THE SPRAY NOZZLE PEOPLE

The Go-to People for Spray Nozzle Solutions

01273 400092
info@spray-nozzle.co.uk

# THE IMPORTANCE OF DROPLET SIZE IN GAS SCRUBBING SYSTEMS

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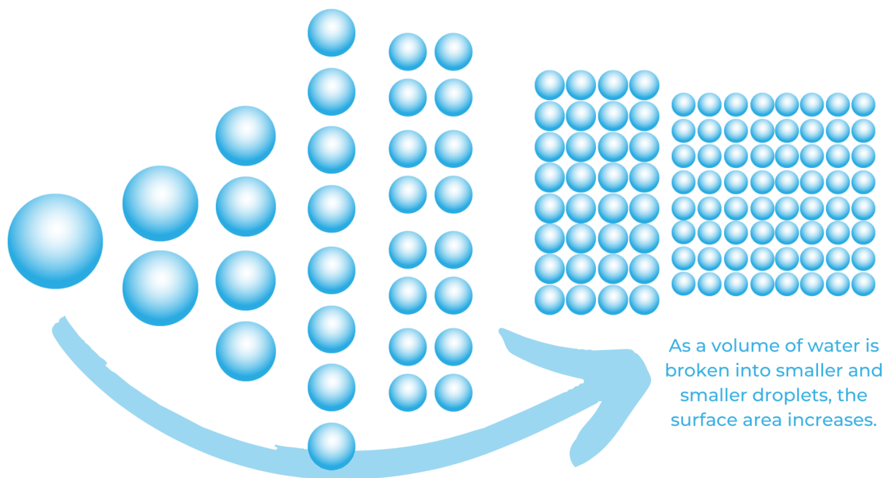
Spray nozzles are a critical component in many types of gas scrubber and drop size is a key factor in achieving optimal performance.

The main objective of a gas scrubbing system is to interact the gas flow with a liquid spray of some description. The spray will proceed to either absorb contaminants and knock them out of the gas flow or induce a chemical reaction to remove the contaminants.

A good example of this would be Flue Gas Desulphurisation (FGD) or ammonia sprays to remove nitrogen oxides.

In order to absorb or react with the gas, a big surface area of liquid must be in contact with the gas.

The larger the surface area, the more reaction or absorption will occur. This will result in a more efficient gas scrubber.




Drop size is what dictates the overall surface area of the spray.

The smaller the drop size, the bigger the overall surface area of the spray will be.

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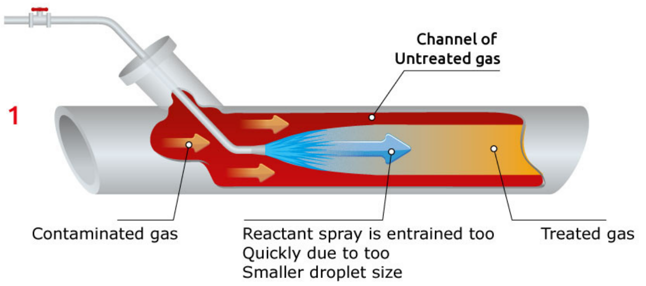
If you imagine a litre of water atomised to roughly 400 microns, this will have half the surface area of the same litre of water if we were atomising it to 200 microns and only a quarter of the surface area, if we were to further break that part into 100 micron drop sizes.

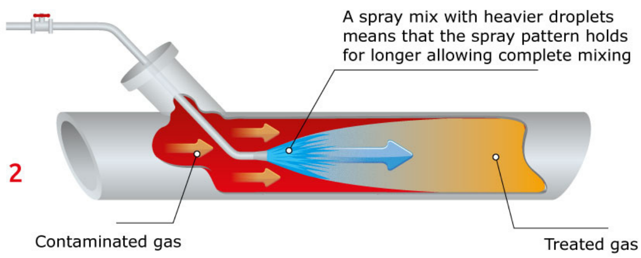
Each time the drop size is halved, the surface area is doubled which also doubles the potential for reactions or absorption in the gas scrubber to occur.

This can sometimes result in assumptions that, for any gas scrubbing system, the drop size needs to be as small as possible. This would maximise the surface area of the spray and so improve absorption or reaction.

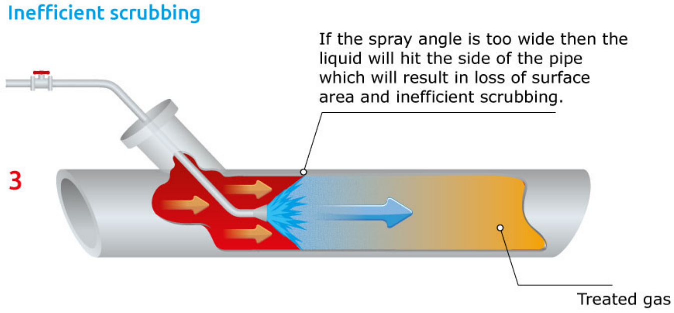
Unsuccessful Gas Scrubbing



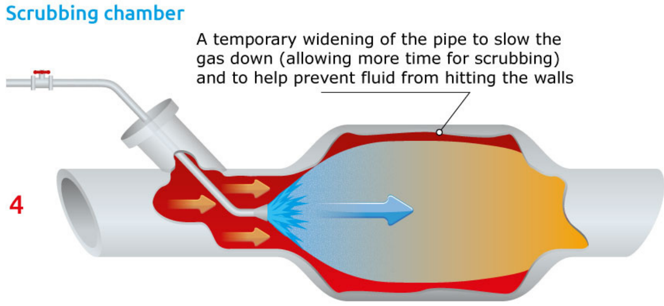

Successful Gas Scrubbing




Inefficient scrubbing




Scrubbing chamber




However, there is a lot more to consider than this; finely atomised sprays do produce much greater surface areas, but the light drops also get rapidly entrained in gas flows. Therefore, they are not able to reach the outer parts of a fast moving gas flow and parts of the gas will not come into contact with any of the reagents at all. Parts of the gas are going to be missed.

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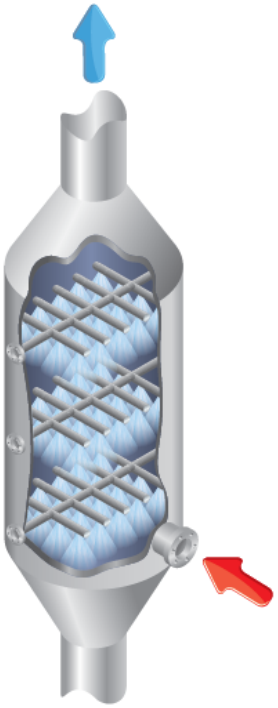
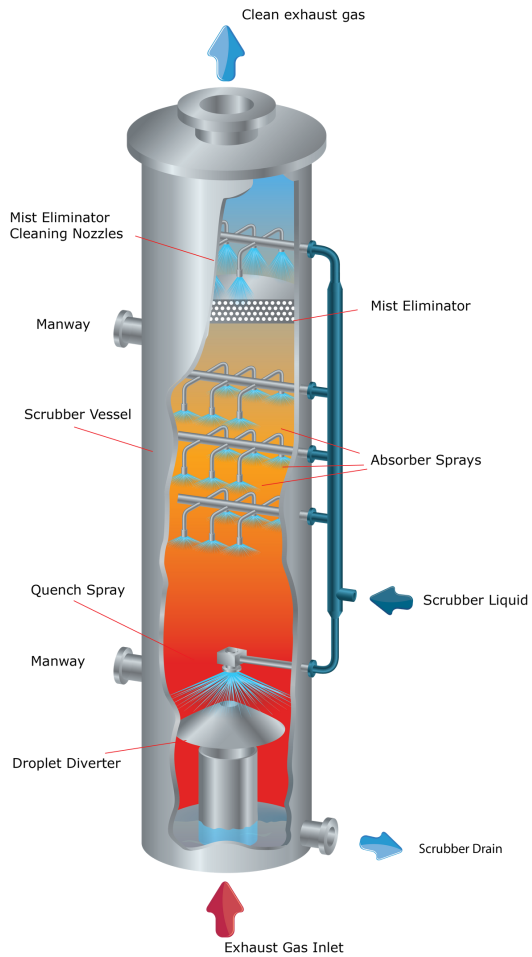


Having a large array of tightly packed nozzles over the entire gas flow could compensate for this by ensuring that it's all treated. This is where a theoretically good idea appears against practical realities.

How would those nozzles get removed for maintenance in such an array? What about the cost of the extra pipework?

There needs to be a balance between getting the small drop sizes and theoretically producing greater absorption, and having a big enough drop size to penetrate the gas flows with a reasonable number of spray nozzles to ensure optimum coverage of the flow.




Another limitation on fine drop size is entrainment within the scrubber. If a lot of the liquid is being whipped up into the gas flow, this may overload mist eliminators further up the gas stream and allow contaminants to escape.

There is no point in absorbing contaminants only to have them escape the scrubber due to entrainment and overloading the mist eliminators. Therefore, balance is required between smaller and larger drop sizes.

What does this mean for nozzle selection?

The general rule is to speak to a nozzle supplier that understands all of this. When looking at scrubber design, not only the overall surface area of the spray needs to be considered. It is also the larger and finer drops sizes and how that spray is constituted.

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All sprays consist of a spectrum of different drop sizes; it's not just one uniform drop size in any spray.

There are 3 drops sizes that hold great importance in scrubber design.

## 1. D.32 (Sauter mean drop sizes)

This is a really good measure of the relative surface area of any spray. We need to know this so we can compare the abilities of different sprays to absorb or react with contaminants.

## 2. DV0.9

DV0.9 is a drop size in which 90% of the volume of spray is made up of drops smaller than this drop size. It is a measure of heavier drops which dictate the direction of the spray and these are the ones that penetrate further into a fast moving gas flow. These bigger droplets also serve to carry smaller droplets further into the spray as well.

## 3. DV0.1

Only 10% of the volume of the spray is made up of droplets smaller than this drop size. This is often referred to as the measurement of the 'fines' (the fine droplets within the spray).

Knowing what this is and how these drops will behave in a gas flow can help the studying and estimating of factors such as the fluid amount that's going to get entrained with the gas flow and the calculation of mist eliminator load.

Here at SNP, we supply nozzles to gas scrubbers all over the world to engineering and chemical companies large and small. This is bread and butter business for us and we can enter into a discussion about all these different types of drop size and which one is going to have the most implications for your scrubber design. You are in safe hands with The Spray Nozzle People when it comes to specifying nozzles for gas scrubbers of all types.