Drying

Solid-liquid separation with centrifuge dryer
Safe production even with broad grain size spectrum

Solid-liquid separation with the help of centrifuge dryers is common practice. With certain product features such as a broad grain size spectrum with a high proportion of fine grains, conventional centrifugation systems fail. Through a new production process, these problems can be avoided safely and reliably.

The known production sequences in a centrifuge dryer begin with the filling of the suspension into the filter drum. In the centrifugal field, the solid is retained in the multi-layer filter tissue and the mother liquor is filtered through the product cake. The filter cake is then washed. After washing, the centrifugation for the mechanical dehumidification begins. The remaining capillary height can be reduced by pressure overlap. In the next process step, the extremely efficient and gentle thermic drying begins in the form of packed bed drying and/or fluidised bed drying. After the product cake has been dislodged – the loose debris is located in the process chamber -, with fluidised bed drying either a stop-and-go or a continuous drying process is used.

With the stop-and-go procedure, the drum is positioned, a drying nozzle is moved against the stationary drum and the drying gas injected into the segmented work chamber through the openings in the drum base. The shot nozzles return to their original position and the drum is then turned further by the angle set until the next opening and until the next 'shot' of drying gas is carried out. The product is mixed and evenly dried through the successive rotation of the drum.
With continuous drying, the shot nozzles remain with a minimal gap in front of the drum base. The drum rotates permanently at a slow speed. Every time one of the openings in the drum base is located in front of the shot nozzle, drying gas is injected into the drum. Through the continuous rotation of the drum, the drum contents are continually mixed up and dried in a very homogenous, efficient and gentle manner.
With packed bed drying, the product cake is initially not dislodged. The drying gas is blown into the process chamber, the product cake is passed through in an outwards direction and the moisture drawn out. The product is dried in its ring form and only subsequently dislodged from the filter drum. Materials that tend to clump are thus dried safely and without clumping.
Products with a broad grain size spectrum and a high proportion of fine grains, with bimodal distribution cannot be centrifugated and dried with this procedure, or only with considerable effort.
During the formation of the filter cake, the fine product parts clog in the gaps between the larger parts; the liquid phase has trouble in draining off. This leads to the filtrate draining off very slowly through the product cake. The liquid ring becomes higher and higher and also breaks down extremely slowly. Furthermore, an undesirable sedimentation results from the long liquid ring.
Due to the different ratios between mass and surface, the large product parts settle in the centrifugal field more quickly on the outer edge of the filter cake in contrast to the finer parts. The finer parts float longer in the liquid ring, are deposited in the end on the cake ring and form an impermeable film of grease.

During washing and centrifugation, the filtrate speed is also very low and the process time is extended considerably. An increase in the rotation speed, i.e. an increase in the C value and/or overlying pressure does not lead to any better results in the overall process as the product cake is highly condensed and even less permeable for the drying gas during the continuation of the packed bed drying.
This is where the new filtration and dehumidification variant comes into play. The counter impulse procedure can loosen up the product cake in every process step. During filling and washing, the C value is kept very low; a liquid ring is no longer formed, sedimentation and the formation of a film of grease are excluded. With the counter impulse procedure, the product cake is also not dislodged. The shot nozzles inject into offset openings in the base of the drum every time the drum is rotated. The gas flows through the moist product ring in the opposite direction to the centrifugal forces in an inward direction. As this is done at higher speeds, the product ring is kept upright by the centifugal forces in the filter drum. This ensures that the material is loosened across the entire circumference of the drum, that its porosity is increased and processing facilitated again. In contrast to the previous processes, the drying gas also flows through the product cake twice, first when it is injected into the drum in an inwards direction. As the gas has to escape from the filter drum again, it flows through the filter cake a second time; the transfer of moisture to the drying gas is used more efficiently. To shorten the drying process, drying gas can also be blown into the filter drum via the fill shaft. In contrast to conventional packed bed drying, the gas flows through the product more efficiently due to the higher porosity of the filter cake. Another aspect is that no drying cracks can form as a result of the permanent loosening of the product cake. This means that the additional gas cannot escape from the filter drum without being used. As the filter drum remains stationary, the products in the filter drum cannot roll away as is the case with stop-and-go or continuous drying. Materials with a tendency to agglomerate remain homogenous and powderlike.
The dried product is then removed. For this, the filter basket within the system, that remains closed, is opened at the front side and the powder is transported to the disposal chute solely by the rotation of the conical filter drum. As an option, equipment for gravimetrical removal and/or pneumatic or vacuum transport is connected to the disposal chute.
The product that remains in the filter is blown out through the shot nozzles. As the interior chamber of the centrifuge has been kept free of any fittings, the system can be emptied without encrustations and free of any residual layers. It is then available immediately for the next load.
This counter impulse procedure was developed by FIMA Maschinenbau (Obersontheim). It is also available as an update for existing systems. The TZT centrifuge dryers can also be equipped with CIP, SIP, PAT modules and an online sample extraction.

The centrifuge dryer is thus also specially suited for toxic products in high-containment systems. The hygienic design of the TZT complies with GMP and prevents any cross-contamination; all sealing systems are compliant with FDA.

To date, TZT centrifuge dryers have primarily been used in the pharmaceutical and chemical industry in the production of APIs; most recently, however, there has been

growing interest from other areas, for example, the fine chemistry, mineral or colour pigment industries. Depending on the application, systems are available for technical schools and production. The fill volume ranges from 37 to 800 litres of suspension, which corresponds to a cake volume of between 20 and 400 litres.

The project and process engineers at FIMA advise customers on the planning of the system, integration in the existing production process, the selection of the control unit and software and in the layout of the periphery.

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