by Alfons Calders

A spray nozzle is more than a bolt with a hole

The most well-known applications of spraying are coating (paint spray nozzles) and agriculture (a/o spraying insecticides). There are a whole range of other applications where spraying technology can be used in an industrial environment. Think of wetting objects or whole rooms ("humidification"), the cooling of (waste) gases, the cooling of cutting tools ... There are also lots of applications in the food industry, such as the cleaning of installations (a/o CIP, cleaning in place), of course, in addition to process applications (think of greasing moulds, decorating cakes and chocolates...).

Today, spraying processes are considered in a more critical way on three different levels: quality (i.e. constant drop size and spray pattern), consumption and maintenance. Indirectly, the consequence of this is that customers no longer ask their nozzle suppliers to 'give us a suitable nozzle for our spray application'. Nowadays, they want a total solution. Customers demand a repeatable spraying process, flexibility in monitoring and registering the spraying data. And here, in addition to the 'experience' required to choose the right nozzle, the supplier must also be able to provide intelligent controls, incorporated into the spraying technology. For a little more than a year, Spraying Systems have been using AutoJet Spray Controllers in an increasing number of applications. Because customers often have a competitive edge when using such controllers, they rarely grant outsiders a glimpse into their spraying process. Therefore, Industrie Technisch Management, together with the whole sales team at Spraying Systems Belgium and with Raoul De Winne from AutoJet Technologies, examined a number of typical systems.

THE SPRAY NOZZLE IS ALWAYS THE DUPE

When a spraying installation does not work as it should, according to the user, the culprit is always 'that damned spray nozzle'. In a number of cases, the nozzle is indeed worn out or unsuitable for the application. Very often, however, the problem lies in the installation. An example is a sputtering spray nozzle. Users may immediately think that the nozzle must be dirty. But it wouldn't be the first time that a diaphragm pump is used in the installation to regulate the flow rate to the spray nozzle! And often, it is still hard to make the customer understand that the pulsating action of the diaphragm pump has an impact on the spray pattern.

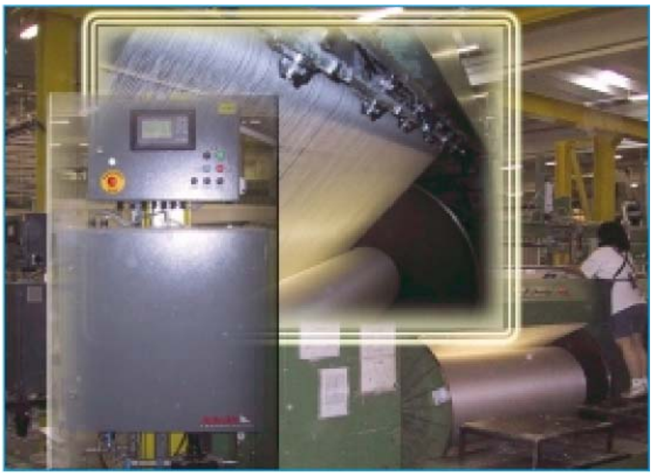
Often, the spraying installation works satisfactorily for years, until suddenly, problems start. The first reaction is often: let's change the spray nozzle, without result. Then, the nozzle supplier is called and he asks a number of questions: "Did you change the products being sprayed, has the nozzle been moved, was the speed of the machine increased, were the pressure and/or flow rate changed (to increase the output)?"

Nowadays, questions are also asked like "I want a flexible installation that still always produces the exact flow rate and a correct spray pattern". In that case, the nozzle alone cannot provide the solution anymore and a controller must be added. At a specific pressure, a spray nozzle produces a specific pattern with a specific flow rate.

Low-mist coating in a textile factory.

If so, then there is a good chance that a nozzle adapted to this new "environment" will solve the problem. Indeed, each nozzle is designed specifically for a well-defined drop size and spray pattern at a specific pressure and at a specific flow rate. The materials that the nozzles are made of are adapted to the aggressiveness of the spray liquids … (e.g. we can choose between stainless steel and ceramic types). As a result, spray nozzle suppliers have a huge range of products available. On the basis of his experiences, the nozzle supplier can suggest suitable types. Via external tests (or on the basis of prior experience), the best solution can then be chosen for the "new production environment".

Changing the pressure to increase the flow rate will also change the spray pattern of the nozzle, and this is not always desirable. Providing a flexible flow rate, while keeping the spray pattern unchanged – e.g. because the conveyor speed must vary and the user wants to spray a specific amount of product per m^2 - this cannot be solved with the nozzle alone. As pressure and flow rate are linked, it would be possible to spray at a higher pressure when the speed increases, but the spray pattern changes according to the pressure, and that may not produce the desired effect anyway. The solution is provided by a suitable controller that controls a magnetic valve. Using a nozzle that is suitable to spray the



The controller automatically adjusts the spray angle, according to the distance to the thread. The sprayed amount is also adjusted according to the speed of the thread.

right pattern at maximum speed, the controller will shut off the pipe for a certain percentage of the time when the speed drops. The opening/closing frequency of the valve is frequency controlled with the frequency depending on the speed of the conveyor belt. As a result, a specific pattern can be produced at a specific pressure, while spraying the right amount per m^2, even when the speed of the conveyor belt varies greatly.

CONTROL AND MONITORING

In the past, the accuracy of many spraying installations was not a big issue. Very often, users only had to make sure that they "sprayed enough". Nowadays, users are much more cost-conscious and want to ensure the best possible quality. Over-spray, for instance as a result of the wearing out of the nozzle, is too expensive in spraying materials when oiling coils. Sometimes, it is not desirable

Precision dosage and uniform coating of pharmaceutical products with the AutoJet control system.

for the process. Cleanliness of the “environment”, including the work floor, is a major concern: if users want their workers to care for high-quality production, they need to care for their work environment. Soiling the floor by over-spraying, with all the safety problems this involves, must be avoided. On the other hand, clogged nozzles, even only one in a row of 10, can disrupt the process. The wrong spraying pattern can also generate problems. These flaws, however, cannot be seen with the naked eye. With traditional PLC’s, it is difficult to integrate all the facets of the spraying process. Therefore, the AutoJet Spray Controllers are embedded computer systems, which revolve entirely around the nozzle, with a double task: monitoring and controlling. Pressure and flow monitoring, process control, flow and time control.

For many applications, measuring the drop size is also very important. An example is gluing-in metal plate for laminating safety doors. The applied glue is activated by vaporizing a very precise but small amount of water. Too little water has an adverse effect on the adhesive power of the glue. Too much water increases the curing time and can result in poor adhesion. This gluing process is carried out on an automatic conveyor belt travelling at speeds varying on a scale from 1 to 150. Moreover, at the highest speed, the amount of water to be sprayed was six times higher than at the lowest speed. “Preferably with a single spray boom” says the customer. This meant achieving a flow ratio of almost 1 to 1,000, with a single spray boom and a single nozzle type. With a traditional pressure controller, this is absolutely out of the question. The solution was a fast triggering spray gun and a controller with an advanced algorithm integrated in the system. Together, they not only provided the correct flow rate at all possible speeds, they also controlled the droplet size, because otherwise, a large cloud would have been sprayed on and

In this waste incinerator, AutoJet makes sure that the temperature of the combustion gases is lowered.

around the machine. The problem was solved. The spray pattern could also be adapted according to the type of door.

THE RIGHT WATER DROPLET, OR IT’S CONCRETE

Another very critical example is the application installed by Spraying Systems at CBR: cooling the combustion gases of a cement kiln. These combustion gases leave the kiln at a temperature of more than 850°C and contain cement dust that is filtered out in dust filters. These filters don’t withstand temperatures higher than 160°C, and therefore, the combustion gases must be cooled down. This is done by vaporizing the right amount of water into the hot gases, which must evaporate within one second of being sprayed. The evaporation energy is withdrawn from the combustion gases, which cool down as a result. This water spraying is a critical process. It must introduce just enough water to consume the excess heat through evaporation.

Too much water would not evaporate fast enough, and the dust would get damp. When wet dust cakes together, it becomes heavy and drops out of the air flow. The effect is the accumulation of a layer of concrete at the bottom of the flume until the admission pipe at the bottom is clogged up. And then, this concrete must be broken up with pickaxes to be removed. Too little water consumes too little evaporation energy, and then the dust filters get damaged. If the droplets are too large, the water doesn’t evaporate fast enough, and this again forms damp cement dust that cakes together, while not cooling the combustion gases enough. Such applications cannot be entrusted to the good working of a nozzle alone.

Application: re-humidifying paper.

The waste gas flow can vary, and therefore, the sprayed volume and the droplet size must be kept accurate at all times. In the past, this application operated with a controller based on a "most likely" simulation model of the tower and the control happened on the basis of the switching on and off of the nozzles. There were always problems, and concrete had to be removed every week. These problems are solved by the use of an AutoJet Spray Controller, which takes into account the spraying pattern. A frequency controlled pump streamlines the inflow, a/o according to the temperature and the maximum admissible droplet size.

Similar installations, also for combustion gas cooling, are operational in the smoke stacks of waste incinerators. They produce a spray pattern whereby the water is sprayed in the centre of the smoke channels, where it has 6 seconds to evaporate. Because no water condenses on the walls (these walls are always cooler), less dirt deposits on the sides of the smokestack, and as a result, the chimney needs cleaning less often. ■