Powder Induction and Pigmenting, dust-free and effective

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Powdery raw materials are used in almost each product in the lacquer and paint industry, in all sealing compounds, adhesives, and construction chemicals. They are being used as fillers, thickeners, matting agent, conserving agent, improvement for adhesion, anti suspending or thixotropic additives and many others and last but not least as pigments.

The ystral-Conti-TDS is a machine to induct and disperse powdery materials that works much more effective and more clean than a dissolver or stirrer could ever do. It works according to the principle of a shear ring dispersing machine and builds up a strong induction vacuum exactly in the zone with the highest shear rate. This vacuum is being used to induct powdery materials loss-free directly into the High-Shear zone where they are immediately and completely wetted and dispersed.

When comparing between the dispersing effects of the Conti-TDS with conventional systems, astonishing results are stated. The most important parameter to describe the dispersing effect is the shear gradient - the quotient out of shear speed and gap in-between rotor and stator. A stirrer generally only offers a shear gradient of about 20 s^{-1}, a dissolver calculates to about 50 s^{-1}, the Conti-TDS on the other hand results in a value for the shear gradient of 50.000 s^{-1}, and such is thousand times higher than a dissolver.

Five steps in one

Processing aim during powder adding and pigmenting of lacquers, dispersion paints and coatings is the complete wetting, desagglomeration and homogeneous distribution of the solid contents (e.g. pigments) in the film forming solution or dispersion. This process consists of the following steps: vessel emptying, powder transport, and powder incorporation, wetting and dispersing.

When using a Conti-TDS, all these five partial processes are realised with one machine only. This does not only shorten the whole process, it also results in a reduction of manufacturing cost (TDS = Transport- and Dispersing-System).

Dosing of pigments and wetting in conventional processes are always affiliated with the forming of dust. One of the main arguments for the TDS-principle is the dust-free operation.

Pic. 1: ystral Conti-TDS with a Big-Bag-station in-between two processing vessels

Pollution of the working area as well as bothering or endangering of the personnel is avoided. The induction vacuum is not produced by an external vacuum pump or a vacuum transporting system but inside of the wetting liquid itself. The full amount of powder such comes into the liquid, without any loss.

The induction vacuum causes the barrel emptying, the powder transport and the powder incorporation. Additional transporting means and systems for dust exhaust are not required. All cost for the purchase, the operation, maintenance and monitoring of exhaust systems are omitted. The disposal of filter remnants and filters is omitted.

No dust is formed on top of the surface of the liquid. No partially wetted agglomerates build up in the liquid as with a dissolver or a stirrer. The well known powder crusts that build up on the wall of the vessel, cover and mixing shaft that fall off in a dissolver vessel and such reduce the quality of the final product definitively do not occur when using a Conti-TDS system. The quality of a product in any case can be improved when using a Conti-TDS. Agglomerates and lumps do not build up.

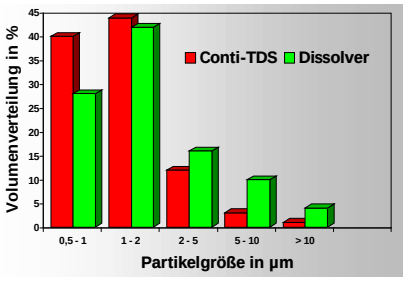
Explosion protection

Powder incorporation into open vessels with a dissolver or a stirrer is extremely dangerous. It is well known that not the solvent containing liquid is inflammable but the solvent containing vapour on top of the liquid. Powder – this is very often forgotten – always contains oxygen. Powder that is poured may electrically load up and produce an ignition spark. To ignite solvent containing vapour, a very small spark with a minimum ignition energy is already sufficient.

When using a Conti-TDS the powder is no longer poured into the vessel with the solvent containing vapour but into the circulating liquid. With the induction vacuum, the powder is directly inducted into the liquid. Because of the induction effect no solvent containing vapour builds up. Conti-TDS-machines of course are certified by ATEX.

Wetting and dispersing

The selection of a suitable wetting and dispersing method has a remarkable influence on the quality criteria such as stability during storage, optical characteristics, resistancy to the weather and last but not least the brightening and coverage ability of lacquer systems and paint.



Pic. 2: Dispersing results of a dissolver and a ystral Conti-TDS for a car repair lacquer

Powders provide a very high specific surface. For ultra fine pigments and highly disperse silicic acid this can be over 300.000 m² per kg of powder. If you realise that for conventional powder incorporation from top into the vessel not only one but many kgs of powder fall onto the surface of a few sqm only then it is obvious that because of the inadequacy between liquid and powder surface only agglomerates are partially wetted.

Different to this, the Conti-TDS immediately provides a fine distribution of the powder directly with the wetting. In the shear field in-between the fast running rotor and the stator the wetting surface of the liquid is set to an equivalent volume of powder. The maximum dispersing effect immediately during the wetting process does not only reduce the treatment time, it also results in a much better properties of the product compared to conventional powder incorporation.

A lack of shear energy later on cannot be compensated, even not by an extended dispersing time. For this reason the shear energy in the first phase of the wetting must be as large as possible. It has to be stated that some products of course do not need a strong dispersion or may be over-sheared (e.g. dissolving of granulated resin into solvent, induction of shear sensitive effect pigments or similar). For such cases, the stator of the machine simply may be removed without any problem. The wetting is the effected by the Conti-TDS under vacuum but without any remarkable shear.

High viscosity products

Conti-TDS-machines are offered in five different sizes with a power range of 7,5 to 150 kW. Depending on the application they can be equipped with a variety of powder inlets or dispersing tools. In the low to medium range of viscosity the machines transport the liquid by itself.

Only when inducting into high viscosity media, such as **adhesives**, **knifing filler**, **offset printing ink** and **seal compound** or similar an additional volumetric pump must be switched in line at the outlet of the machine.

Pic. 3: ystral Conti-TDS with induction tube for the dust-free incorporation of strong dusty powders

Pic. 4: Conti-TDS with an additional volumetric pump for the production of high viscosity seal compound

For the production of low viscosity products, such as lacquers and paint, it is absolutely nonsense to adjust the viscosity to a high value for the incorporation of the powder. The viscosity of the liquid has a main influence on the wetting and dispersing effect. Liquids with a low viscosity of course have a better and much faster capability to wet powders than a high viscosity liquid.

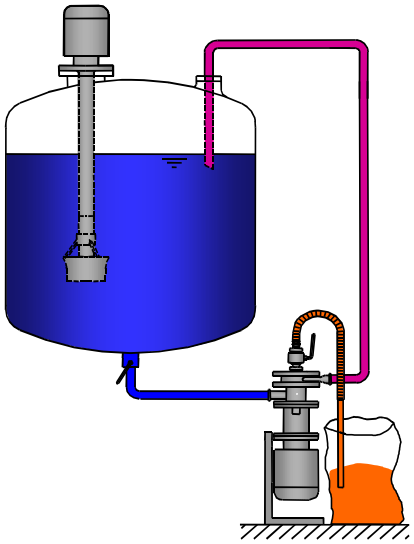
A dissolver process on the other hand requires a high viscosity. A high viscosity is mandatory that a shear effect builds up in the product and that the product does not splash out of the vessel because of the high speed of a dissolver disc. This high viscosity is not optimal for the powder wetting effect. Agglomerates build up – this is unavoidable – and the energy of the machine is wasted to again break the agglomerates as good as possible.

The use of the Conti-TDS is completely different. The shear gradient of the Conti-TDS is a thousand times higher compared to the shear gradient of a dissolver disc. For this reason, the Conti-TDS does not depend on a high viscosity to build up a comparable dispersing effect. The dispersing step for this reason with the aim of a complete wetting may be executed in the low viscosity range. In the low viscosity range the speed of the powder induction also achieves a higher value.

The performance of the Conti-TDS is not related to the size of the vessel and the filling level, a combination with small as well as with large vessels is absolutely no problem. If the vessel is equipped with a Jetstream mixer, installed close to the bottom of the vessel, then variable volumes may be produced (Pic. 8).

Set-up and function

Similar to an Inline dispersing machine, the Conti-TDS is installed outside the vessel and connected to the vessel using a piping system or flexible hoses. The machine works independent from the size of the vessel or the filling level.



Pic. 5: Installation of a ystral Conti-TDS in a loop with a vessel

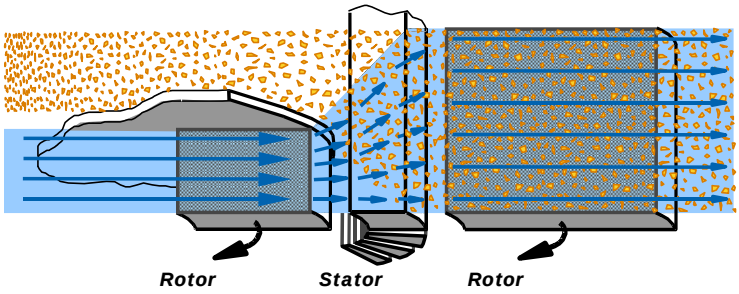
Very often the machine is not only connected to one vessel but is combined with two and more vessels. (Pic. 1) Especially significant is the possibility to integrate the machine into existing processing systems, practically no modification is required (installation of new flanges, anew technical approval of the vessel, moving other machines etc.)

The machine may be operated either in a horizontal or a vertical position and the flange connections may easily be adapted to the on site situation. Relatively seldom, a machine on casters for transportation is used in the paint and lacquer industry to use it in several places.

The place of installation of the CONTI-TDS may be selected in such a manner that the effort for transporting the powder may be reduced to a minimum. Lifting of bags to the platform of the vessel is omitted.

All TDS-machines create the induction vacuum directly in the liquid stream. This induction vacuum is used to induct the powder directly from bags, silo, BigBag or containers into the liquid. The powder is immediately wetted and dispersed. Powders and liquid reach the mixing chamber on completely separated ways and only come in contact with each other in the dispersing zone. There the mixture is dispersed with high shear energy and vacuum. This allows the production of solid concentrations that can never be achieved with stirrers or dissolvers.

Another important aspect is the optimised and always constant powder induction rate, independent from the influence of the operator. This problem is well known from dissolvers: one operator carefully pours the powder very slowly directly into the Vortex of the dissolver, another pours complete bag into the vessel. The dispersing results at the end of the process are completely different and may not be corrected, even with a lot of time and dispersing energy. The quality of the end product varies a lot.



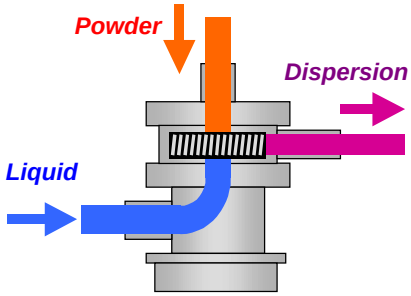
Rotor-Stator zone
- Air is in-between powder particles
- Vacuum increases
- Air expands
- Distance between particles increases
- Particles are accelerated

Stator zone
- Passage between rotor and stator Stator-Rotor extreme dispersing under vacuum
- In this phase maximum vacuum, maximum particle distance
- Specific surface of the liquid million times enlarged
- Complete wetting and dispersing

Stator-Rotor zone
- Maximum pressure
- Compressing the air in the powder
- Penetration of the liquid into the inside of even compact agglomerates
- Wetting from inside koagulation of the air

Pic. 6: Wetting and dispersing zone of the Conti-TDS

Very often we encounter processes where thick film glaze before filling have to “ripe” for eight hours, as controlled powder incorporation could not be achieved. The viscosity develops uncontrolled and the end product must be diluted or the viscosity has to be “re-adjusted” before it is filled. Similar problems arise in the adhesive industry. With the use of a Conti-TDS, these problems are eliminated. The machine inducts exactly the amount of powder as it can wet optimally. The quality of the end product is constant.



Pic. 7: Powder and liquid only meet in the dispersing zone

When the powder induction is finished, the powder inlet is closed. The product is then additionally dispersed in a loop until the optimal particle size, required matting degree or consistency is reached. In this phase, the machine works as a shear ring dispersing machine with a high pumping rate and many passages through the High Shear zone.

Not only for powders

Of course the TDS-principle is not restricted to powder induction, the same machines may as well be used for the induction and dispersing of liquids. This is especially of interest, when in the production of thick layer glace high viscosity gels have to be mixed into a low viscosity basic liquid. In vessels equipped with stirrers or dissolvers a homogen mixing is not possible. When using a Conti-TDS, the high viscosity gel is inducted inline into the basic liquid and reaches the vessel already completely homogen distributed.

Similar arguments apply to the incorporation of low viscosity additives or any other liquid in high viscosity dispersion paints or pastes. In vessels with stirrers or dissolvers, low viscosity liquids stay on top of the high viscosity basic liquid very long and are not mixed with each other. The Conti-TDS in this case also provides homogen incorporation into the circulating liquid.

Thixotroping

Besides the induction of pigments or fillers, thixotroping is one of the most important fields of applications for the

Conti-TDS. In case very dusty and highly disperse silicic acid has to be inducted into the liquid. Common procedure is pouring the powder onto the surface of the liquid. Additional to well known problems such as dust, adherence and agglomerates during wetting in solvent containing systems in this case the silicic acid stayed in the solvent containing atmosphere and had enough time to bind the vapour of solvent. This tremendously and uncontrollable reduces the thixotroping effect in the lacquer.

Using a Conti-TDS, the induction is effected dust and loss free. (Pic. 3) This already is an enormous advantage. The powder is inducted directly into the liquid and is not exposed to the vapour of solvent. It is completely available for the building up of the structured viscosity in the lacquer.

Matting

Matting agents are being used to adjust the degree of brightness of a lacquer. The problems using a dissolver are well known: during the powder incorporation agglomerates are formed. If these are dispersed for a long time, the matting effect is destroyed, if dispersing is too short, the agglomerates are not yet destroyed. Applied to black leather surfaces or furniture, the result is fatal.

The Conti-TDS is featured by an agglomerate-free powder induction and an extremely narrow particle size distribution during dispersing. This allows precise and repeatable and accurate matting.

Dissolving of resins

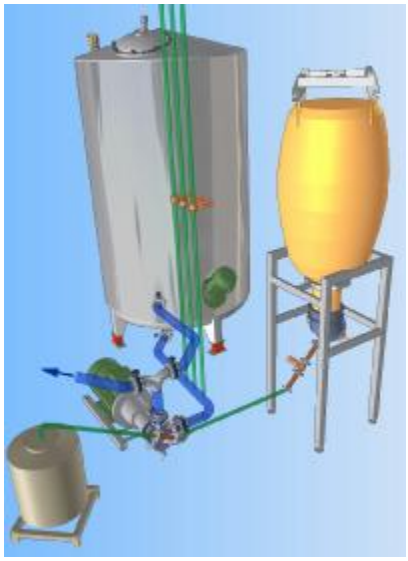
The most extreme reduction in time at all is the use of a Conti-TDS for dissolving of resin and granulated resin. Wetting and dissolving times of a few seconds per bag are not very seldom.

In the conventional dissolving process the powder is poured onto the surface of the liquid solvent. Partially wetted powder lumps and agglomerates are formed that require a long stirring time to be dissolved. Using a Conti-TDS results in an immediate and complete wetting of each powder particle. In one case for the induction of PMMA into MMA with a Conti-TDS after 3 minutes the same result was achieved compared to a conventional method with 6 - 8 hours of dissolving time.

Pic. 8: ystral Conti-TDS in a system for varying batch sizes

Some examples

The production of **low viscosity printing ink** and **dispersion paints** is the field of application with the maximum effect. In a possible shortest time, large amounts of powders have to be inducted into a basic liquid and dispersed to a constant quality. Powder induction rates up to 450 kg/min for Calcium carbonate or 200 kg/min for Titanium dioxide are achievable. Systems are in operation where a Conti-TDS is installed in-between three 50 m³ storage vessels and one single operator produces batches from 10 to 70 tons with an effectivity that could never be reached before.



Pic. 9: ystral-Conti-TDS with vessel on weighing cells, powder induction from a BigBag station or a bag, liquid components from a barrel

In the field of **Automobile lacquers, Building paints, Industrial lacquers** and **Wood lacquers** the flexibility and a universal usability of the system is the main argument. By simply changing the dispersing tool, metallic effect pigments can be treated with the same machine.

For the production of **Coil-Coatings a**nd **Plastisols** another effect is of interest: the controlled temperature incorporation. The processes have to be carried out with low temperatures. Different to a dissolver, with a Conti-TDS this is absolutely no problem.

When producing high quality **paper coating paste** highest concentrations can be reached with the lowest possible amount of dispersing agent. When producing **Parquet lacquers**, over-dispersing of the anti foam is omitted. A lot of applications can be found in the building chemistry: from concrete additives to adhesive material for tiles where the Conti-TDS offers advantages that can't be provided by conventional mixing principles.

Modern lacquer manufacturing

In the book „Lackherstellung" (Production of Lacquers) by Dr. Friedrich Vock (Verlag CC Press AG) some old pig tails are cut off in the lacquer industry, such as the preparation of already sufficient fine and coarse particles, from soft and hard pigments and many others. 500 pages of experience are compressed in the section „Layout-Konzepte für neue Lackfabriken" (Layout concepts for lacquer manufacturing). It is obvious: modern manufacturers of lacquers do not possess a single dissolver.

Powder induction as well as micro homogenising is exclusively carried out with inline dispersers. (Conti-TDS). The macro homogenising is carried out in a vessel installed on weighing cells and a mixer, which can handle different filling levels (in our case a Jetstream mixer). The dosing of the liquid components is not fed directly into the vessel but through the inlet of the Conti-TDS. Powdery components are directly dispersed into the liquid from a BigBag, a container or bags, liquid components are dispersed from a barrel. The advantages of this "dispersing modus" have been proved for the complete pallet of semi products up to the production of paste. Depending on the requirement, the process is completed by a filter or mills.

Ten years ago, the introduction of the Conti-TDS for the induction of Titanium Dioxide in the production of nylon or polyester fibres caused a complete modification of the production philosophy. Companies that do not use the Conti-TDS principle in this field are not competitive anymore.