



Powder Induction and Dispersion, dust free and effective

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Powders are used in almost every product in the lacquer and paint industry. They are used in all adhesives, sealing compounds, and construction chemicals. Powders are used as pigments and extenders, as thickeners or matting agents, preservatives, adhesion promoters, anti-settling agents, thixotropic agents and much more.

Ystral provides a powder addition technique which is different from all other technologies available on the market. It is so effective, that the production costs can be reduced to 1/10th the costs associated with traditional methods.

Ystral's Conti-TDS is a machine used to induct and disperse powders in a manner more effective than any stirrer or dissolver could ever reach. It works according to the rotor-stator principle of a shear ring dispersing machine and builds up a strong vacuum exactly in the zone with the highest shear rate. This vacuum is used to induct powder directly into the High-Shear zone where it is immediately and completely wetted and dispersed.

When comparing between the dispersing effects of the Conti-TDS with conventional systems, astonishing results are shown. The most important parameter in describing the dispersing effect is the shear gradient, which is the quotient of the shear speed divided by the distance between rotor and stator. A stirrer generally offers a shear gradient of about 20 s^{-1} , a dissolver provides about 50 s^{-1} . The Conti-TDS generates a shear gradient of $50,000 \text{ s}^{-1}$, or a gradient one thousand times higher than a dissolver. The specific dispersion energy is one thousand times higher as well.

Five steps in one

The aim during the process of adding powder into lacquers, emulsion paints, inks, coatings and any other dispersion is the complete wetting, de-agglomeration and homogeneous distribution of the solid into the liquid. This process usually consists of five steps: bag or container emptying, powder transport, powder incorporation, wetting and finally dispersing.

When using a Conti-TDS, all five of these processes are completed with one machine. This shortens the entire process, as well as reduces total manufacturing costs (TDS = Transport and Dispersing System).

Dosing of pigments and wetting in conventional processes normally results in the creation of dust. One of the main strengths of the TDS-principle is the dust- and loss-free operation.

Pollution of the working area, as well as endangering of personnel, is completely avoided. The induction vacuum is not produced by an external pump or any other pneumatic conveying system, but by the liquid itself. The total quantity of powder is conveyed into the liquid without any pollution of the working atmosphere.

The suction created by the induction vacuum unloads the bag or container, transports the powder, and incorporates the product all at the same time. Additional transporting machines and systems for dust exhaust are not required. This means that the all costs associated with the purchase, operation, maintenance and monitoring of exhaust systems are eliminated, as well as additional costs for filter maintenance.

No dust touches the surface of the water until dispersion; preventing partially wetted agglomerates from building up in the liquid, a common problem with industrial dissolvers and stirrers. The infamous powder crusts that build up on the walls, cover, and mixing shaft of the vessel, then fall into the dissolver vessel and reduce product quality, cannot occur when using a Conti-TDS system.

Explosion protection

Powder incorporation into open vessels with inflammable liquids or solvents using a dissolver or a stirrer is extremely dangerous. It is well known that it isn't the liquid solvent itself that is flammable, but solvent's vapour. Also, it is often forgotten that powder always contains oxygen, which contributes to flammability. Powder that is poured may produce a spark. To ignite solvent vapours, a small spark with low ignition energy is more than sufficient.

When using a Conti-TDS, the powder is no longer poured into the vessel with the vapour, but rather into the circulating liquid. With the induction vacuum, the powder is directly inducted into the liquid. Because of the induction effect, no flammable vapours build up. This simple safety feature leads to Conti-TDS machines being ATEX certified.



Fig. 1: ystral Conti-TDS with a Big-Bag-Station between two process tanks

Wetting and Dispersing

The selection of a suitable wetting and dispersing method has a profound influence on many characteristics; such as optical characteristics, weather resistance, storage stability, and the lightening and coverage ability of lacquer systems and paint.

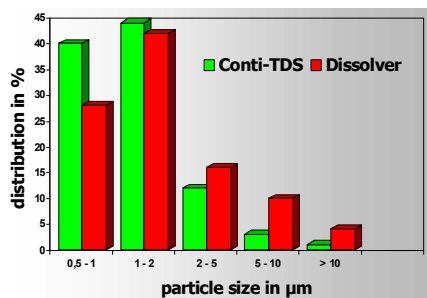


Fig. 2: Dispersing results of dissolver and ystral Conti-TDS for car refinishes

Powders provide a very high specific surface. For ultra fine pigments and highly dispersed fumed silica this can be over 1.6 million square feet per pound (300.000 m² per kg). This leads to many problems for standard addition methods, since the powder is poured onto the liquid surface of only a few square feet. This creates agglomerates or lumps, which aren't thoroughly wetted; creating an obvious problem.

Conversely, the Conti-TDS immediately provides a complete distribution of the powder directly in the shear field between the fast running rotor and the stator.

In that shear zone the wetting surface of the liquid is increased some million times and matches with the surface of the powder. The maximum dispersing effect is reached immediately during the wetting process. It also results in much better properties for the product compared to any conventional powder incorporation.

A lack of shear energy during powder addition cannot be compensated for later in the production process, not even by an extended dispersing time. That means, the shear energy in the first phase of the wetting process must be as high as possible. It must be stated, however, that some products do not need a strong dispersion, since over-shearing is possible (e.g. dissolving of granulated resin into solvent, induction of shear-sensitive effect pigments, etc.). For such cases, the stator of the machine simply may be removed without any problem. The wetting can be done by the Conti-TDS under vacuum without any noticeable shear.

High Viscosity Products

Conti-TDS-machines are offered in eight different sizes with a power range of 7.5 to 250 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 themselves.

Only when inducing into high viscosity mediums, such as **offset printing inks, Polyurethane materials, adhesives, seal compounds and knifing fillers**, is an additional volumetric pump required at the outlet of the machine.



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

For the production of low viscosity products, such as lacquers and paints, it is unnecessary to adjust the viscosity to a high value for the incorporation of the powder. The viscosity of the liquid has the greatest influence on the wetting and dispersing effect. Liquids with a low viscosity are naturally easier and much faster at wetting powders than high viscosity liquids.

A dissolver, on the other hand, requires a high viscosity, since the shear effect that builds up can cause lower viscosity products to spill out of the mixing vessel due to the high speeds of the dissolver disc. This high viscosity is not optimal for powder wetting, because agglomerates are inescapably created and the energy of the machine is wasted to break them up again.

The use of the Conti-TDS is completely different. The shear gradient and also the specific shear energy of the Conti-TDS are a thousand times greater in comparison 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. Allowing for the dispersing step to be executed in the low viscosity range and still reach complete wetting of the product.

The speed of the powder induction also achieves a higher value in the low viscosity range. The performance of the Conti-TDS is not related to the size of the vessel or the filling level. A combination with small as well as with large vessels is absolutely no problem. If the vessel is installed with a Jetstream mixer near the bottom of the vessel, then variable volumes may be produced (Fig. 8).



Fig. 3: ystral Conti-TDS with induction tube for the dust-free incorporation of fine powders

Setup and Function

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

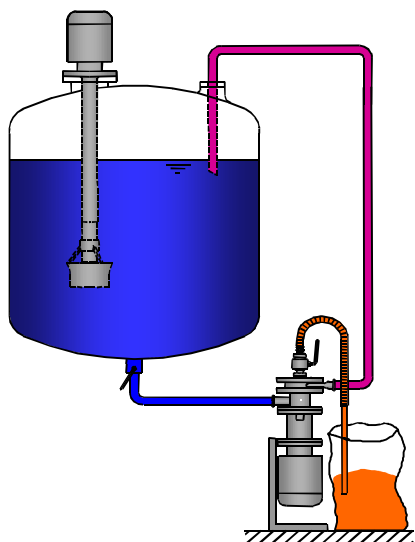


Fig. 5: Installation of an ystral Conti-TDS in a loop with a vessel

Very often, the machine is not only connected to one vessel but is combined with two or more vessels. (Fig. 1) There is even the possibility to integrate the machine into existing systems with practically no modification required (no installation of new flanges, no new approval of the vessel, no moving other machines etc.)

The machine may be operated in either a horizontal or vertical position and the flange connections may easily be adapted to the on site situation. Rarely, a machine on casters for transportation is used in the paint and lacquer industry for use 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, silos, Big-Bags or containers into the liquid, immediately wetting and dispersing the powder. Powder and liquid reach the mixing chamber from completely separated lines 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 cannot be achieved with stirrers or dissolvers.

Another important aspect is the optimized and always constant powder induction, independent from the influence of the operator. This problem is common with dissolvers; one operator carefully pours the powder very slowly and directly into the Vortex of the dissolver, while another pours the bag into the vessel all at once. The dispersing results at the end of the process are completely different and cannot be reversed, regardless of time and dispersing energy. The quality of the end product varies greatly.

Very often we encounter processes where semi-transparent wood lacquers or adhesives must ripen for hours or days before filling. The problem is: if filled immediately, the viscosity develops uncontrolled in the can, since controlled powder incorporation could not be achieved. After ripening, the viscosity has to be re-adjusted before it is ready to be filled. With the use of a Conti-TDS, these problems are eliminated. The viscosities are always constant and will not change in the can. The machine always inducts at an optimum induction rate, creating an end product of constant and homogenous quality.

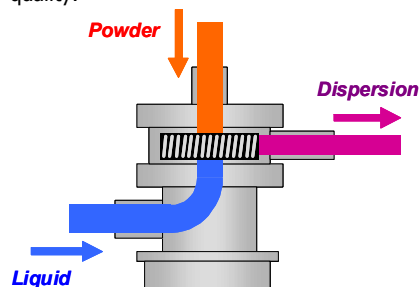


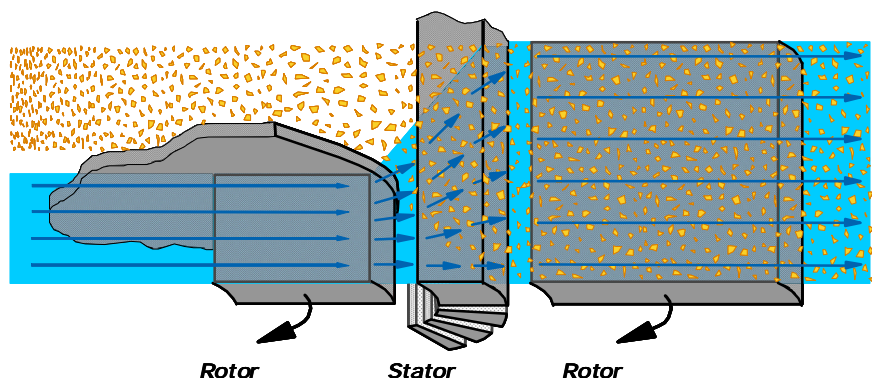
Fig. 7: Powder and liquids only meet in the dispersing zone

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 rheology is reached. In this phase, the machine works as a shear ring dispersing machine with a high pumping rate and many cycles through the High Shear zone.

Not just for Powders

Of course the TDS-principle is not restricted to powder induction. The same machines may be used for the induction and dispersing of liquids as well. This is especially of interest when in the production of wood lacquer, for example, a high viscosity Bentone Gel must be mixed into a low viscosity basic liquid. In vessels equipped with stirrers or dissolvers a homogenous mixture is not possible. When using a Conti-TDS, the high viscosity gel is inducted inline into the basic liquid and reaches the vessel completely homogeneously distributed.

Similar arguments apply to the incorporation of low viscosity additives or binders 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 for a protracted period and are not actually mixed together. The Conti-TDS also provides homogenous incorporation into the circulating liquid.



Entry into the wetting chamber:	Dispersing zone	Exit from the wetting chamber
q Vacuum increases	q Between rotor and stator extremely high-frequency dispersion	q Maximum pressure
q Distance between particles increases	q In this phase maximum vacuum, maximum distance between particles	q Minimum distance between particles
q speed of particles increases	q Specific surface of the liquid is enlarged million times	q Air is compressed
	q Complete wetting and dispersing	q Coagulation of the air bubbles

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

Thixotroping

Besides the induction of pigments or fillers, thixotroping is one of the most important applications for the Conti-TDS. Common practice is to pour the powder onto the surface of the liquid. This leads to the standard problems of dust, adherence and agglomerates. When very dusty and highly dispersed silica was inducted into a liquid in this manner, the powder stayed in the solvent medium and had enough time to bind the solvent vapor. This tremendously reduces the thixotropic effect in the lacquer.

However, since Ystral technology directly inducts the powder into the liquid, the silicon dioxide is not exposed to the solvent vapour. This allowed the lacquer to develop its characteristic viscosity and maintain its thixotropic effect.

Matting

Matting agents are commonly used to adjust the degree of luster of a lacquer. The problems using a dissolver are universally known. Once again, the formation of agglomerates cannot be avoided. These matting agents are very delicate, in that if they are dispersed for a long time, the matting effect is destroyed- but if dispersing is too short, the agglomerates are not broken down. If such agglomerate-laden agents were applied to black leather surfaces or furniture, they would be thoroughly ruined.

The Conti-TDS once again has a solution to this common flaw. Agglomerate-free powder induction and an extremely narrow particle size distribution during dispersing allow all Conti-TDS systems precise, repeatable, and accurate matting.

Dissolving of Resins

The most extreme case of reduction in manufacturing time recorded by a Conti-TDS system occurred when dissolving resin and granulated resin. Wetting and dissolving times of a few minutes per bag are very uncommon.

The conventional dissolving process calls for the powder to be poured onto the surface of the liquid solvent. Partially wetted powder lumps and agglomerates are formed that require a prolonged stirring time to dissolve. The use of a Conti-TDS system results in an immediate and complete wetting of each individual powder particle. In one case, a Conti-TDS completely inducted PMMA into MMA in only 3 minutes; compared to 6-8 hours required for a comparable industrial dissolver to perform the same task.



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

Some Examples

The production of **low viscosity printing ink** and **dispersion paints** are fields where the maximum benefit is seen. In the shortest time possible, large amounts of powders must be inducted into a basic liquid, then dispersed with a uniform quality. Powder induction rates up to 1000 lb/min (450 kg/min) for Calcium carbonate and 800 lb/min (350 kg/min) for Titanium dioxide are typical for the Conti-TDS. Systems currently exist where a Conti-TDS is installed between three 15,000 gallon (50 m³) storage vessels and a single operator produces batches from 10 to 70 tons with proficiency that had never been recorded before.

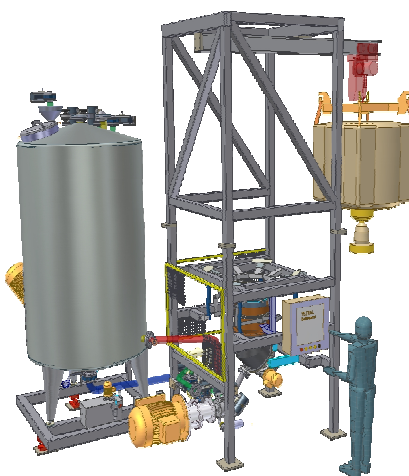


Fig. 9: Ystral Conti-TDS module with process vessel on load cells, powder induction from a Big/Bag station

In the field of **Automotive lacquers**, **Decorative paints**, **Industrial lacquers** and **Wood lacquers** the flexibility and universal usability of the system is the main strength. By simply changing the dispersing tool, a single Conti-TDS can successfully handle a multitude of applications.

For the production of **Coil-Coatings** and **Plastisoles** another effect is important- controlled temperature incorporation. These processes have to be carried out at low temperatures. Unlike industrial dissolvers, a Conti-TDS can perform this feat problem free.

When producing high quality **paper coating paste**, a Conti system can produce the highest concentrations with the lowest amount of dispersing agent. When producing **Parquet lacquers**, over-dispersing of anti-foam is eliminated. Many applications exist in building and construction chemistry, from concrete additives to adhesive material for tiles, where the Conti-TDS offers advantages that can't be matched by conventional mixing principles.

Modern Lacquer Manufacturing

In the book „Lackherstellung“(Production of Lacquers) by Dr. Friedrich Vock (Verlag CC Press AG) he summarises on 500 pages all the experiences of his work at BASF and he proposes that the lacquer industry should rid itself of some bad habits. In the section „Layout- Konzepte für neue Lackfabriken“(Layout concepts for lacquer manufacturing) it becomes strikingly obvious that modern lacquer manufacturers do not use any dissolvers in their processes.

Savings Up to 90%

The ystral Conti-TDS will not replace all dissolvers. In small batch productions with many colour changes the dissolver may have a niche. But in all other applications the Conti-TDS delivers much better results with much higher efficiency. Users save 40% of their initial investments and more than 65 % of the energy and reach a better quality. With less than 25% of the operators you produce 4 times more useable product. The production area is very compact. Depending on the initial situation users of the Conti-TDS reduced their production costs more than 90 %.

Fifteen years ago, the introduction of the Conti-TDS in the production of nylon or polyester fibres for the induction of Titanium Dioxide caused a radical change in production philosophy. Companies that do not use the Conti-TDS principle in this sector are no longer able to compete and many of them have disappeared.