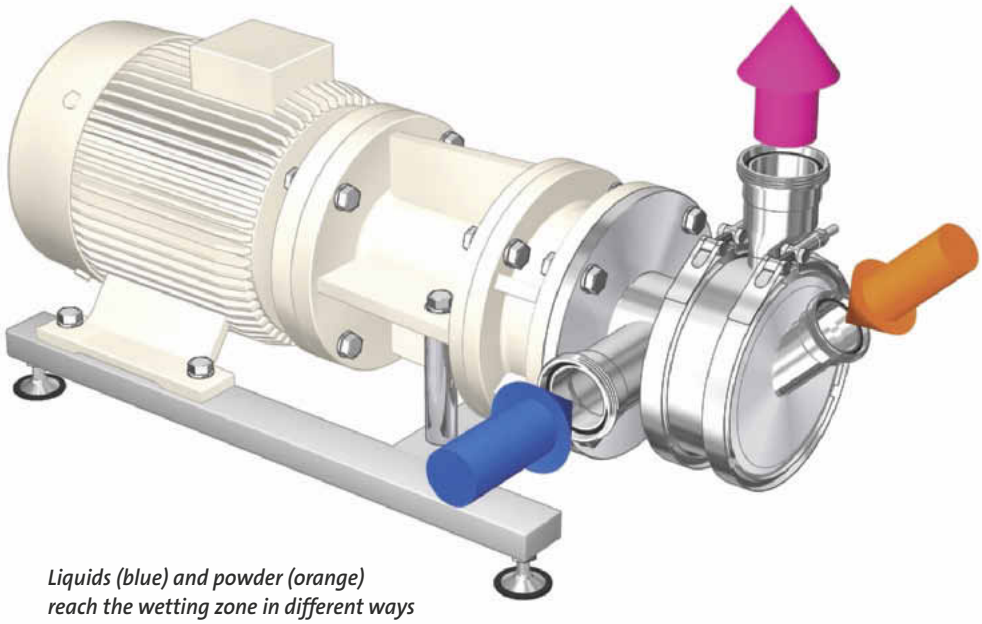
*Mixing and dispersing of powders into liquids*

# No chance for agglomerates

Mixing powders into liquids is a complex task. The quality of the final product is highly influenced by perfect or poor wetting and dispersing of the powders. Particularly good results are achieved with the Ystral Conti-TDS, which inducts the powder dust-free, disperses it under vacuum and distributes it homogeneously throughout the carrier liquid without any agglomerates remaining.



*Liquids (blue) and powder (orange) reach the wetting zone in different ways*

When yoghurts taste better, lacquers provide better coverage, glues offer stronger adhesion and sun creams give better protection, then all these products have one thing in common: the content of powdery material was very effectively dispersed, ensuring that it develops its full effect in the final product. This is not easy to achieve because powdery particles have an enormous specific surface, which can quickly add up to some 100,000 m² per kilogram or more of powder. If powder is mixed into liquids by conventional means using stirrers, dissolvers, injectors or in-line blenders, the particles come into contact with the liquid as a dense, bulk product. In this case, the liquid can only wet a large number of particles all at once – and agglomerates are inevitable. The main problem with these methods is that when the powder is mixed in, there is a mismatch between the large surface area of the powder phase and the very small surface area of the liquid phase. The enclosed agglomerates lead to another obstacle: a lot of air is trapped between the powder particles. When agglomerates are enclosed by a liquid, the locked-in air cannot escape and hinders the liquid's further penetration. This results in partially wetted agglomerates that have to be destroyed by long stirring or additional dispersing – something which is only rarely desirable. In yoghurts and desserts, for example, the texture will be destroyed and additional proteins or stabilisers will be necessary. In shampoos and gels the viscosity is reduced and more thickener is needed. In dispersions and lacquers the additional stirring process stresses the binder and impacts on the quality while with polymer or active ingredients the product is heated up excessively and has to be cooled down again. Furthermore, additional dispersing requires time, energy and capacity in the vessel. Another deficit is that if the in-line dispersing is carried out immediately after the powder has been added using either the same or another machine, then the air in the product is detrimental to the dispersion of the agglomerates. Instead, the air is finely dispersed and stabilised in the product.

The Ystral Conti-TDS employs a completely dif-

*Powder induction into a liquid directly from a big bag with the Conti-TDS*

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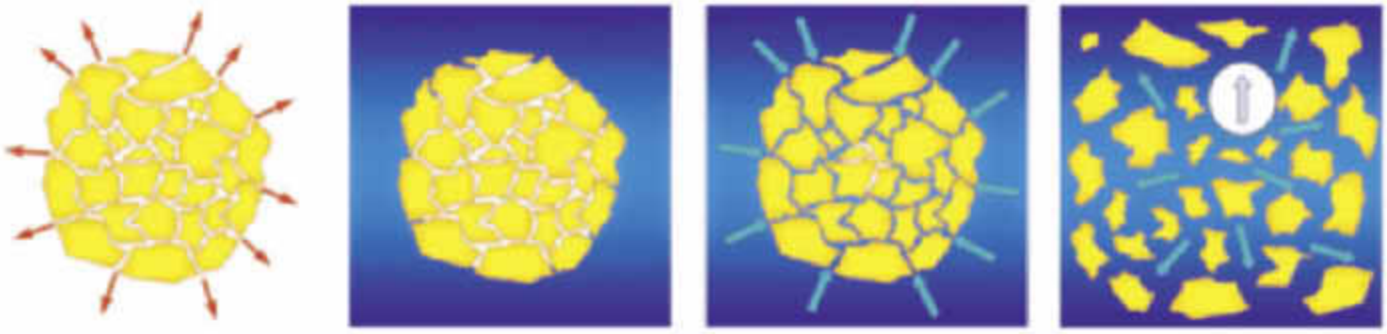

*Air expands and escapes under vacuum*

*Wetting under maximum vacuum*

*Liquid is sucked in under pressure like an implosion*

*De-agglomeration and separation of the air*

*Solid agglomerates are destroyed by the vacuum and the dispersing effect*

ferent principle to disperse powders into liquids. Due to the optimised and patented geometry of the tools, the powder and liquid are immediately mixed and dispersed with maximum turbulence at the very first contact. The surface of the liquid inside the mixing head is enormously enlarged and far exceeds the surface of the powder to be wetted. This is mandatory for complete wetting.

The shear gradient in this zone is about a thousand times higher than with conventional mixing systems. The complete mixing energy is applied in a tiny space. The resulting very high energy density is directly converted to wetting energy. Even particularly problematic products can be dispersed without any difficulty.

The Conti-TDS builds up a strong vacuum inside the wetting and dispersing zone and inducts powders directly from sacks, hoppers, big bags or silos into liquids. The powder is added without creating any dust. No dust is produced

during induction from the powder container and no dust escapes from the surface of the liquid. In traditional processes the latter can be a cause of baking, agglomerates and powder crusts on the wall of the vessel, the cover and the mixing shaft that very often crumble away, fall into the mixture and thus reduces the quality of the final product.

Due to the vacuum, the air between the individual particles is expanded on its way to the dispersing zone, its volume increasing several times over in the process. The distances between the individual particles are greatly enlarged and the particles are separated, allowing the liquid to penetrate easily between the powder particles and wet them from all sides. This effect only occurs in a flowing powder that is inducted under vacuum. For bulk powder in a vacuum processing vessel or in a metering valve, where powder is transferred into a chamber under vacuum, the conditions are identical but the volume of the bulk powder does not change. Air is withdrawn but the distance between the particles remains the same.


*Mobile processing system for product development with a powder hopper, induction hose and tube*

### Agglomerates in the powder itself

Powders very often contain dry agglomerates as well; these are so solid that they do not break up when the air expands inside them. However, even these agglomerates are no problem for the Conti-TDS. Since they do not break up, only the air escapes. It is in the wetting zone that the vacuum is at its peak, in other words this is where the air is expanded to its maximum volume. This is also the moment when the agglomerate is completely wetted from the outside. After passing through the wetting and dispersing zone, the product is transferred back to the vessel under pressure. The air inside the agglomerate contracts under pressure similar to an implosion and sucks in liquid. The combination of these conditions and the simultaneous dispersing effect causes the agglomerates to break up and the particles are completely wetted. In the outer area of the rotor the dispersion is subjected to strong centrifugal forces. Due to the lower density, the air separates from the dispersion and coagulates to form large air bubbles that can easily escape from the inside of the process vessel.

The Conti-TDS is available in several sizes with powder induction rates from 0.5 to 500 kg/min. The machine is connected to one or more processing vessels by a piping system and automatically pumps the product in a loop. The special Atex version which can be supplied for hazardous areas permits even dusty, potentially explosive powders (flour, starch, organic thickeners, etc.) to be handled safely and legally in safe areas. Experience has shown that the costs for manufacturing paints and lacquers can be reduced by more than 90 %. The dissolving time for resins is only about one fiftieth. In the production of cleaning agents and toothpaste the mixing process is completed while the vessel is still being filled. The separate processing steps such as melting, emulsifying, high pressure homogenising or saponification which are normally required in the production of lubricants, spray emulsions and pharmaceutical gels are eliminated altogether.

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*AT A GLANCE*

## Differences compared to conventional methods

- The powder is completely wetted with maximum turbulence at the first contact with the liquid
- The surface of the liquid is enormously enlarged
- Wetting is carried out under vacuum – particles of the powders are separated and solid powder agglomerates de-stroyed
- The centrifugal effect separates the air from the dispersion
- Dispersion takes place during wetting and not after it – as a result of this, the separated air does not remain in the dispersion and can easily escape
- Powders have very different properties: they can attract liquids or repel them and they can swell, stick, thicken, be abrasive or sensitive to shear energy or even react with the liquid. The Conti-TDS can be easily adapted to specific conditions and if necessary equipped with several powder inlets to meet these challenges
- To avoid any potential build-up of agglomerates, the powder and liquid are guided directly into the wetting and dispersing zone on completely different paths inside the Conti-TDS