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Design measures for difficult process media

Information **E09041**

A comparison of design measures to keep your seal clean in case of difficult process media

When media containing solids or media with a tendency to glueing, sticking or hardening are used in a process then there may be problems for the shaft seals leading to a significant reduction in service life. Even in apparatus with a top drive in which the gas phase is sealed and there is normally no direct contact with the product, deposits in the area of the shaft seal represent a recurring problem, particularly with foaming, polymerising and crystallising media, because of the high tank fill levels. As result the function of the seal can be impaired or the seal can even be failed. Over recent years, this problem has been observed much more frequently due to a continuous increase in machine capacity utilization.

To protect shaft seals in case of difficult process media, it is basically possible to use a multiple seal and pressurize it. However, if this measure alone is not enough or if the customer prefers not to use a pressurized multiple seal, then there are other design options that are possible also in combination with a single seal:

1) Continuous flushing with a clean external medium.
2) A “polymerization barrier” arranged in front of a mechanical seal.

Operating principle

Flushing involves a clean external medium being supplied into the seal chamber in the area of the shaft seal to be protected whereas the flow of the flushing medium into the process medium is adjusted by a flow restrictor. This can involve flushing with liquid, e.g. water, or gas, e.g. nitrogen.

Flushing can be used in all mounting positions such as top, bottom and side drive. As standard, a floating throttle is used, although in individual cases other versions such as lip seals, U-cups or flushing holes in the seal housing can represent a good option.

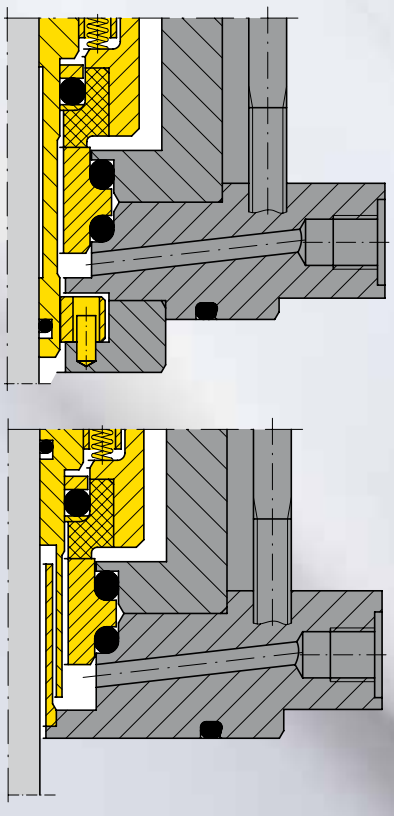
In the case of a polymerization barrier, the medium inside the polymerization barrier acts as a barrier for the process medium and thereby prevents deposits on the shaft seal. This is recommended above all for top drives in which the process medium is not always in direct contact with the seal.

It has performed very effectively in practice in this way. In most cases, the design takes the form of a concentric labyrinth.

Mode of operation

With flushing, the flushing pressure should always be somewhat higher than the pressure to be sealed, in order to guarantee the flushing function. The differential pressure or flow rate to be set depends on the optimum flow velocity in the throttle gap in accordance with the design configuration. The flow rate can be set using, for example, a dosing pump or a flow control such as the FLC 200 from EagleBurgmann. The flushing must always be switched on before the apparatus is started up. After the drive system has been switched off, it is recommended that the flushing should be allowed to continue running for a few more minutes. It is also a good idea to switch on the flushing during cleaning of the apparatus. If necessary, it is also possible to use the cleaning

The EagleBurgmann M481KL-D20 for top driven steel tanks acc. to DIN can be equipped with an polimerization barrier.



Design measures for seal protection: Continuous flush (above) and polymerization barrier (below).

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It shouldn't look like that: Mechanical seal with deposits.

medium instead of the flushing medium. In this case, however, a corresponding connection must be provided. In most applications the flush is operated continuously. In this case, it is impossible to prevent a certain amount of the flushing medium getting into the product. If this cannot be tolerated, it may be sensible to adopt flushing with nitrogen. The flow rate can be set here using a gas supply system such as an EagleBurgmann GSS.

When a polymerization barrier is used, filling must always be performed in unpressurized operation before the apparatus is started up. If a pressurized multiple seal is used then medium inside the polymerization barrier is enriched over time with the barrier medium due to the pressure difference between barrier pressure and pressure to be sealed. Ideally, therefore, the same medium should be selected for the barrier medium and the medium inside the polymerization barrier. If the maximum fill level of the polymerization barrier is exceeded then there will be an overflow into the product. However, this overflow quantity is a minimal amount and can be compared with the leakage of a pressurized multiple mechanical seal. Indeed, it is even possible to avoid this overflow into the product by adopting a pressureless operation or using a quenched single mechanical seal. The polymerization barrier should also be flushed during cleaning of the apparatus, either with the medium used inside the polymerization barrier or the cleaning fluid. There is no need for the medium inside the polymerization barrier to be changed regularly if a small amount of liquid is continuously supplied using a dosing pump or a flow control system. Also, this guarantees that the polymerization barrier will always be adequately filled. Furthermore, regular checking of the fill level can then also be dispensed with.

When selecting the flushing medium and/or the medium inside the polymerization barrier, make sure that a certain clearance is maintained between the process temperature and the boiling curve of the selected liquid in order to prevent evaporation. The viscosity should not be too high either. In other respects, any medium can be used that is compatible with the process and satisfies the requirements of health & safety and environmental protection.

	Flush		Polymerization barrier
	Liquid	Gas	Liquid
Design configuration	Floating throttle (standard) Lip seal U-Cup		Concentric labyrinth
Mounting position	Top, bottom or side drive		Top drive
Advantages	Increased safety to prevent deposits at the seal		Smaller amount of external medium in the process Very low instrumentation effort
Disadvantages	Certain quantity of external medium in the process is unavoidable		In case of vacuum vaporization of the liquid may occur
Seal type	Liquid-lubricated Gas-lubricated		Liquid-lubricated
Supply system	Dosing pump or flow control	Gas supply system	Option: Dosing pump or flow control

Pros and cons

Basically, flushing always offers better protection than the polymerization barrier. Above all, in bottom and side drive applications where the seal is in direct contact with the product, only flushing can be used effectively. In applications with a high operating temperature, the input of cold flushing medium additionally has the effect of cooling the seal. A polymerization barrier can be sufficient in apparatus with a top drive in which the gas phase is sealed and therefore the product is not always in direct contact with the seal. The advantages of the polymerization barrier include the small amount of external medium in the process and the very low effort of instrumentation. However, the polymerization barrier is not recommended for vacuum applications, because there can be vaporization of the fluid in this case. Therefore, flushing should be used in these applications. Also, in case of gas seals only flushing is reasonable.

To select the optimum solution for the particular application, it is necessary to analyze the process medium and the plant specific surrounding conditions carefully together with the seal supplier. Ideally, this analysis should be carried out during the engineering phase of a new production plant. This procedure and the use of suitable design measures can significantly increase the service life of the shaft seals. Maintenance costs, and therefore service life costs, are significantly reduced. By taking the most suitable design measures, also difficult process media loose there terrifying effect to shaft seals.