

TECHNOLOGY PROCESS ENGINEERING & OPTIMISATION



Perfect atomisation without bearding



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Anti-bearding air cap ensures that droplets are well distributed, and that coating and moistening are homogenous

The type of nozzle used for coating and moistening determines the process result. Normally, flat jet two-substance nozzles are used for this process. A new, robust air cap withstands even the most adverse operating conditions and thus ensures a clean spraying process with the ideal drop size.

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Increasing automation makes it essential for coating and moistening processes to be increasingly trouble-free and economical. These requirements affect a number of various manufacturing processes in the industrial sector. This is why different liquids (such as water, emulsions, solutions, varnish, amylum, additives etc.) are applied in order to improve product quality in, for instance, the manufacture of paper, textiles, flat glass, fleece or in web textile processing.

The atomisation system has a similar task in these manufacturing processes. The product to be sprayed is usually put through a conveyor system at high speeds. The width of the conveyor belt is generally between 1000 and 5000 mm. The flat jet nozzle has won recognition in the even application of liquid over the entire width of the belt, because of its more homogenous distribution compared to other forms of atomisation. The term "coating" is understood as the covering of the surface.

The drop size of the coating liquid must range between being coarse enough, so that the drops are not spray dried before reaching the product, and fine enough to coat, blend and dry the surface before the next drop reaches this zone. During humidification the drop collective must be applied homogeneously and finely enough to avoid over-moistened clusters over the entire width of the belt. In the past, too little importance was placed on the precise design of the nozzles in many production processes. However, purely nozzle-related parameters like the necessary flow rate and the fineness of the atomisation are not enough these days to determine the nozzle parameters.

The requirements for production machines are usually clearly defined: the final result must be able to be reproduced and the components must be able to be immaculately cleaned. In order to achieve an even spraying pattern at each spray nozzle, the fluid is partially supplied via individual hoses.

However, this has an impact on the set-up time, as the complex spray arms are difficult to clean, hard to inspect due to the bent welded and screwed constructions and require time-consuming adjustment processes, which also makes them susceptible to faults. In the industrial sector, flat jet two-substance nozzles are used to achieve an even application. If possible, the production process should not be interrupted for economical reasons.

A new nozzle with an anti-bearding cap meets the requirement for operating security and improved handling. When coating for the purposes of moistening, for example, the liquid is finely atomised, formed into a jet and channelled towards the product. The small drops ideally meet on the surface and blend with the neighbouring drops, the liquid evaporates and a closed film is formed with the required properties.

Wanted: a jet made up of even drops

The user has very specific requirements for the atomisation nozzles: They must have a hygienic design (i.e. contain a low number of dead spaces and threads, and have clean passages and surfaces), as well as pneumatic notching up/targeting of the liquid with a cleaning needle. Debris build-up or bearding in the front area of the nozzle may have an impact on the spray or may even block the nozzle.

The spray with small, evenly reproducible drop size should be able to be set flexibly to a particular drop size in order to avoid spray drying of the drops before they reach the spraying surface and, on the other hand, to prevent excess moisture on the surface due to atomisation being too coarse. Further features include the option of altering the width and height of the spray jet formation (ellipse) and even distribution of liquid across the spray width. Based on these requirements, a new nozzle has been developed with an anti-bearding air cap, which provides high operating security.

It is often not even possible to intervene during the process, with the result that a poor spraying pattern or a blockage of the nozzle due to sticking frequently leads to the loss of the entire batch. It is true that there are devices used for the mechanical cleaning of the front of the nozzle, but this entails more machines, increased amounts of supply media and a more cumbersome construction.

Robust air cap holds its own

It is not just the type of nozzle and the nozzle parameters which influence the process. A number of other parameters, such as the system design, environmental influences like temperature, humidity and dust, and finally the substance-specific properties of the liquid, also influence the end result.

A robust air cap, which can withstand even the most adverse environmental conditions and thus guarantee that there will still be a clean spraying process, is therefore all the more important. As a result, tests were carried out both in the visualised flow pattern and on the dual PDA laser to find the optimum design for air caps which will be resistant to bearding and product build-up. Atomisation technology is a discipline of mechanical process engineering and deals with the fragmentation of liquids or dispersions into fine drops. The aim of this often is to greatly increase the free surface to benefit substance or heat exchange processes.

An ideal spray consists only of drops with an equally large diameter. This is known as a monodisperse spray. A drop collective with equally sized individual drops can be easily calculated with regard to the entire surface. Drop collectives with a broader drop size distribution, however, can only be calculated approximately at best. However, a pure monodisperse spray is very rarely achieved, but sprays with a narrow drop size distribution are feasible. A nozzle spray should fulfil the following criteria:

- small, even and reproducible drop size;
- flexible setting of the drop size;
- spray jet forming;
- spray impulse adjusted to the system design;
- even distribution of liquid across the spray width;
- change in the flow rate with consistent atomisation quality.

However, as the size of the drop is only part of the assessment of a nozzle, it is crucial that other relevant criteria are also included in the evaluation. Schlick uses a dynamic drop measuring device (dual PDA= Phase-Doppler Anemometry) for this purpose.

The evaluation of a spray includes drop size, drop speed and volume current density. The scatter cone of the nozzle, program-controlled via a traversing device, is now moved as a result of this measuring volume into two axes. The single drop now changes the direction of the laser beam. This change is registered by the incident lens and evaluated in the processor.



Standard air cap (above) and anti-bearding air cap (below)

Spray arm rules out nozzle spacing errors

This new air cap technology is available both for the newly designed flat jet two-substance nozzle and for the newly completed professional coating arm (PCA). Nozzles from series S35, S45 and ProABC are considerably lighter and have a finer and tighter drop distribution compared to conventional nozzles. They are made up of seven individual parts and three O rings. No special tools are needed for assembly and dismantling. The connection threads are parallel threads, which make cleaning easier. Air consumption is reduced by approximately 20% in comparison to conventional nozzle models. This reduces the operating costs and also results in lower speeds and a gentle impulse.

In the case of the spray arm PCA manifold system for existing and new systems, the modular construction means that it is possible to vary the number of nozzles. The fixation means that the operator cannot make spacing errors. The fact that hose couplings and fittings have been left out means that there are no longer dirty corners. Flat jet caps and cleaning needles are integrated into the nozzles. The system includes a control air, atomising air and liquid connection. The connection block can be adjusted to all fastening systems. As a result of case-dependent design, taking the decisive technical and economic influencing variables into account, the injection lances are individually adapted to the existing features.

Düsen-Schlick will help define the important parameters and develop a customised design.



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