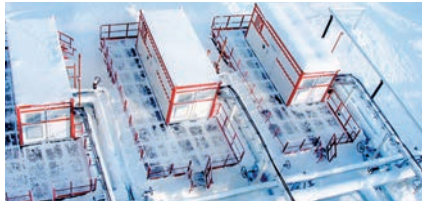
In 2017 Bornemann developed a unique Multiphase Boosting System for an offshore platform in the North Sea.

The system was designed as a wet gas compressor built to boost gas stream with a continuous 100 % GVF. By considering a volume of up to 5,500m³/hr, Bornemann built the world's largest Twin Screw Multiphase Pump based on the MPC 11 Multiphase Pump.

To achieve liquid sealing of the clearances inside the pump, an external separation with backflow to the Multiphase Pump suction was considered along with other system components such as electrical Motor, Variable Frequency Drive, Bornemann Seal Oil System, Lube Oil System, Air Cooler and Control System.

Selected Applications

Arctic Environment



Country	Russia
Pump Type	3 x MPC 208
Medium	Multiphase Mixture Crude Oil
Capacity	500 m ³ /hr 75,472 bpd
Pressure	21 bar / 305 psi
Speed	2,000 rpm
Shaft Power	276 kW / 375 hp
Gas Content	96 % Slug Flow

Onshore



Country	India
Pump Type	3 x MW 10C
Medium	Multiphase Mixture Crude Oil
Capacity	4,828 m ³ /hr 728,755 bpd
Pressure	12.4 bar / 180 psi
Speed	1,500 rpm
Shaft Power	1,140 kW / 1,550 hp
Gas Content	90 % Slug Flow

Sensitive Environment



Country	Ecuador
Pump Type	3 x MPC 9 HD
Medium	Multiphase Mixture Crude Oil
Capacity	1,900 m ³ /hr 286,792 bpd
Pressure	69 bar / 1,001 psi
Speed	1,800 rpm
Shaft Power	1,220 kW / 1,659 hp
Gas Content	32 % Slug Flow

Offshore



Country	The Netherlands
Pump Type	1 x MPC 268 / Dieselengine
Medium	Multiphase Mixture Wetgas
Capacity	610 m ³ /hr 92,075 bpd
Pressure	25 bar / 362.6 psi
Speed	1,765 rpm
Shaft Power	450 kW / 612 hp
Gas Content	99 %

Desert Environment



Country	Algeria
Pump Type	2 x MPC 10 MD
Medium	Multiphase Mixture Crude Oil
Capacity	5,022 m ³ /hr 759,038 bpd
Pressure	25 bar / 363 psi
Speed	2,000 rpm
Shaft Power	1,949 kW / 2,651 hp
Gas Content	98 % Slug Flow

Self Sufficient



Country	Thailand
Pump Type	2 x MPC 268 / Gasengine
Medium	Multiphase Mixture Wetgas
Capacity	498 m ³ /hr 75,170 bpd
Pressure	43,5 bar / 631 psi
Speed	1,800 rpm
Shaft Power	600 kW / 816 hp
Gas Content	50 % - 99.8 %

Selected Applications

Mobile Application



Country	Saudia Arabia
Pump Type	1 x MPC 208 - Super Duplex
Medium	Multiphase Mixture Crude Oil
Capacity	343 m ³ /hr 51,774 bpd
Pressure	10.3 bar / 149 psi
Speed	2,000 rpm
Shaft Power	119 kW / 162 hp
Gas Content	50 % - 99 % Slug Flow

High Differential Pressure



Country	UAE
Pump Type	2 x MPC 400
Medium	Multiphase Mixture Crude Oil
Capacity	1,406 m ³ /hr 212,226 bpd
Pressure	83 bar / 1,204 psi
Speed	1,600 rpm
Shaft Power	2,260 kW / 3,074 hp
Gas Content	22 % - 100 % Slug Flow

Heavy Crude Oil



Country	Venezuela
Pump Type	5 x MW 9.3
Medium	Multiphase Mixture Heavy Crude Oil
Capacity	4,545 m ³ /hr 686,038 bpd
Pressure	18,6 bar / 270 psi
Speed	1,760 rpm
Shaft Power	1,118 KW / 1,520 hp
Gas Content	90 % Slug Flow

Thermal Operations (SAGD)



Country	Canada
Pump Type	2 x MPC 208
Medium	Multiphase Mixture Wetgas (SAGD)
Capacity	143 m ³ /hr 21,585 bdp
Pressure	28 bar / 406 psi
Speed	1,691 rpm
Shaft Power	111 kW / 151 hp
Gas Content	97 %

Thermal Operations (VRU)



Country	Canada
Pump Type	2 x MW 8.5
Medium	Multiphase Mixture Wetgas (Vapor Recovery Unit)
Capacity	440 m ³ /hr 66,415 bpd
Pressure	4 bar / 58 psi
Speed	898 rpm
Shaft Power	69 kW / 94 hp
Gas Content	95,40 %

Shale Oil



Country	USA
Pump Type	1 x MPC 7T HC
Medium	Multiphase Mixture Crude Oil
Capacity	218 m ³ /hr 32,906 bpd
Pressure	11.45 bar / 166 psi
Speed	2,064 rpm
Shaft Power	86 kW / 117 hp
Gas Content	40 % - 82 % Slug Flow

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