



Dispersing with a lighter touch

Benefits of dust-free incorporation of low density filler materials

Contact:

Dominik Seeger
ystral gmbh
maschinenbau +
processtechnik
T +49 7634 5603-767
Dominik.Seeger@
ystral.de

Oliver Dudak
Dominik Seeger

Using a powder wetting machine allows light, dusty fillers to be incorporated quickly and reproducibly into any type of coating system without agglomeration, dust or losses. The lower density of the final product reduces VOC emissions and overall costs per litre. Improvements in technical properties may also be obtained.

Light filler materials are always used when it is necessary to reduce the weight of coatings. In addition, some light fillers can facilitate application, shorten drying times, vary the haptic properties of coated surfaces and cause some matting effects.

On the other hand, these light fillers can be very dusty and difficult to wet and disperse. Their extremely low specific weight and high specific surface – which in extreme cases may exceed 100,000 m²/kg – means that the use of conventional dispersing methods such as dissolv-

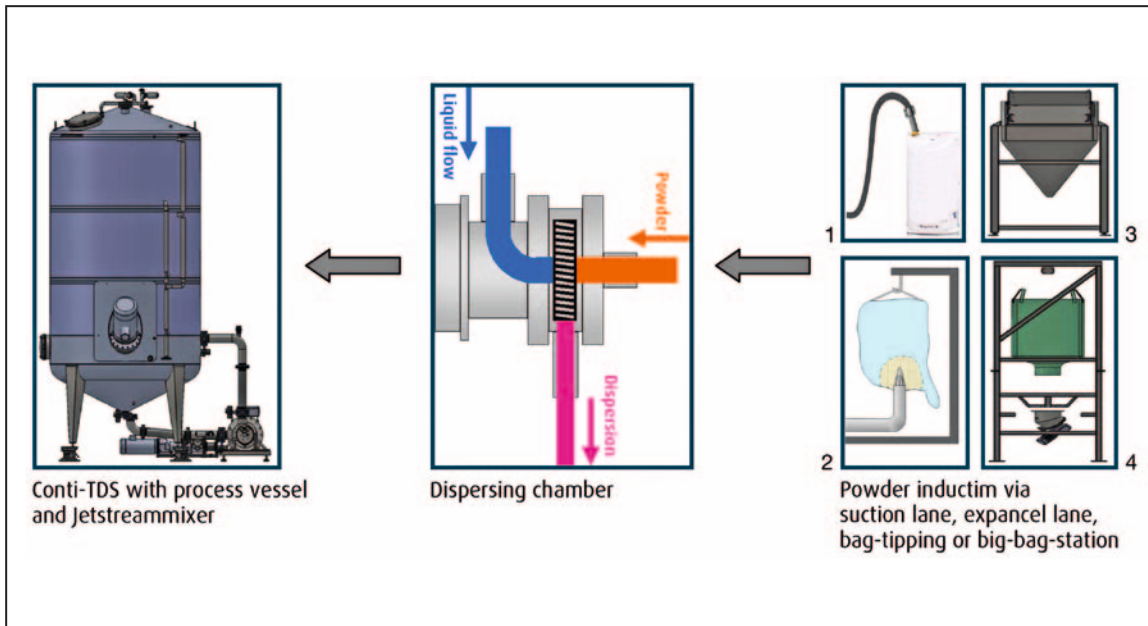


Figure 1: Principle of the function of the "Conti-TDS" powder induction, wetting and dispersing machine

ers or stirrers very often results in an ordeal or the end result becomes a game of pure chance.

A special powder wetting and dispersing machine may eliminate this problem by dust-free and loss-free handling of these light filler materials. The combination of a powder wetting machine and light filler materials provides a very high potential for rationalisation as well as the possibility of producing systems with improved properties.

Results at a glance

- » The combination of a powder wetting machine and light fillers offers potential for rationalisation in production as well as for creating coating systems with improved technical properties.
- » Regardless of batch size and viscosity, agglomerate-free and reproducible products may be produced in a very short time. Their reduced density results in reduced VOC emissions due to the increase in volume.
- » Powders, granulates and liquids may be inducted and dispersed quickly, without dust or losses. Machines are available in a wide range of sizes for research and production.
- » The risk of explosion and other health problems is reduced by the dust-free induction and dispersing of the powders.
- » Machines can be integrated into existing processing systems with minimal effort. Alternatively, individually designed machines and complete designed processing systems can be provided.

Why adding light fillers is problematic

If fine powders are poured onto a liquid that has only a few square metres of surface area, then – apart from contamination by the dust – there is an enormous discrepancy between the surface of the liquid and the surface of the powder. The powder floats on top of the surface of the liquid and can only be incorporated into the liquid by the use of high turbulence (to form a vortex) resulting in air incorporation. The quality of the product suffers and may be different from batch to batch.

Besides the issues with dust, very often insufficient raw material may be used to achieve the required result, or much more raw material has to be used to achieve the required effect than normally would be necessary with complete wetting of the powder.

A fraction of the powder 'disappears' as dust in the environment, exhaust and filter systems. Powders that are sticky or fast-swelling build up crusts on the walls of the vessel and on other devices installed in the same vessel (e.g. the mixing shaft of the stirring device). Agglomerates build up and can be destroyed only by applying increased energy and additional time.

How to disperse without dust or losses

The "Conti-TDS" powder wetting and dispersing machine is completely different to systems currently found on the market. With this machine, light filler materials may be inducted free of dust and losses from a bag, bulk bag or silo directly into the liquid and become wetted and dispersed immediately.

The machine works according to the rotor-stator principle. It is not placed inside but outside the main vessel and connected to it by a piping system. The liquid in the tank is circulated in a loop, as it would be with a pump. Because of the special geometry of the rotor, the liquid builds up a vacuum inside the dispersing chamber. This

vacuum is used to induct powder into the liquid stream directly from any container without dust or losses (*Figure 1*). Inside the dispersing chamber, high shear energy is applied to the liquid stream and the surface of the liquid is strongly expanded to accept the powder that is inducted. In the same way, the powder is transported via vacuum and reaches the dispersing chamber expanded as well, and the distance between the particles is increased. Both streams (liquid and powder) reach the dispersing chamber in separate streams then come together into the dispersing chamber and are dispersed with a defined shear gradient. This results in an ideal prerequisite for the wetting of the individual particles. This procedure allows the fine distribution of the components at the moment of wetting and in many cases an improvement of the properties of the product can be achieved compared to conventional powder addition systems.

Even high viscosity products can be handled

Besides lacquers and paint, a number of low to high viscosity products can be handled with this machine. In this case the product is transported by the powder wetting and dispersing machine itself and this provides powder transport or extraction without the use of any additional equipment.

Only for extremely high viscosity products – such as sealing and insulation materials, adhesives, resins, modelling or filling compounds – does an additional pump have to be installed.

Depending on the recipe, several different powders may be dispersed one after the other through a common inlet or multiple inlets for various containers and/or bags. When the powder induction is finalised and with the powder valve closed, a high pumping rate can be used to apply additional dispersing to the product until

the particle size distribution has been achieved or until the dissolving process is finished.

Powders that are sensitive to shear energy or that might increase the viscosity (thixotropic agent, matting agent, microspheres) are mainly inducted at the end of a process.

Explosion risks are eliminated

Working at an open vessel with a dissolver, mixer or a stirrer involves a certain risk, especially when manually adding the powders. Vapours of the solvents on top of the liquid together with the oxygen out of the powdery material build up an explosive mixture. If the powders are prone to static build-up, during pouring into the vessel the powder may create an ignition source due to static discharge.

In contrast to this, the powder wetting and dispersing machine provides a great advantage. The powder is inducted directly into the liquid stream. The powder immediately becomes wetted in the dispersing chamber and then transferred into the vessel below the surface of the liquid. The risk of an explosion is thus eliminated.

Applications and benefits of hollow microspheres

“Expancel” microspheres that may be expanded at a raised temperature to flexible hollow spheres with a very low density have become established as a useful filler agent. They serve as a physical expanding agent and are applied in any situation where low density and high compressibility are required. They offer additional advantages such as matting properties, and the product is available in already expanded form.

This provides a range of applications for these microspheres. When handling these extremely light powders, the advantages of the machine described above for the dust and loss-free dispersing apply in full. With a special induction device the powder is inducted directly from a bag (see *Figure 2*) or a silo into the liquid (e.g. into a fully formulated lacquer system) and immediately dispersed without any agglomerates and with a finely distributed narrow particle size spectrum.



Figure 2: Induction of the expandable microspheres from a bag

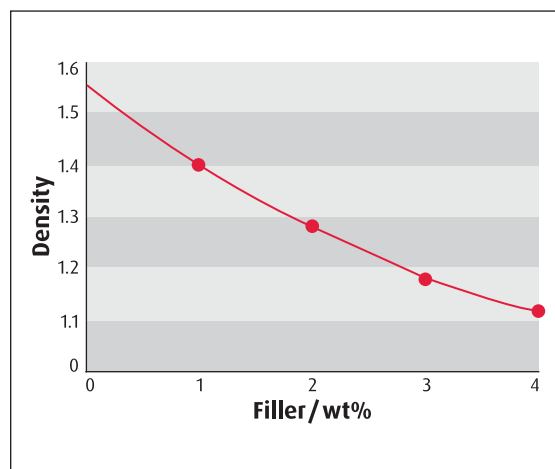


Figure 3: Density reduction with microspheres in standard paint formulation (principle is valid for all standard formulations)

Even further, during the dispersing and wetting procedure the trapped micro air bubbles are separated from the surface of the solid particles, resulting in a colloidal wetting of the particles in the dispersing chamber. The separated micro air bubbles coagulate and thus can evaporate even from products that are difficult to de-aerate. This effect strongly contributes to the de-aeration of the product.

Unlike the dispersing of powders with a dissolver, the powder incorporation is independent of the operator. Because of this defined process, the matting effect caused by the microspheres can be set and repeated from batch to batch. The quality of the product is constant and the properties of the microspheres are used very effectively.

Financial and regulatory benefits of density reduction

Raw material costs have become a central issue in the field of paints and lacquer. Microspheres offer one possible way to reduce costs without sacrificing quality. Even small amounts of expanded microspheres reduce the density of a solvent-based or waterborne lacquer system significantly.

Compared to conventional lightweight fillers, these microspheres with density of 0.024 g/cm^3 – 0.07 g/cm^3 are usually much lower. An increase in volume of 20–30 % is not uncommon. This great increase in volume helps to ensure that solvent-based paint and lacquer systems can conform to VOC limit regulations.

If roughly 2 pbw of microspheres are added into a normal standard based interior dispersion paint with density of 1.55 g/cm^3 , it is possible to reduce the density to 1.22 g/cm^3 (Figure 3). The net weight of a 12 l bucket of paint then falls from 18 kg to 14 kg. This can give a significant benefit in transport costs, but also an increase in productivity of the area to be painted in l/m^2 .

Microspheres can help to reduce binder requirements in the recipe, because their volumetric oil absorption is very low. In this case an increase in PVC (Pigment Volume Concentration) can be achieved without affecting the quality.

As the microspheres also give very good matting properties in the recipe, it is also possible to reduce the standard matting agent (e.g. silicon dioxide). Raw material costs per litre for interior paint can be reduced by 3–5 % and for exterior paint by up to 7 % (Figure 4).

Helping to achieve VOC compliance

VOC (volatile organic compounds) are one source of the increase in world levels of ozone. Therefore all members of the European Union made a commitment in the 1999 VOC directive that they would reduce VOC emissions dramatically.

The last VOC directive (2004/42/EC) has tightened these limits again. Today a lot of solvent-based lacquer systems on the market make use of microspheres to reduce VOCs. This can be achieved because the legislation sets limits in terms of grams per litre – i.e., mass per unit volume.

Because of the low density of the microspheres, it is possible by adding 1–2 pbw to increase the volume by

roughly 20 – 30 %. But microspheres can do more than just reduce the density. When using microspheres in standard formulations, the vapour permeability can be optimised (Figure 5). The hydrophobic properties of the microspheres help to ensure that the water absorption is reduced and thus greatly delay the degradation of the paint film (Figure 6).

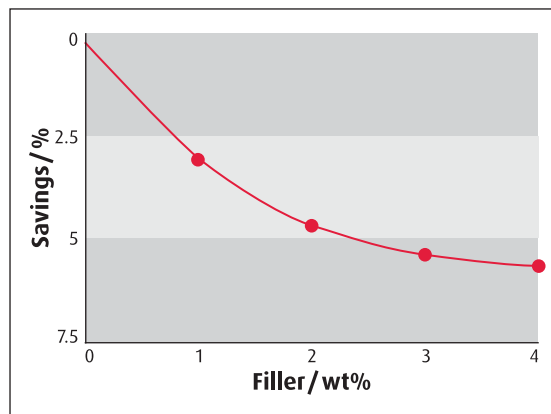


Figure 4: Cost reduction of raw material achieved by volume increase (principle is valid for all standard formulations)

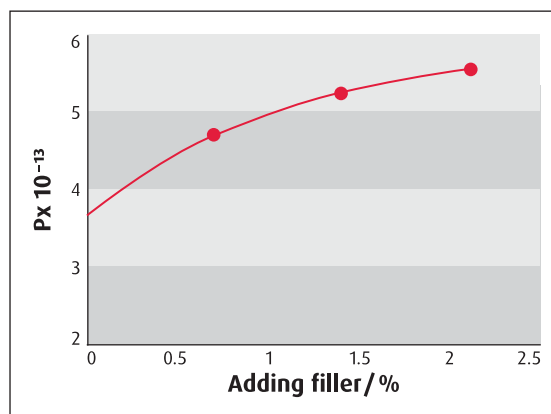


Figure 5: Water permeability can be improved when using microspheres and the right PVC

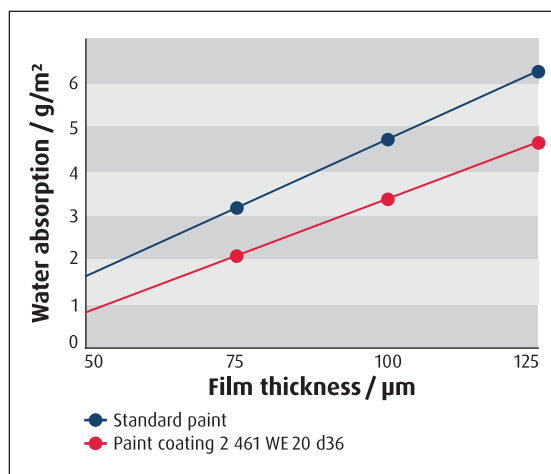


Figure 6: Water absorption of an exterior paint containing 2 % "Expancel" as a function of film thickness, compared with a standard paint

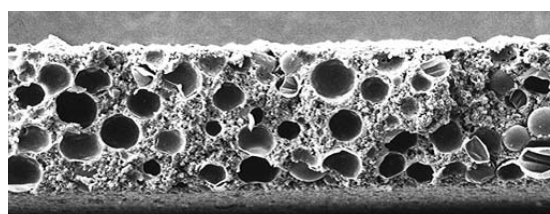


Figure 7: Cross section of a light weight paint containing appr. 4 % microspheres (220x)