CP Case Study
Liquid Sulphur

Introduction
Sulphur changes its physical properties depending on the temperature. This behaviour can be explained with the altered molecular structure.
- 119˚C: melting point
- 119˚C to 159˚C: liquid sulphur (rings and low-molecular chains)
- 159˚C to 444˚C: high-molecular chains (at 159˚C the viscosity sharply increases)
- 187˚C: maximum viscosity

Once sulphur has solidified and hardened within the pump it cannot be liquefied again.

Three general challenges

A liquid sulphur pump must be completely Jacketed
All tanks in which liquid sulphur is stored and all pipes through which liquid sulphur is pumped must be heated. This is necessary to guarantee and maintain the desired temperature of the liquid sulphur within the system. This also requires a fully jacketed pump in which the shroud and rotor can be heated.

A liquid sulphur pump must be leak-free
Classic pumps with axial face seals usually result in leaks at a standstill, as hydrodynamic sealing only functions effectively on pumps during operation. Escaping sulphur leads to deposits and represents a source of danger.

A liquid sulphur pump must not allow contamination of the sulphur
Vertically installed pumps with axial face seals hold the danger that the liquid sulphur can be contaminated with thermal oil, heating steam, condensate or air.

CP solutions

Sealless CP pumps are completely Jacketed
The patented reverse drive principle of the metallic, magnetically coupled CP pumps permits complete heating of the pump, even in the area behind the impeller and rotor. This unique design enables a constant desired temperature to be maintained throughout the pump liquid end.

Sealless CP pumps are leak-free
All sealing problems are eliminated with the sealless, magnetically coupled liquid sulphur pumps from CP. This eliminates all leaks and considerably simplifies maintenance, as no seals need be maintained. Standard pumps fitted with mechanical seals usually result in leaks when not in operation, as the hydrodynamic sealing only functions effectively on pumps during operation. Escaping sulphur leads to deposits on seal faces and represents a source of leakage and danger.

Sealless CP pumps prevent contamination of the sulphur
The heating jacket of vertical CP liquid sulphur pumps has been especially designed so that no contamination of the liquid sulphur by the heating medium (thermal oil, heating steam, condensate or air) can occur. The heating circulation is optimised so that it is impossible for the medium to escape.

CP products

CP offers the customer two ways to pump liquid sulphur:
1. with a sealless horizontal pump (MKP) or
2. with a sealless vertical pump (MKTP)

Both pump models are equipped with tungsten carbide bearings for liquid sulphur as standard. The most frequently used material is 1.4581.
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Three specific requirements

Horizontal Pump Installation

Customer’s storage tanks are mounted above ground. It is desirable for the liquid sulphur to be pumped out horizontally at the lowest point of the tank. A vertical pump cannot be used for this reason.

CP solutions

MKP - horizontal magnetic coupling pump suitable for liquid sulphur

The “Magnetic Coupling Pump” (MKP) is a hermetically sealed, magnetically coupled horizontal pump which ideally meets the requirements for pumping liquid sulphur. The patented reverse drive principle makes it possible to continually heat liquid sulphur inside the case - even with a shroud and rotor, which is not possible on conventional pumps.

Verticarl Pump Installation

Customer’s storage tanks are mounted below ground. These tanks are often over 4 metres deep with no bottom outlet. This requires a submerged vertically mounted pump design.

MKTP - vertical magnetic coupling pump suitable for liquid sulphur

The “Magnetically Coupled Pump” (MKTP) is a hermetically sealed, magnetically coupled submerged vertical mounted pump which ideally meets the requirements for pumping liquid sulphur. The pump features a triple hermetic sealing arrangement. First the shroud is sealed off from the atmosphere, then against the thermal oil, steam or condensate located in the internal heating system and finally against the tank surface due to the pressure and heating-jacket design and layout.

The horizontally designed pumps must be temperature-monitored

The customer wants to ensure that the correct temperature of the sulphur in the pumps is maintained. With submerged vertical mounted pumps the heated storage tank continuously maintains the medium temperature of the surrounding liquid sulphur and hence the pump. This however can not be guaranteed with horizontal pumps located outside the storage tank, these require a fast reacting, preventative pump temperature monitoring function.

Temperature monitoring directly on the shroud

As sulphur can only be pumped within a narrow temperature band, only limited deviations from the specified temperature range can be tolerated. The temperature monitoring function, patented by CP, indirectly measures the medium temperature exactly at the point on the shroud at which the temperature is highest due to eddy current losses within a magnetic coupled pump. Any temperature changes or loss of liquid within the pump leads to measurable values within an extremely short time. This then enables the pump to be switch off before the sulphur reaches its critical temperature.

Conclusion

The reverse drive principle from CP has proven itself with many customers who pump liquid sulphur. This is true for both horizontal and vertical pumping requirements. The advantages of MKP and MKTP are certainly convincing, i.e. hermetic sealing, no unheated areas around the shroud or rotor and a quick response temperature monitoring function.

We will be happy to send you references or additional information.

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Did you know?

Sulphur is the 15th most common element on earth, and therefore makes up 0.048% of the earth’s crust.

<table>
<thead>
<tr>
<th>Name</th>
<th>Sulphur</th>
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<tbody>
<tr>
<td>Other names</td>
<td>None</td>
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<tr>
<td>Chemical formula</td>
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<tr>
<td>CAS No.</td>
<td>7704-34-9</td>
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<tr>
<td>Density [at melting point]</td>
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<tr>
<td>Melting point</td>
<td>115.21°C</td>
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<tr>
<td>Boiling point</td>
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