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Titel:

Inline-Dispersing-Machine provides optimal powder induction, wetting and dispersing

Vereinigte Fachverlage

Induction instead of raising dust

Optimal powder induction into liquids

Hans-Joachim Jacob

It is very easy to incorporate powder into a liquid. You simply pour it onto the surface of the liquid and then you mix it in. It is obvious that this creates a lot of dust powder falls to the side and beneath the vessel, but knives, pens and other items often fall into the vessel accidentally as well. It is also typical that powder sticks to the walls of the vessel and other devices built into the vessel, and it is well known that lumps and agglomerates build up when the powder comes in contact with the liquid. It takes a long time to break these agglomerates down. Powder incorporation is unhealthy, for the operator as well as for the process.
But there are other means…..

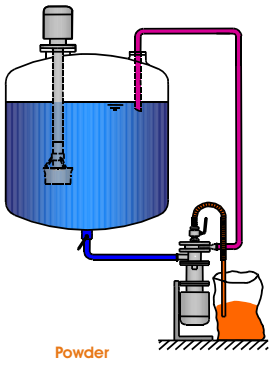
Author: Dr.-Ing. H.-J. Jacob, ystral gmbh Ballrechten-Dottingen

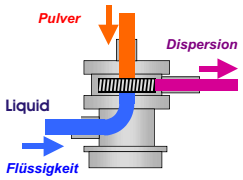
TDS machines are systems that induct powder dust- and loss-free directly from a bag into the liquid. The powder is wetted below the surface of the liquid and dispersed completely agglomerate-free (TDS = Transport and Dispersing System). No dust sticks to the wall of the vessel, no bag has to be lifted on top of the tank or to a filling tray. TDS machines cannot be directly compared with conventional powder transporting or conveying systems as they do not require any air for the transport, no filters, no infiltration, no discharge and also no extra means to produce the vacuum. They produce the vacuum directly in the liquid and thus induct the powder 100% into the liquid. It is also very interesting that these machines can even handle further tasks.

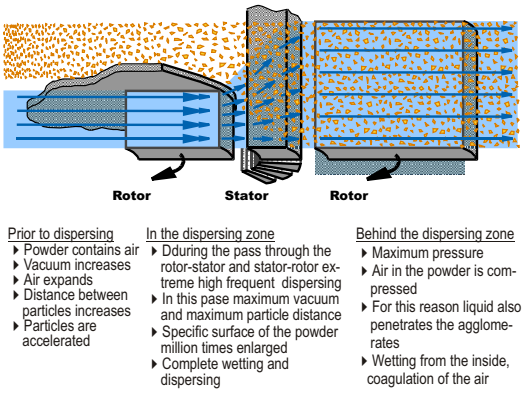
Dust-free handling with TDS induction mixers

The TDS induction mixer is a variant of the Jetstream mixer. Jetstream mixers are well known for a very effective vertical mixing of the liquids in vessels and by this means produce a much higher homogeneity compared to conventional stirrers. The mixing head consists of a hyperboloid rotation guiding pipe the stator. In the centre of the stator a fast rotating rotor is placed.

The rotor forces a strong stream of liquid that is directed towards the bottom. On the bottom, the stream is separated, guided to the wall of the vessel and then upward until it reaches the surface of the liquid and there again re-directed. That way the complete content of the vessel is vertically circulated and a homogeneous mixture is produced. This mixing principle is especially suitable for liquids with solid contents as sedimentation at the bottom of the vessel, and a circulation of only the liquid is avoided.
The TDS induction mixer during mixing builds up a vacuum in the centre of the rotor. This vacuum is being used to induct powdery material. The powder may be inducted into the liquid by using an induction tube and induction hose. The induction tube is anti-static resp. electrically conductive. Because of the high speed of the powder in the hose, this is very important. The complete wetting of the powder is effected in the mixing head below the surface of the liquid. Because of the enormous turbulence in the fast rotating rotor, an immediate and intensive micro mixing of the powder and the liquid is given. No dust comes out of the liquid. This of course also avoids the sticking of powder and crusts on the wall of the vessel. While powder is inducted from a bag using the







Left: Powder induction with a batch TDS induction mixer
Centre top: Installation of the Inline powder wetting and dispersing machine
Center bottom: Powder and liquid can only meet in the dispersing zone
Right: Wetting and dispersing zone of the Inline powder wetting machine

induction tube, a flow of air from the outside into the bag occurs. Because of this effect, no dust can come out of the bag during the induction procedure. The bags are completely emptied. In cases where only a part of the powder in the bag is required for the process, the bag may be placed on a balance scale and only the required amount of powder can be inducted. TDS induction mixers have proved themselves in any case where dusty and harmful powders such as black carbon, activated carbon or highly disperse silicic acid have to be incorporated into low viscosity liquids. In respect of the current discussion about fine dust in the air, the public naturally is much more sensitive against any kind of dust in the air. All dust with a particle size of less than 10 µm is considered as fine dust.

The risk for the operator is reduce to a minimum

The permissible limits are determined by µg/m³ of air. Persons who have to handle such materials know very well that these limits are never adhered to when pouring powder into an open vessel. TDS machine on the other hand allow an almost dust-free handling of powders. The risk for the operator is reduced to a minimum. For this reason the use of TDS induction mixers is recommended by the Employer's Liability Insurance Association.
Batch TDS induction mixers may be used for a variety of products and processes but unfortunately they are limited in their field of application. The viscosity of the basic liquid may not exceed 1.000 mPas. Heavily sticky powders cannot be inducted with this machine. The filling level in the vessel must follow certain conditions and the maximum length of the machine is restricted by construction reasons to a maximum of two metres.
For this reason an improved TDS machine was developed that can be used almost without limitation for all processes. This is the Conti-TDS.

Dust and loss-free handling with the Conti-TDS

The Conti-TDS is an Inline dispersing machine that produces a strong induction vacuum in its dispersing zone. This vacuum is used to induct powders dust-free from bags, hoppers, containers, BigBags or silos into a liquid. The machine can handle any viscosity that can be pumped and also faces no problem with sticking or gelling powders. The machine is installed outside the vessel and connected to the vessel using a piping system or vacuum resistant hoses. In this way the machine works irrespective of the size of the vessel, or the filling level in the vessel. Very often the machine is not only connected to one vessel, but to two or more vessels or the machine is placed on casters and moved around to several places. Similar to a pump, the machine circulates the liquid by itself in a loop. Powder and liquid reach the mixing chamber from completely separated directions, and only come in contact with each other when they reach the dispersing zone. There the product is dispersed with a high shear rate and under vacuum. Even finest powder particles are immediately and completely wetted. A quality of dispersion and concentrations of solids can be reached which traditional or conventional mixing systems such as dissolver mixer or injector systems can never achieve.

Even finest powder particles are immediately and completely wetted

The place of the installation for a Conti-TDS machine may be selected in such a way that the effort for transporting the powder is reduced to a minimum. The lifting of bags to a platform is eliminated. The machine may be operated either in vertical or horizontal set-up and the position of the liquid connections can be adapted to the on site situation. A great advantage is the possibility to easily integrate the machine into existing processing plants. Modifications of buildings, welding of new flanges to a vessel with required acceptance procedure from the Technical Inspection Authority or replacement of other machines are not necessary anymore.
After powder induction, the powder valve is closed and the Conti-TDS may be operated as a conventional Inline dispersing machine until the required particle size distribution, homogeneity or consistency is reached. In this phase the machine works according to the principle of a teeth ring dispersing machine with a high flow and many passages through the high shear zone.
Another important advantage is the independence of any influence from the operator and the constant powder induction rate. A well known problem when producing lacquers, gel like cleaning detergents, or cosmetic products is that the quality and the viscosity of the end product varies with no controlled consistency, depending on how fast the powder is added during the process. Using a Conti-TDS, these problems are overcome.
Conti-TDS machines are offered with a power range from 7,5 to 150 kW. Induction rates can reach values of about 400 kg/min when inducting Calcium carbonate or starch from a BigBag. The average shear speed in the dispersing zone reaches values ranging between 20 and 30 m/sec.
When you compare the dispersing effect of the Conti-TDS with conventional systems, then astonishing improvements can be stated.

Left: Conti-TDS in an ATEX processing plant with strong variation in the batch size
Centre: Conti-TDS with a BigBag station and two processing vessels
Right: Processing system for high viscosity media

The most important parameter to determine the dispersing effect is the shear gradient , which is the quotient out of shear speed and the gap in-between the shear rings. In general, a stirrer offers a shear gradient of about 20 s^{-1} and a dissolver about 50 s^{-1} while a Conti offers a shear gradient of 50.000 s^{-1} and thus is a thousand times higher compared to a dissolver.

A Conti-TDS offers a shear gradient a thousand times higher than a dissolver

Depending on the processing task, the machine can be equipped with a variety of powder inlets and dispersing tools. In cases where shear sensitive products have to be treated, the stator easily can be removed and powder is inducted into the liquid without any appreciable shear energy.
Low and medium viscosity products can be handled by the machine alone, and no additional pump is required. For this reason the machine at the end of a process may be used as a transfer pump to the next processing step. Additional pumps are not required. Only when inducting into a high viscosity liquid, such as knifing fillers, glue, offset printing ink, seal mass or similar, a volumetric pump is installed at the liquid outlet of the machine.

Certified according to ATEX

Incorporating powder into an open vessel containing solvent based liquid which is equipped with a stirrer or a dissolver is very dangerous. It is well known that not the liquid, but rather the vapour on top of the liquid is inflammable.
Powder [this is very often forgotten], always contain air. Powder that is poured into the liquid may statically load up and produce an igniting spark. To ignite solvent containing air, a spark with a low energy is sufficient. When using a Conti-TDS machine, the powder is not poured into the vessel with the vapour but inducted directly into the circulating liquid. The vacuum in the mixing head inducts the powder directly into the liquid. Due to the induction vacuum no solvent containing vapours build up. Of course all Conti-TDS machines are certified according to the ATEX specifications

Not only for powder

The TDS principle is not restricted to powder only, the same machine can be used for the induction and dispersion of liquids. This is especially of interest in the production of glaze, deodorants or drinks when high viscosity gels or concentrates have to be mixed into a low viscosity basic liquid. Stirrers or dissolvers in a vessel cannot produce a homogeneous mixture. When using a Conti-TDS the high viscosity gel is inducted inline into the low viscosity basic liquid and reaches the vessel already completely homogeneously distributed.
The same arguments apply when low viscosity additives, dispersing aid or other media, have to be mixed with high viscosity liquids or creamy products. In vessels equipped with a stirrer or a dissolver, the low viscosity liquid stays on top of the high viscosity product for a very long time and is not mixed in. Also in this case the Conti-TDS provides a continuous dispersing into the circulating liquid stream.

***ystral* gmbh**
maschinenbau + processtechnik
Wettelbrunner Straße 7
79282 Ballrechten-Dottingen
GERMANY
Tel.: +49 (7634) 5603 0
Fax: +49 (7634) 5603 99
Email: ystral@ystral.de
WEB: www.ystral.de