

Dr Hans-Joachim Jacob, Ystral, discusses the latest dispersion technology, which is displacing traditional dissolvers in lacquer and paint production

High efficient dispersion in lacquer and paint production



Figure 1. Conti-TDS with process tank and big-bag station

Dissolvers were invented in the middle of the last century and have survived in lacquer and paint production until today. They have too many disadvantages, limitations and negative effects on the final product.

A new and advanced dispersion technology has started to displace traditional high speed dissolvers in lacquer and paint production. This new technology enables enormous reductions in production costs and process times. Additional effects are a higher degree of dispersion, improved quality and raw material savings. Finally, the energy consumption is reduced to about 30% compared to the old dissolver technology.

Dispersion is the most important process in lacquer and paint production and has the highest influence on the quality of the final product. The better the dispersion, the higher the efficiency of the dispersed ingredients in the final coating.

Traditional high speed dissolvers are simple free rotating discs with bent teeth at their circumference. Due to the wide distance between the rotating dissolver disc and the static wall of the vessel the shear gradient is very low: about 50 reciprocal seconds. To create shear forces with low shear rate a dissolver needs a high viscous liquid or at least a shear thickening or dilatant rheology.

Lacquers and paints have exactly the opposite rheology: they are low viscous, shear thinning and thixotropic. A dissolver cannot create significant shear in a low viscous lacquer or paint. To shear

with a dissolver the viscosity has to be increased significantly. For that reason the dissolver process starts with just a part of the liquids but all the thickeners to maximise the viscosity.

This is a complete paradox since the most important ingredients to be dispersed are very fine powders

(pigments, silica, fillers and extenders). Making a liquid extremely viscous before adding the finest powders is absurd. A high viscous liquid will not get into the smallest capillaries and cannot wet fine particles as fast and completely as a low viscous liquid. The results are stable agglomerates, quality issues, extra-long dispersing and milling times, heat generation and a waste of energy.

In other industries dissolvers have disappeared over recent years. Now the dispersion technology in lacquer and paint production has started to change as well – worldwide.

■ CONTI-TDS TECHNOLOGY

The new technology is based on an in-line dispersing machine, which is able to induct and disperse powders into liquids under high speed and vacuum. The machine is installed outside the process tank and recirculates the liquid with high speed. Additional pumps are not required.

The core of the machine is the dispersing chamber equipped with high shear tools. In the high shear dispersing zone the machine creates a very strong vacuum and inducts powder directly from bags, bag tipping stations, hoppers, drums, containers and big bags into the liquid. No vacuum tank or vacuum pump is required, which pulls uncontrolled amounts of powder or solvent vapour out of the liquid into filters or exhaust systems as in a vacuum dissolver. The induction is dust free because 100% of all the powder goes into the liquid. Dust pollution of the working area is completely avoided.

The powder is inducted into the recirculating liquid loop and arrives in the vessel as a liquid dispersion. No dust appears above the liquid surface and no partially wetted agglomerates are built up above the liquid surface, a common problem with dissolvers. The infamous powder crusts that usually build up inside a dissolver tank above the surface and then fall into the liquid and reduce product quality never occur when using this system.

The mixing and dispersing chamber of the Conti-TDS has three connections: a liquid inlet (blue arrow), a powder inlet (orange) and a product outlet (purple, **Figure 2 and 3**). Liquid and powder are introduced into the machine from opposite sides and leave the chamber in the

Figure 2. Ystral Conti-TDS

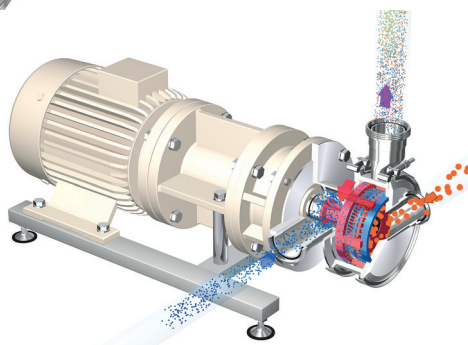
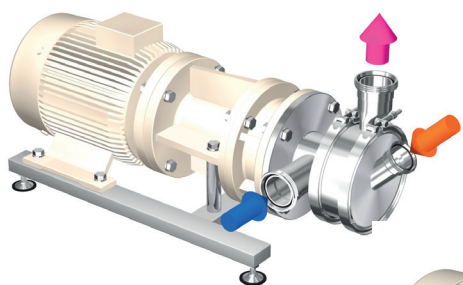


Figure 3. Wetting and dispersing zone

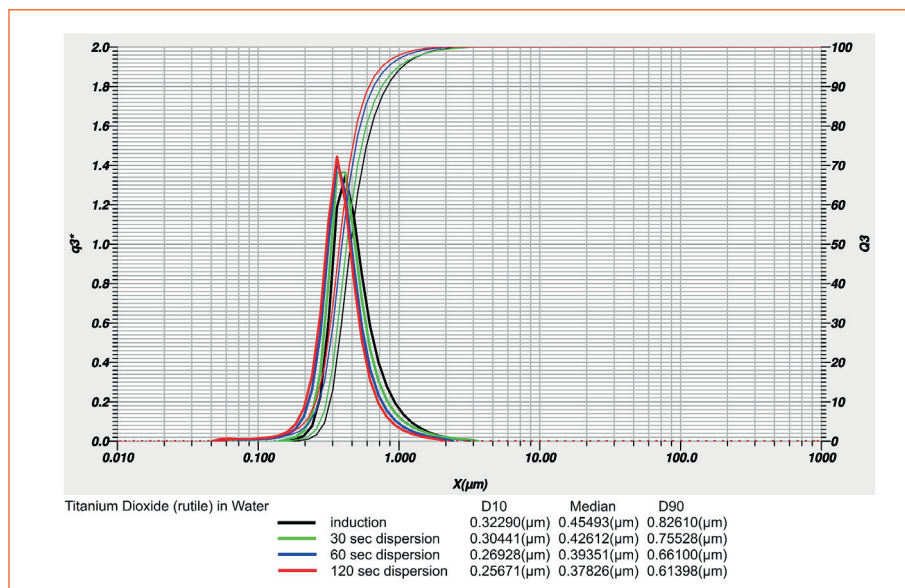


Figure 4. Particle size distribution titanium dioxide after induction, 30, 60 and 120sec dispersion

middle. That means the machine pulls liquid and powder from two different directions, mixes and disperses them and pumps the final dispersion back to the vessel.

Liquid and powder cannot get in contact with each other before they reach the dispersing zone. This way uncontrolled agglomerations are avoided completely. The dispersion of the powder into the liquid is always done under equal, constant and controlled conditions, independent from the speed of the operator. The product quality is absolutely reproducible, even for different batch sizes.

Constant quality has been one of the biggest problems with dissolvers. Particle size, colour strength, viscosity, air content, gloss and film formation are influenced by the way the operator has added the powder. The quality changed from batch to batch, from operator to operator. Slower powder addition caused longer process times, higher temperatures, lower viscosities. Faster addition caused more agglomerates and further post processing time. It means longer shear, higher temperatures and lower viscosity as well. Dissolver batches always had to be quality checked – adjusted – checked and adjusted again. These steps took time and blocked production capacity, while waiting for the QC results.

The Conti-TDS produces absolutely constant qualities. Because of the much faster process and the not required post-adjustment. One Conti-TDS can always replace a number of dissolvers.

The high vacuum inside the dispersing zone has two important functions:

1. To induct the powder directly into the liquid
2. To wet and disperse every single particle.

Every powder contains air – lots of air. The powder particles are touching each other but there is always air between the particles, even inside their capillaries and agglomerates. The amount of air in the powder is always underestimated. A heavy powder, such as titanium dioxide contains at least 75 volume % air. A very light powder, such as fumed silica contains up to 98% air.

Air is compressible. It compresses under pressure but expands under vacuum. Under the high vacuum inside the dispersing zone it expands up to 20 times compared to its normal volume. All the air between the single powder particles expands. The distance between the single powder particles increases in the same range. Particles that have touched each other initially become separated during their passage through the dispersing zone.

To reach this fluidisation and separation no additional air is required, just the existing air under the influence of vacuum. Because of the wide distances between the particles in the dispersing zone, liquid easily gets around them. The vacuum allows the liquid to completely wet each particle from all directions.

The dispersion takes place in the relatively small rotor-stator-rotor zone under maximum vacuum, turbulence and shear. During the shear zone passage the effective liquid surface is increased some million times. This way the available liquid surface during powder wetting is larger than the powder surface. This is the ideal precondition for complete 100% wetting and immediate dispersion. Every single particle is wetted completely before it leaves the shear zone.

The air, which came in together with the powder, is separated from the dispersion due to the centrifugal forces outside the



Figure 5. Skidded unit with one Conti-TDS-5 between two process tanks

dispersing zone. It leaves the product in the process tank as big bubbles.

Figure 4 shows a typical particle size distribution for the induction and dispersion of titanium dioxide. Immediately after induction the result is better than reference samples produced with dissolver and mill. The medium particle size is already 0.46μm and 99.9% of the particles are less than 2μm. No oversized particle is visible. The distribution is very narrow.

After 120sec additional dispersion, the medium particle size goes down to 0.38μm and 100% are less than 2μm and 98% are less than 1μm.

Titanium dioxide is the most important pigment in lacquer, paint and ink production. It covers more than 59% of the global pigment demand. The prices for titanium dioxide have risen since 2009. Companies which are using the Conti-TDS for titanium dioxide are reporting enormous savings. They save time, energy and raw material because of the better dispersion.

■ INSTALLATION AND OPERATION

The machine is installed in a recirculation loop with a process vessel. This way it operates independently from vessel size and filling level. To double the capacity with minimum additional costs one machine is often installed between two vessels (Figure 5). You need just one machine, one control system and one powder addition point to double the production output.

During production in one vessel the last batch from the other vessel is discharged and it filled with the liquid for the next batch already. In the average 50sec after finishing the powder induction the required particle size is reached and the product is ready to transfer.

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