

Sealing solution in the chemical industry (TDI production) to protect atmosphere from process gas

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Espey WKA300 for sealing a paddle dryer



For the production of dry residue TDI (toluene diisocyanate) the end user in France has chosen a Dutch supplier for sophisticated drying technology. TDI is an important intermediate product for the production of adhesives, high-end paints, polyurethane and elastomers.

Process description

Paddle dryers are used for a wide variety of applications. The dryer for TDI production has a heated process room, containing rotating heated paddle shafts. The specially shaped paddles do not have a transport function but are designed for maximum heat transfer. This results in an excellent control of the product temperature and enables a uniform product quality. At the outlet side, the product discharges out of the machine via an adjustable overflow. The paddle dryer is based on a system of indirect sludge heating. The indirect heat transfer avoids air flows while the fully enclosed operation enables the safe treatment of any sludge type. Due to the low operating speed of the shafts its wear is reduced to a minimum.

TDI is an organic compound produced in the pure state, but often marketed as mixtures. Besides MDI, TDI is the most produced isocyanate with extremely toxic intermediate process compounds.

Toluene is the matrix of TDI and TDI is prepared in 3 steps from toluene. It has to be doubly nitrated with nitric acid to give dinitrotoluene. This step determines the isomer ratio of the ultimate TDI. Hydrogenation of the dinitrotoluene produces the corresponding isomers of diaminotoluene (TDA). In the final step, the TDA is subjected to phosgenation, i.e. treatment with phosgene to form TDI. Pure TDI is produced in the main process stream. The remainder is recovered from distillation residue containing TDI and for this process the paddle dryer is used.



Paddle dryer in operation for the production of TDI

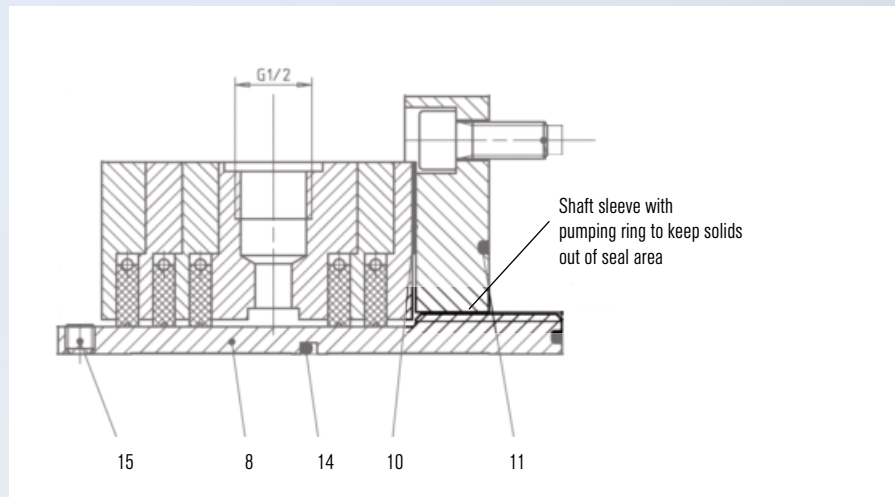
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Problem and challenge

To keep the media in the process tank, 2 gastight seals are required. Process media is here the residue from the main manufacturing process of TDI to evaporate the remaining TDI. The paddle dryer operates with 2 parallel special designed paddle shafts, which convey the media through the process tank. This means that a solid loaded process is to be handled. The seal, which was installed before, could not fulfil the requirements of this application. No process gas leakage to atmosphere is tolerated. The seal has to deal with 1.05 bar (15.2 PSI) as process pressure, 110 °C (230 °F) as operating temperature at a revolution speed of 45 rpm.



Espey WKA300 as sectional view

EagleBurgmann Espey solution

To increase life time and to fulfil the process requirement of no powder leakage and competitive cost Espey designed the carbon floating ring seal Espey WKA 300 with chamber non-split design, 2 seal rings on process and 3 seal rings on atmosphere side – all made of PTFE compound. This guarantees a defined flow of barrier gas and this ensures that no process gas will leak to the atmosphere. 2 seal rings on process side have been chosen to have a back up ring, if still some solids enter the seal area. a second seal ring on process side also reduces the barrier gas flow into the process, which also was undesired. To protect the dryers' shaft against wear the seal is equipped with a shaft sleeve. It had to be ensured that no or nearly no solids can enter the seal area. Therefore the shaft sleeve is designed with an integrated labyrinth to keep solids out of the seal area. The seals guarantee a long-term operation time.



Espey WKA300 in operation with barrier gas connection

Operating conditions

Application: paddle dryer
Seal type: Espey WKA300
Medium: powder, dry residue TDI
Operation temperature: 110 °C (230 °F)
Pressure abs.: 1.05 bar (15.2 PSI)
Revolutions: up to 45 min⁻¹
Shaft diameter seals: 95 mm (3.74")
Barrier gas: nitrogen