



PROGRESSIVE CAVITY PUMP



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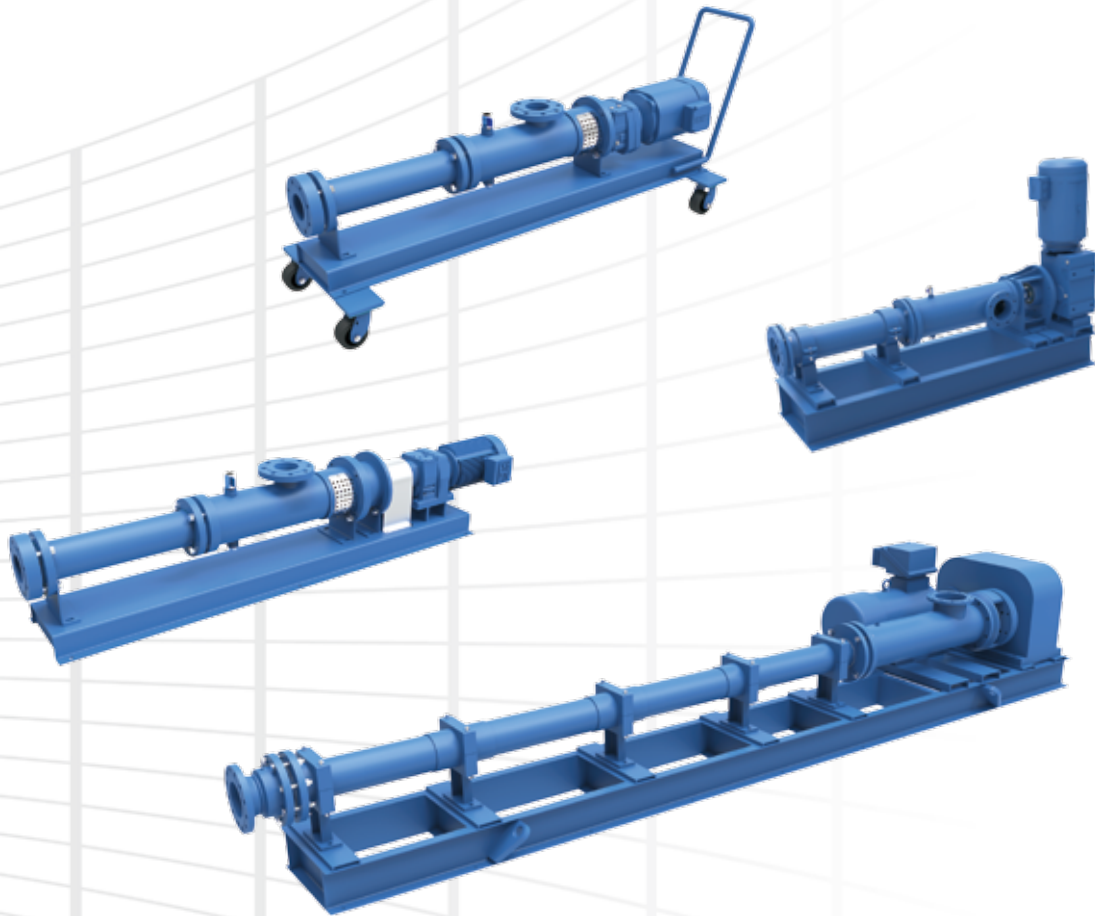
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public number or scan our QR code.

Progressive Cavity Pump in Oil Field

German Technology Leading Standards Worldwide



High Performance German
Downhole and Conveying Technology





We are SUBTOR

Company Profile

Weifang Subtor Rotating Precision Machinery Co.,Ltd., a joint venture between Germany Subtor GmbH in China, as a professional in research, design and production of relative products based on moineau principle. Subtor with plants and technical centers in both Germany and China, also sales offices and customer service centers in both Central America and Asia Pacific region. In addition, we have working agents and sales representatives at your service in Russia, Kazakhstan, America, Kuwait, India, South America.

Our Key Products: Progressive Cavity Pump, Grinder Macerator, Power Section for Mud Driller, Down Hole PC Pump, Stator Core and the relevant spare parts and services.



China Factory



Quality Inspection



Production Workshop



PS1000 Multifunctional Helicoidal CNC

Quality Assurance System

- ISO 9001 Quality Management System
- ISO 14001 Environment Management System
- OHSAS 18001 Occupation Health and Safety Management System
- To ensure all the production procedures being completely under the control of quality management system is the basic guarantee for quality products in Subtor.

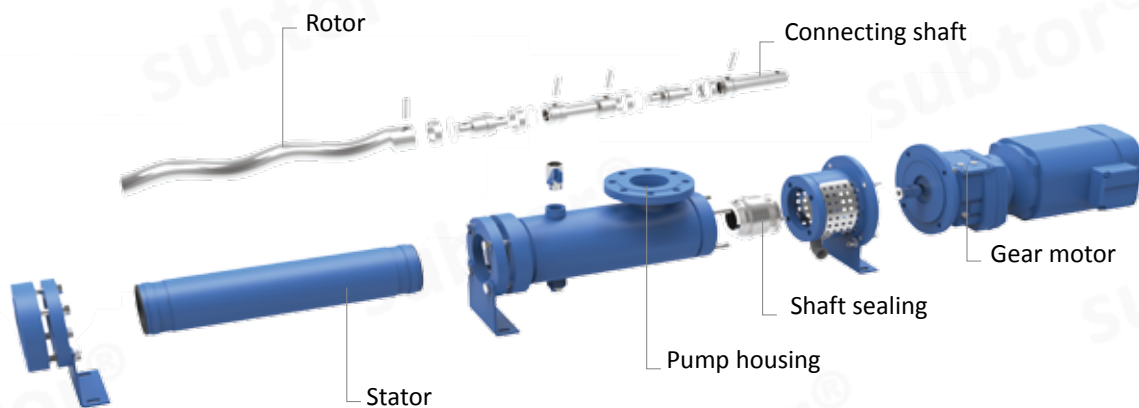
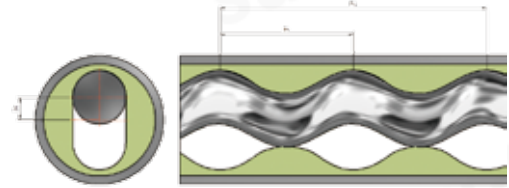


Working Principle and Structure of PC Pump

PC pump as a type of positive displacement pump works based on the interference fit between the fixed stator and the eccentric running rotor. This interference movement forms several separated and air-proof cavities, running from the inlet to outlet along the axis because of the rotor's rotation, which results in the medium's continuous conveyance in cavities.

Normally, there is small interference fit between the stator and rotor. In practice, not only the medium's temperature but also its viscosity and material all affect stator rubber's swelling, which must also be considered. Under this condition, the diameter of rotor is properly reduced as the compensation for the rubber swelling changes caused by medium's temperature, viscosity and material.

For the special structure and working principle, PC pump is the most suitable for the conveyance of various medium of solid particle or fiber, viscous, corrosive, shear-sensitive, mixture of gas and at different temperature.



Key Characteristics of PC Pump

- High efficiency, volumetric efficiency up to 95%, mechanical efficiency up to 65 to 85%, energy saving.
- Pulsation free, low shear, no extrusion, no damage to medium's physical property.
- Pump flow rate is directly proportional to rotating speed, which can be used for metering, with measuring accuracy tolerance +/- 1%.
- Low vibration, low noise, continuous conveyance during working.
- Suitable for medium with temperature range from -20 ° C to +180 ° C.
- Suitable for medium with high solid content up to 75%.
- Suitable for medium with viscosity up to 1,000,000 cp.
- Suitable for medium mixed with fiber, grass and gas.
- Suitable for the shear-sensitive or centrifugal force-sensitive polymer medium.
- Suitable for the multiphase medium mixture of gas, solid and liquid.
- Excellent self-priming capacity, suction height 5-6 meter water column.
- Simple structure, easy to maintain, no special tools required for maintenance.



Progressive Cavity Pump in Oil Field

Key Properties of Stator Rubber

Name	Code	Advantageous property	Disadvantageous Property	Propylene Nitrile content / Temperature Range
Nitrile Butadiene Rubber	NBR	common used rubber, good comprehensive property, good performance of abrasion resistance, anti-corrosion, diluted acid endurance, compression resistance, wide usage field	Poor performance of concentrated acid, high temperature, alkylation, ketone, ester and ozone resistance.	35-36%, -15°C /+110°C
High Propylene Nitrile Butadiene Rubber	NBRH	good performance of anti-corrosion, diluted acid endurance, swelling resistance, anti-aging, oil-bearing, abrasion resistance, and compression resistance, suitable for oil and chemical field.	Poor performance of concentrated acid, alkylation, ketone, ester and ozone resistance.	40-41% -15°C /+120°C
Hydrogenated Nitrile Butadiene Rubber	HNBR	excellence performance of anti-corrosion, diluted acid endurance, swelling resistance, anti-aging, oil-bearing, abrasion resistance, and compression resistance, suitable for oil and chemical field.	Poor performance of alkylation, ketone, ester and concentrated acid resistance	43-45%, -15°C /+120°C
Ethylene Propylene Diene Monomer	EPDM	excellence performance of concentrated or diluted alkaline resistance, diluted acid endurance, anti-corrosion, anti-aging, steam bearing, alcohol and ketone resistance, low temperature endurance, anti-tear, compression resistance, water-proof ability	Poor performance of oil, benzene and alkylation resistance	-20°C /+120°C
Fluoro Rubbe	FKM	excellence performance of anti-corrosion, concentrated or diluted acid resistance, high temperature endurance, medical resistance, anti-aging, compression resistance, ozone and oil endurance	Poor performance of abrasion resistance, elastic deformation, tensile strength	0°C /+120°C

•To ensure the stator's high quality, all our rubber materials are produced and tested in Germany, then imported to China.



Rotor Material

Material Code	code	Material Name	Hard Chrome Plating Surface Treatment		Integral Vacuum Furnace Quenching Treatment		Remarks
			Cr Thickness (Single Face)	Hardness Range	Quenching Thickness	Hardness Range	
42CrMo	1.7225	Alloy Carbon Steel	150 um	HRC56-60			high strength, suitable for rotors' material of multi-stage pump, down hole pump and driller
2Cr13	1.4021	Martensite Stainless Steel	150 um	HRC56-60			widely used in sewage treatment field
SS304	1.4312	Austenitic stainless steel	150 um	HRC56-60			suitable for weak corrosion medium, like chemical, paper-making, petrochemical, food and beverage field
SS316	1.4401	Austenitic Stainless Steel	150 um	HRC56-60			suitable for strong corrosion medium, like chemical, paper-making, petroleum and food field
S32205		Intermediate Duplex Stainless Steel	150 um	HRC56-60			suitable for strong corrosion and much chloride medium, like chemical and petroleum field
S31260	1.4501	Advanced Duplex Stainless Steel	150 um	HRC56-60			suitable for strong corrosion and much chloride medium, like chemical field
Cr12MoV	1.2436	Tool Steel	No Cr Plated		3-6mm	HRC65-68	suitable for strong abrasive medium

Besides, medium with higher solid and corrosive particles, WC or CrC spraying welding is used as the rotor's surface treatment, with spraying welding thickness of 0.6-2mm and surface hardness HRC65-70. Service life of rotor is greatly extended.





Progressive Cavity Pump in Oil Field

Gear Reducer and Motor

- Reducer

To ensure the pump reliable operation, the gear reducer of Germany SEW brand and NORD brand or domestic brand ANJIFU brand is strongly recommended for the outstanding advantages of stable running, low noise, no vibration, safety working and well-known high quality and reliability.

- Explosion-proof Motor

Usually, explosion-proof motor of Jiangsu Dazhong or Wuxi Anda brand is recommended. ABB brand or Nanyang brand explosion-proof motor is also available, if necessary. Protection class IP55, insulation class F, explosion-proof class DIIBT4.



SEW
EURODRIVE



NORD
DRIVESYSTEMS

ABB

Other Accessories

- Germany maker such as Burgmann's mechanical seal, imported Sweden SKF or FAG brand bearing and imported Germany UKS brand skeleton oil seal are used to improve the pump quality and ensure the reliable operations.



Mechanical Seal



Bearing



Skeleton Oil Seal

- **Safety Valve(Pressure Relief Valve)**

Safety valve is usually installed at the outlet with high pressure. It will automatically open when the outlet pressure exceeds the set point, and return medium to inlet or other lower pressure area to release the pressure at the discharge end.



- **Check Valve(One-way Valve)**

High pressure exists at the pump outlet. The medium will have the force to reverse the rotor when the pump stops, then result in motor's running in the opposite direction, which is dangerous. Check valve is to isolate the high pressure medium and outlet to protect the pump system.



- **Pressure Sensor**

Pressure sensor installed at the inlet or outlet to monitor and convey the pressure value to the control system. The pump will stop automatically through the control system to protect itself, when the pressure value exceeds the pre-settings.



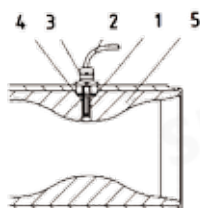
- **Basket Filter**

Installed at the inlet, the basket filter is used to filter out big solids and sand in crude oil in case of blockage to the pump suction.



- **Stator Protection Device from Dry Run**

It's used to measure the rubber's temperature, and the temperature controller will gives alarm or stops automatically when the actual temperature exceeds the pre-set value.



- 1— Temperature Sensor
- 2— Sensor Wire
- 3— Cable Protection Union
- 4— Thermal Conductive Catheter
- 5— Stator



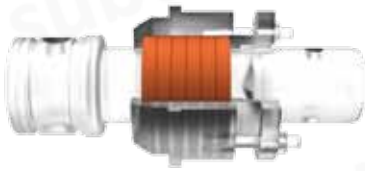


Progressive Cavity Pump in Oil Field

Types of Shaft Seal

• Packing Seal

Packing seal is divided into two types: one with water washing and another without water washing. The sealed section of connecting shaft is treated with CrC thermal spray weld technology, with the HRC63-66, excellent abrasion resistant property. Small leakage of packing seal is permitted to lubricate the connecting shaft and take away the heat caused by friction to protect connecting shaft and stuffing from dry running.



• Single Mechanical Seal

Mechanical seal is usually divided into two types: single mechanical seal and double mechanical seal, used based on different medium conditions.



M7N Single Mechanical Seal



MG1 Single Mechanical Seal

• Double Mechanical Seal

Two sets of mechanical seal are installed back to back. The pressure of the liquid in the middle cavity must be higher 1-2 bar than the pressure of medium conveyed in the suction housing, so as to prevent the medium into the mechanical seal cavity. It's suitable for the conveyance of medium with high viscosity, toxic or with high solid content.



Back to Back Double Mechanical Seal



M74D Double Mechanical Seal

Usage Introduction in Oil Field

With the ability of conveying high solid content, high viscosity and gas medium, pc pump is widely used in the process of oil field, including: down hole oil extraction, conveyance of oily water and mud, transportation of polymer, water and polymer injection with high pressure, conveyance of viscous oil and the mixture of gas and oil, transportation of various medical, additive and other viscous products.



Transportation of Crude Oil

PC pump as positive displacement pump works on the basis of interference movement between stator and rotor. It's ideal for the conveyance of light and medium oil, heavy and extra heavy oil, with viscosity from 5cp to 50000cp ,API from 6 to 40.

(API=141.5/ρ-131.5, API of water =10)

classification	API degree	viscosity	Vgm rpm
extra heavy oil	6 to 11	5000-50000cp	0.5-1.5
heavy oil	12 to 16	500-5000cp	1.0-2.0
medium oil	17 to 28	50-500cp	1.5-2.5
light oil	29 to 40	5-50	2.0-3.0

The crude oil is conveyed to main station for further processing with transportation distance from 5km to 40km,after extraction from down hole.





Progressive Cavity Pump in Oil Field



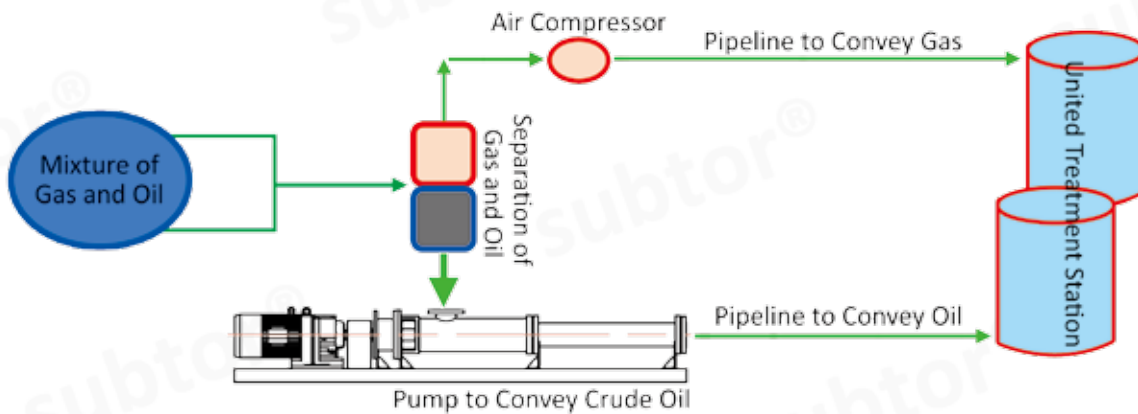
Long distance transportation in African oilfield



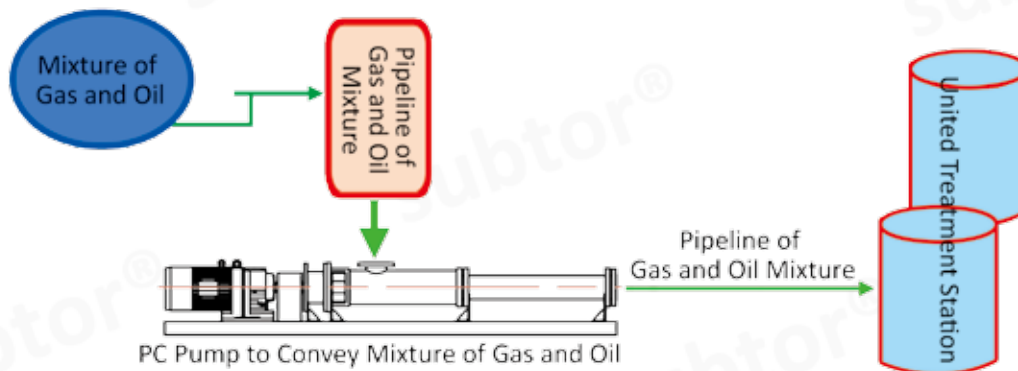
Used in Iran Oilfield

Transportation of multi-phase gas and oil

- The oil and gas is separated roughly at the wellhead and then transported in 2 different lines in a traditional method. (shown as following)



- Now PC pump is able to convey the multi-phase mixture of gas and oil only in one pipeline. (shown as following)



PC Pump to Convey Mixture of Gas and Oil

Advantages of mixture conveyance as following

- Saving one gas pipeline, greatly reduce the initial investment.
- Reduce the pipeline pressure before pump, reduce the quantity of reflux and improve extraction efficiency.
- Reduce down hole pump load and maintenance cost, prolong service life.
- Improve the pipeline pressure after pump, high transportation efficiency and increase output.



Flow amount and pressure calculation of multi-phase mixture conveyance pump

$Q(\text{total}) = Q(\text{oil}) + Q(\text{water}) + Q(\text{compressed gas}) + Q(\text{mud and sand})$

Pressure value = outlet pressure value - inlet pressure value = differential pressure ΔP

For 1 set of pc pump, flow range 5-350m³/h, 1-12 grade class, pressure range 6-72 bar.

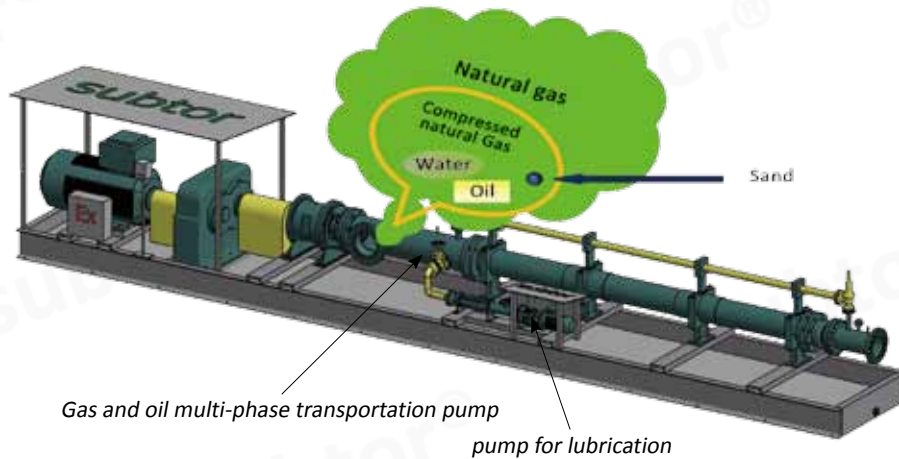
For higher flow, several sets of pump can be installed in parallel, Eg: 2 sets in operation and 1 set in standby, 3 sets in operation and 1 in standby.

According to several years' experience, it's proven to be better for the percentage of liquid sucked into pump not less than 10%, if not, external lubrication is needed. One small capacity priming pump can dose some amount of liquid to lubricate the stator and to avoid dry run.



Progressive Cavity Pump in Oil Field

Considering the unstable gas oil ratio in oilfield, it's better to start the pump to lubricate the multi-phase mixture conveyance pump, when the gas content is above 80% in the mixture.



Common used control types in oilfield

- Constant pressure control system at the inlet

Pressure sensor installed at the inlet is to monitor and convey the pressure value to the control system. The pump will accelerate the speed automatically to reduce the inlet pressure and keep the stable pressure, when the pressure value exceeds the pre-set value.

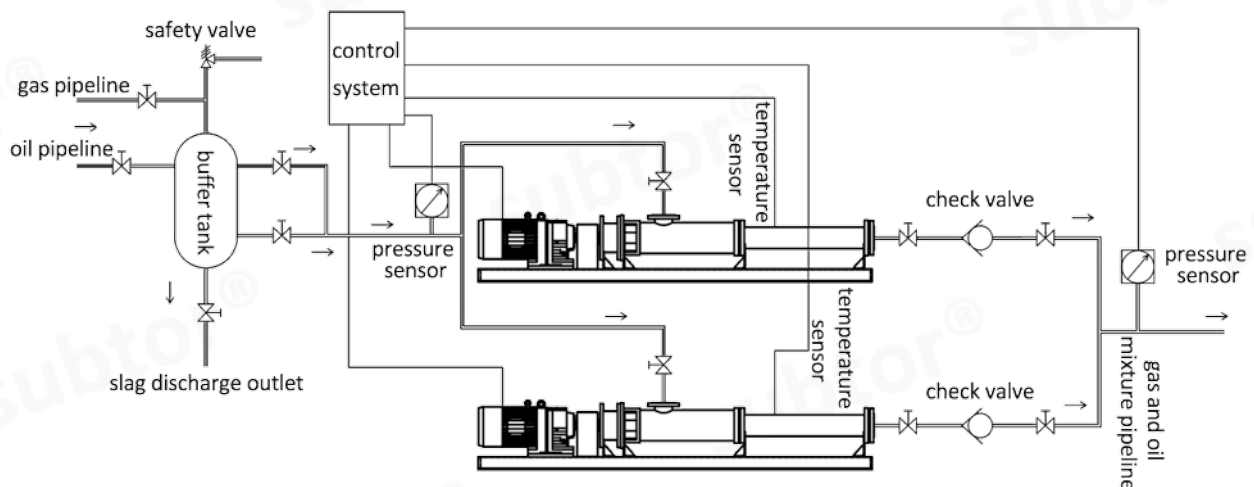
- Overpressure control system

Pressure sensor installed at the inlet or outlet is to monitor and convey the pressure value to the control system. The pump will stop or decrease rotating speed automatically through the control system to protect itself, when the pressure value exceeds the pre-set value.

- Stator Protection Device from Dry Run

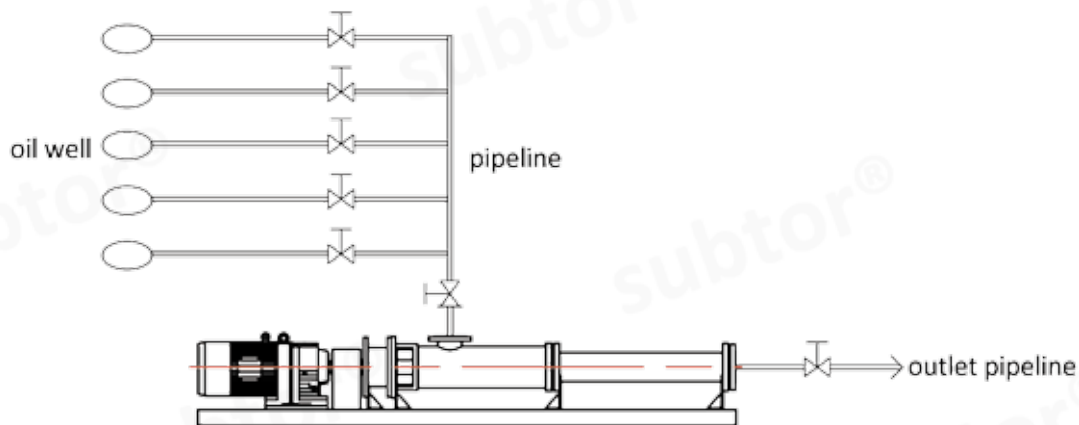
It's used to measure the rubber's temperature, and the temperature controller will give alarm or stop automatically when the actual temperature exceeds the pre-set value.

The following is the typical electrical control system for 2 sets of pump installed in parallel

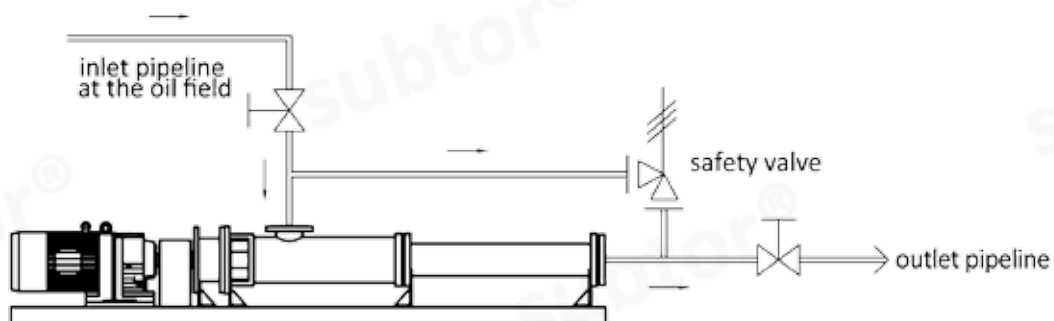


Common layout types of multi-phase mixture conveyance pump

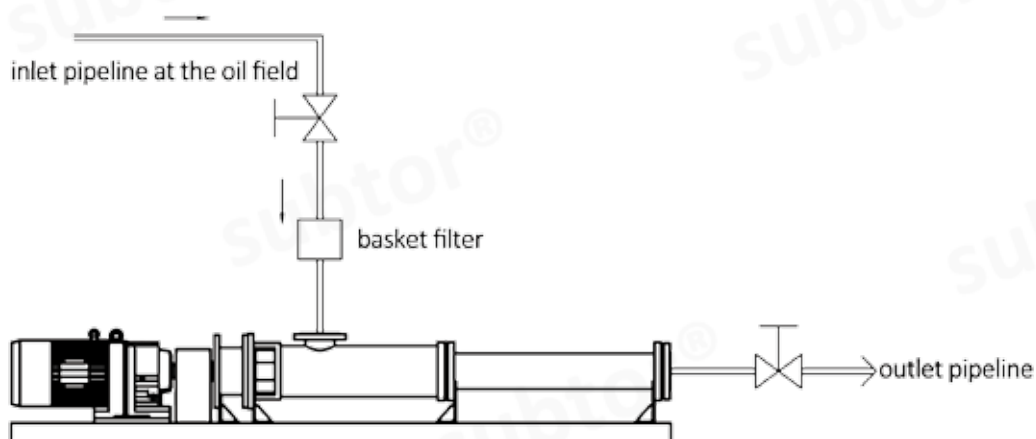
- One set of pc pump is used to convey the mixture of gas and oil collected from several oil wells to the united station for further process.



- If the outlet pipeline is blocked for some reasons, safety valve will automatically open when the outlet pressure exceeds the pre-set value, and return some medium to inlet or other lower pressure area to release the pressure.



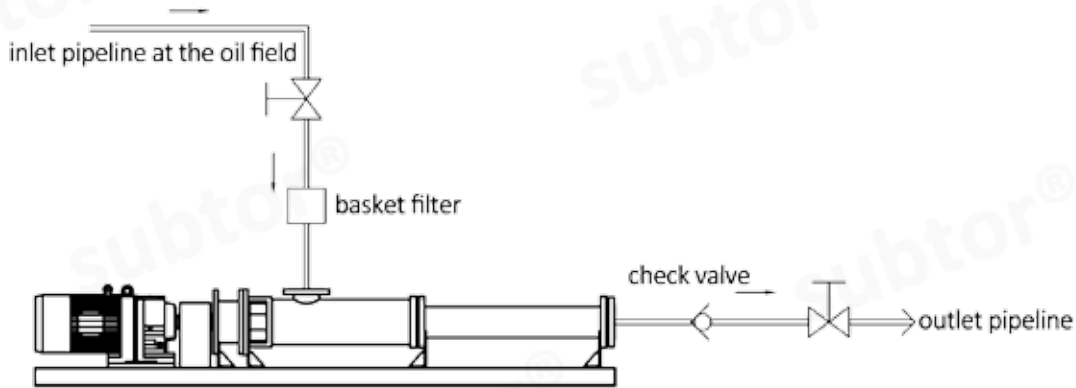
- Installed at the inlet, the basket filter is used to filter the big solids and sand in crude oil in case of blockage to the pump. Periodic cleaning is needed to keep it in good running conditions.



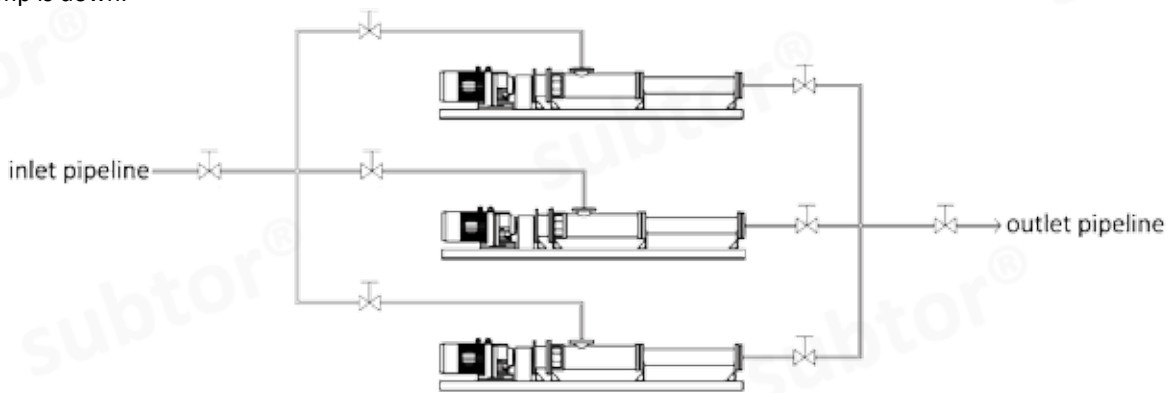


Progressive Cavity Pump in Oil Field

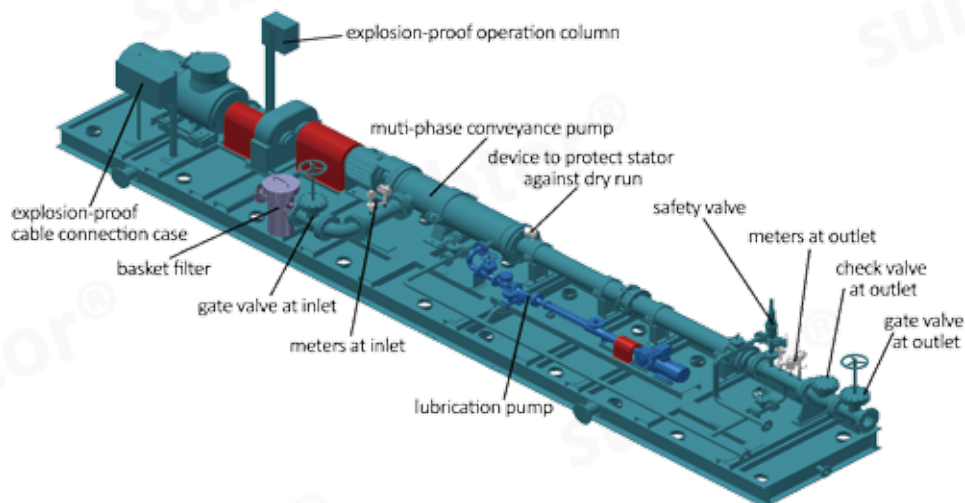
- High pressure exists at the pump outlet. The medium will have the force to reverse the rotor when the pump stops, then result in motor's running in the opposite direction, which is called the phenomenon of running. Check valve is installed at the outlet to separate the high pressure medium and pump to protect the pump system.



- Several sets of pumps are installed in parallel for higher flow requirement, as 2 sets in operation and 1 set in standby or 3 sets in operation and 1 set in standby. Under these circumstances, the systems still run well even if some set of pump is down.



- The typical layout of multi-phase oil and gas conveyance pump system on one skid-mounted platform. PC pump and many other accessories are installed at one set of skid-mounted platform, like basket filter, valve, lubrication pump, meters and so on.



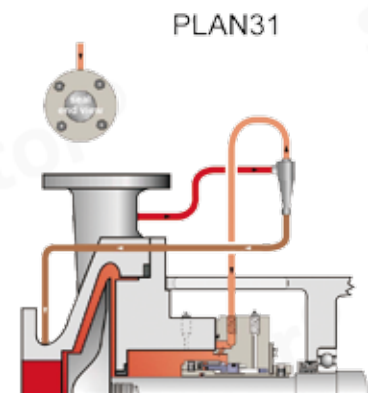
Flushing system for mechanical seal

Double mechanical seal are usually used in pc pump to convey the multi-phase mixture of liquid, solid and gas. Different flushing systems like plan31, plan 53a and plan54 are adopted to ensure the reliable, safe and enduring running according to various medium conditions, as standard API682.

Plan31

Principle: Cyclone hydraulic separator is used to remove impurities in the flushing liquid and seal chamber. This also helps dissipates heat.

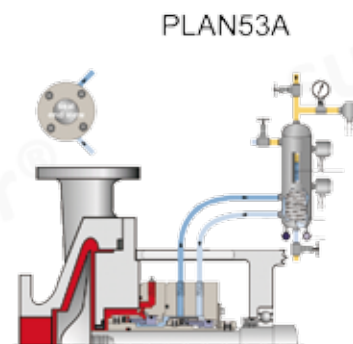
Application: For working conditions when lubrication and dissipation are dependent on the transmitted substance. Sometimes the substances contain solid foreign matter which can cause issues.



Plan53a

Principle: Liquid seal tank used to pressurize spacer fluid and perform circulation for the pump. This isolates the substance and dissipates heat.

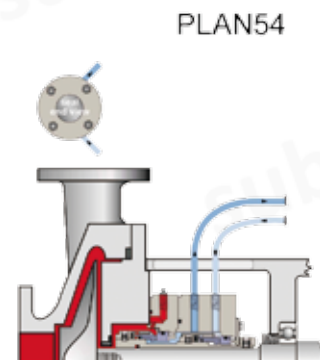
Application: transmitted substances include liquids with high saturated vapor pressure like light hydrocarbons, toxic liquids, heat transfer liquids, solid liquid mixtures, etc.



Plan54

Principle: Pressurized spacer fluid runs in the outer circulation system; transmitted substance needs to be isolated with external tap water.

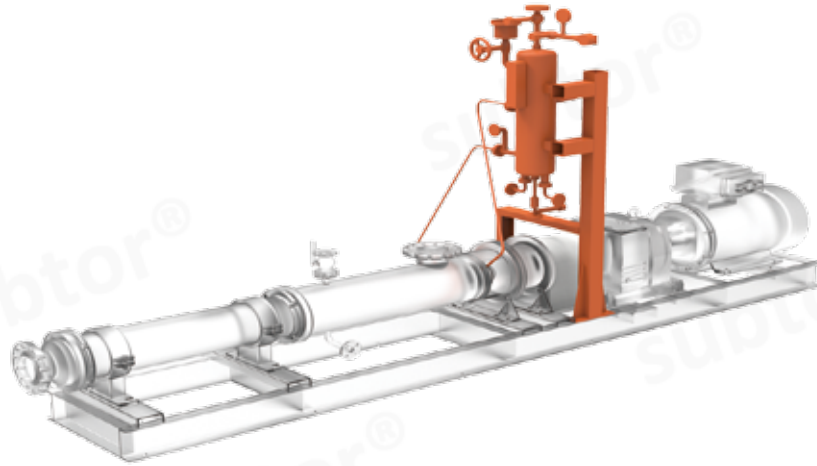
Application: the similar working conditions as the one of plan 53a.





Progressive Cavity Pump in Oil Field

The typical mechanical seal flushing system plan 53 is shown as below.

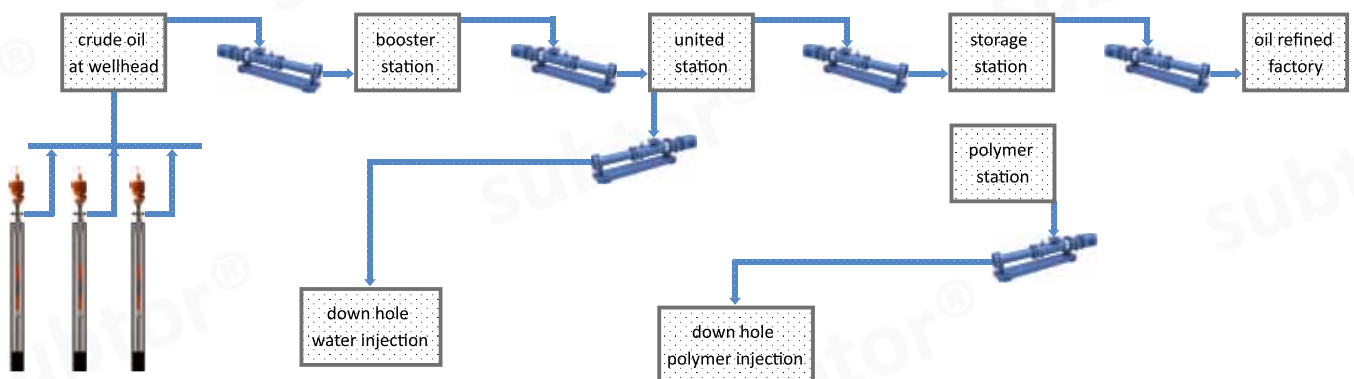


Two sets of pump being installed in parallel in Indian oil field



Pump to convey gas and oil mixture in Chinese western oil field

Flowchart of pump for oil industry



Polymer Conveyance

During the three times of oil extraction, many oil fields adopt the method of down hole PAM polymer injection to increase the oil output. PAM polymer belongs to long chain molecule organics with viscosity form 300 to 500cp. Once injected down hole, it will float on the oil surface or gather oil among sands to increase the output. It will not be able to gather oil once the structure is destroyed.

PC pump is most suitable for the conveyance of pam polymer for its non-pulsation, non-shear and continuous transportation property.



used to convey polymer solution



polymer configure station in oil field



pump room in oil field



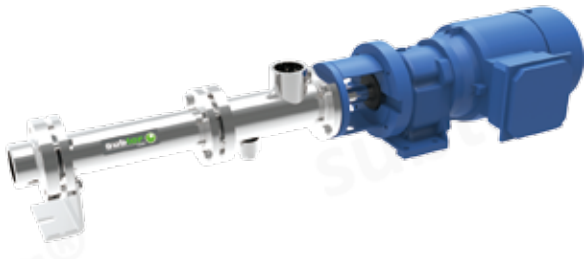
pump to convey polymer



Progressive Cavity Pump in Oil Field

PC pump used as meter

PC pump has outstanding conveyance property of stability, no pulse, no shear, continuous transportation and being proportional to rotating speed. Therefore, it's widely used as the meter to dose additives like flocculent, lime milk and lubricant agent in oily sewage treatment, with accuracy tolerance 1% and no physical damage.



MM PC Pump Ready for Delivery

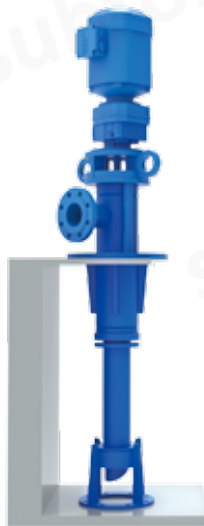


Used in Medical Configure Station

waste oil, oily sewage and oily sludge treatment in oil field

It's very important to treat the oily sewage properly produced during the process, not only for environment protection but also for considerable economical benefit. For the unique structure of pc pump especial the vertical type, it's also suitable for the transportation of oily sewage and oily sludge. The vertical type pc pump has the outstanding advantages of non-cavitation and non-dry run while transportation the oily waste from the collection pond to the plate and frame filter, compared with horizontal mounted pump.

Vertical pc pump is usually installed at the wall of pond or tank to raise the liquid. With customized length of pump, it can be used in the liquid with various depths. Part of stator and rotor immersed in liquid while the gear motor is above the liquid without any contact with the liquid. Mounting flange fixed at the bottom of well, welded on the pump together as a stabilizer, hence pump can runs smoothly.



Installation method of vertical pump



Vertical pump being installed



Vertical pump in Iran oil field



Vertical pump for delivery





Progressive Cavity Pump in Oil Field

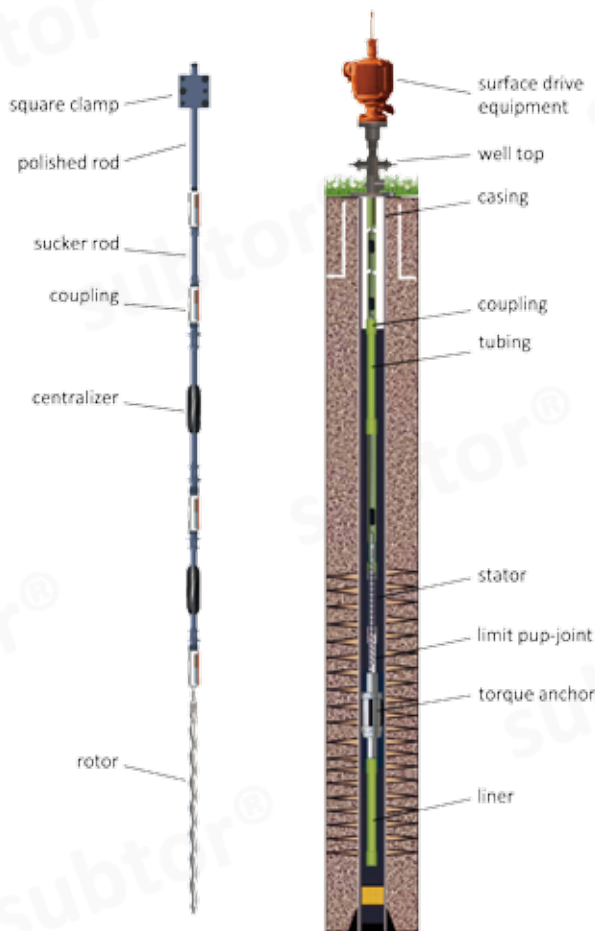
Down hole oil extraction

Method to extract oil with surface drive device: the stator and rotor is connected to the oil rod and sucker rod, and then the power of surface drive is transferred from sucker rod to the rotor. Finally, the crude oil is raised to the ground by the rotor's continuous rotation.

Method to extract oil with down hole drive device: the low speed permanent magnet motor installed down hole is connected with the universal coupling rod and directly drive the rotor. No need of sucker rod, the pump can be used in both inclined well and horizontal well with higher efficiency.

•Professional rubber swelling test is done in the oil sample collected from the oil field to measure the changes in size, weight and hardness. The test result will help us to determine the proper type of rubber, and we will reconfigure if no suitable rubber are available.

•Our pc pump have been widely used in the oil field located in Russia, South America, Canada, China and so on, with maximum installation depth of 2500 meter and daily output up to 300 cubic meter. It can also be customized to meet different requirements of various medium.



PCP Down-hole Pump

•Low initial investment, the lowest initial investment compared with electric submersible pump, hydraulic piston pump and beam pumping unit.

•High efficiency, energy-saving, low maintenance cost, stable loading, pump efficiency being 55%~65%, highest up to 75%, while plunger type pumping unit and centrifugal electric submersible pump efficiency being 30%~40%.

•Simple structure, small volume, low transportation cost, easy to maintain.

•Down hole pc pump is most suitable to convey the medium with high viscosity, high solid content and high gas content.

•It's more suitable for offshore platform cluster well, inclined well and horizontal well with the advantages of simple structure, small volume and low transportation and maintenance cost.



the traditional driving

Spare Parts

Common used parts are always kept in stock. We guarantee to deliver the spare parts to customers when they need it.

- Stator and rotor
- Connecting shaft, universal joint, coupling rod and flexible rod
- Internal and external rubber sleeve of joint, skeleton oil seal, mechanical seal and O-ring
- other accessories, such as round pin, spacer sleeve, long/short sleeve, clamp spring



After-sale service

Our professional after-sale engineers are ready to provide solutions for you at any time.

Services include:

- Training operators on-site
- Fast response and solution to solve clients' problems
- Commissioning, maintenance and repair
- Technical consultation and the spare parts purchase suggestion
- Resolution within 24 hours after notice





Progressive Cavity Pump in Oil Field

The operation and maintenance attentions

- The operators must read carefully and understand thoroughly the whole operation and maintenance guide and safety warning instruction. If any doubt, please inform us in time so as to offer answers or training.
- Check the pump and the whole pipeline carefully and make sure no other substance, if any remove it immediately. Add some liquid into the pump through water inlet valve to avoid dry run. No other additional heavy load on the pump after installation. Before starting, check the rotating direction and make sure the rotating direction the same as the one marked on the plate. Make sure all the valves are open on the inlet and outlet pipeline.
- The over-pressure automatic protection control system and safety valve must be installed at the outlet pipeline. Once over-pressurized, the electricity must be able to cut off so as to protect the pump and avoid accident.
- Make sure there are enough medium. Safety device should be installed to avoid running out or dry run. Dry run is strictly forbidden.
- If the medium's actual temperature is different from the set one while designing the pump, it will affect the property even can't work or cause safety risk.
- It's forbidden to alter the working condition at random and the installation position, if any change, approval from the manufacture is required in advance.
- There should be completed record on the pump's daily running condition, including running time, medium temperature, pressure, flow, incident etc.



Weifang International Kite Festival



Cooperation and Mutual Win



The Overall View of Weifang



Dynamic Subtor Team



Oil Extraction



Offshore Oil Extraction Platform



Multiphase Conveyance PC Pump



Down Hole PC Pump

