REDUCTION OF RAW MATERIAL CONSUMPTION DUE TO MORE EFFICIENT DISPERSING

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Whether in the Chemical, Pharmaceutical, Cosmetics or Food Industry, the costs for raw materials is permanently increasing all over the world and in all fields.

Manufacturing companies search for new processes and new possibilities to remain competitive and distinguish themselves from their competitors. Occasionally, they are successful by, for example, substituting expensive raw materials with cheaper ones.

Another possibility for savings is to reduce the raw materials consumed in production but, if quality is to be maintained, it is often necessary for processing steps to be modified or improved.

A large variety of products, such as lacquer and paint, glue and binders, baby food and beverages, detergents and shampoos, as well as drugs and creams are being produced based on a number of dispersions. A prevalent type of dispersion is the suspension, consisting of heterogeneous liquids with finely dispersed particles in it. The two components do not dissolve or combine chemically and will eventually sediment if left unattended.

For the production of suspensions, existing agglomerates and aggregates have to be crushed and reduced in size, distributed in a liquid, wetted and stabilised. A homogeneous distribution of these particles into all elements of the liquid volume is the target.

Dispersing (Latin - dispergere – to dissipate, to distribute) is mandatory for the quality of the suspension. In case powders (here the dispersed phase) are dispersed into a basic liquid (continuous phase), the complete and homogeneous wetting of the solids is the most important factor for the quality of the suspension.

A complete - respectively a colloidal - wetting of the raw materials very often provides the possibility to reduce the quantity of materials used in the process.

There are different technical solutions to disperse or to produce a suspension:

1. Batch Disperser: Mixer and Stirrer, Dissolver and Rotor-Stator-Systems

Mixer and Stirrer consisting of a drive, a shaft with respective seals and a mixing or stirring element. The stirring or mixing element may be executed as a simple propeller or equipped with a stator inside of which the propeller rotates (Jetstream mixer). These systems only distribute the existing particles in the liquid; a milling of the agglomerates and aggregates is hardly affected, as almost no shear energy exists. These systems may be applied for dispersing of easy to wet, non-sticky and non-agglomerating raw materials and powders or to keep a suspension homogeneous.

The set-up of a **Dissolver** is equal to the principal of the mixer and stirrer, but uses a toothed mixing disc instead for dispersing. This disc produces stronger impact effects. The processing aim in this case is to crush agglomerates and aggregates to achieve a finer suspension. The shear effect however is restricted and the shear gradient strongly depends on the viscosity of the liquid. The moment the liquid starts to rotate, the impact and shear effect is dramatically reduced.

The function of the **Rotor-Stator-System** by construction depends on the narrow gap between rotor and stator. In general, both parts (the rotating and the static part) are equipped with toothed geometries. Due to the given geometries, the shear gradient is maintained constant and almost independent from the viscosity of the liquid.

In practice, the production of a suspension is sometimes quite difficult. All types of machines mentioned above, are installed directly into a vessel or lowered into the vessel by the means of a lift. Normally the basic liquid is filled into the vessel and the raw materials are added simply be pouring them onto the surface of the liquid. Powders have a rather large specific surface, in extreme cases (e.g. for fine pigments, Nano powders, or Silica Acids) it calculates to about 300.000 m²/kg of powder. In most production scenarios, several kgs of these powders are added directly onto the surface of the liquid. The liquid only has an area of a few square meters so it soon becomes obvious that there is an adverse relation between the surface of powder and the surface of liquid. The result is that individual particles will not be wetted, only the agglomerates and aggregates become roughly wetted.

The powder floats on top of the surface and an intensive mixing effect has to be applied to wet all the particles. When a dissolver is used, a Vortex builds up in the liquid and besides the powder air is brought into the product as well.

Very often, different raw materials have to be dispersed into a liquid, creating a high work load for the handling of the different packing systems such as bags, barrels and containers that have to be moved and emptied.

Many of these powders are sticky and most tend to form dust. Layers of crusts and

agglomerates build up at the wall of the vessel and other equipment installed inside the vessel. These agglomerates in a later process are very difficult to destroy and require a lot of energy and time. The quality of the product suffers by a coarse defined dispersion and with the consequence of different quality from batch to batch. Because of the inefficient use of the raw materials much more raw materials than normally required to be added in order to achieve the desired effect. A part of the raw materials "disappear" as dust in the environment, exhaust systems and dust filter systems. In total, this results in high production and general cost.

2. Powder Wetting Machines according to the Rotor-Stator-Principle:

Different to the installations described above, the Conti-TDS powder wetting machine is installed outside and beside the vessel and connected via a simple piping system.

The basic liquid is circulated in a loop which creates a vacuum inside the dispersing chamber of the machine. This vacuum is used to induct powders dust- and loss-free, directly from bags, containers, BigBags, silos or even from a silo truck. The powders are transported in a dense-phase without the need for false air, and are directly dispersed into the liquid under vacuum. Due to the vacuum, the entrained air is expanded, opening up the surface of the powder, ready for wetting. Simultaneously the surface of the liquid in the dispersing zone is also extremely expanded. Only at this point, the powder comes in contact with the liquid (see respective pictures) and become wetted in a most efficient way. In this area, the shear gradient is about 1000 times higher compared to a dissolver. Due to the blast waves created during the pumping action the colloid wetting is completed. The micro air bubbles that stick onto the surface of the particles are separated, coagulated and will collect on the surface of the liquid as a layer of coarse foam, even in products considered difficult to ventilate.

The suspension produced in the dispersing chamber returns to the vessel as a "ready made" product. Depending on the amount of powder and the required solids loading, the induction of the powder may interrupted by closing the powder inlet. Additional dispersing, respectively homogenising in the recirculation loop in order to achieve a specific particle size distribution or homogeneity, is also possible. This procedure serves to de-aerate the product at the same time. Independent from the viscosity, type of vessel and batch size, stable suspensions may be produced in a fraction of the time required by conventional mixing and dispersing systems.

As an example: 40 tons of a Titanium Dioxide Slurry in complete in less than 2 hours.

The large potential of rationalisation by the Conti-TDS technology is given by the combination of 5 processing steps in one machine (emptying containers, powder transport, powder induction, powder wetting and dispersing). Time and energy are saved.

Because of the complete colloidal wetting of the raw materials the required amount of raw material can be reduced.

Eventual separate:

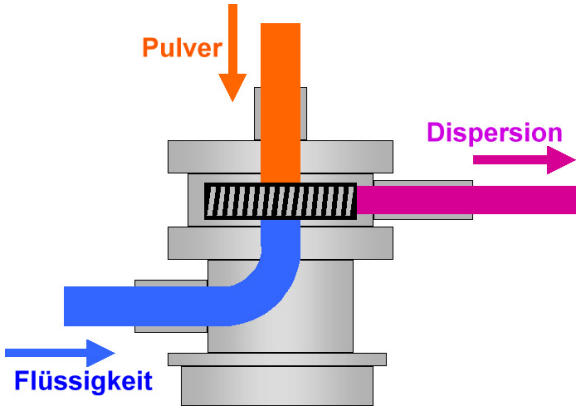
In most cases the aim of a dispersing process is the production of a suspension (liquid/solid) or an emulsion (liquid/liquid). Occasionally it is the dispersing of liquid/gas to build up foam.

When dispersing is applied (Latin - dispergere - to dissipate, distribute) existing agglomerates and aggregates are being reduced in size down to the primary particle size, distributed in a medium, wetted and stabilised. A statically homogenous distribution of the particles achieved to all elements of the volume of the medium is the aim of the process. (Source E DIN 55943)

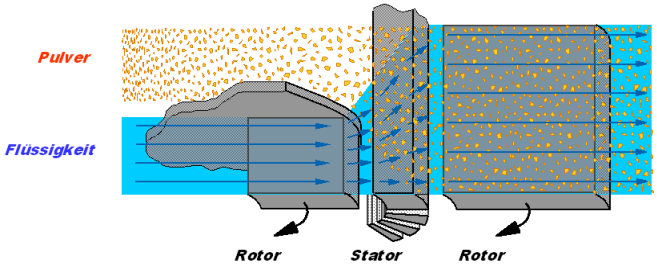
Different dispersions:

Liquid/gas	Foam	Sample foam of soap	seldom
Liquid/solid	Suspension	Sample paint	often
Liquid/liquid	Emulsion	Sample margarine	often

Conti-TDS powder wetting and dispersing system



Functional principle Conti-TDS powder wetting



Colloidal wetting in the Conti-TDS dispersing chamber

Dissolver disc

Rotor-Stator-Systems

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