LECHLER

Precision Nozzles and Systems for Pollution Control

Unusual problems call for unusual materials

Air pollution, caused by the emissions of power stations, waste incineration plant, factories, etc., severely affects our environment. Since its effects are to be seen in every direction, operators of combustion and steam raising plants have become deeply aware of the problem and government authorities are issuing ever more stringent regulations aimed at reducing environmental pollution.
As a specialist in the field of dust extraction systems, Lechler too has faced a challenge, because the majority of dust extraction plants is equipped with precision nozzles of Lechler manufacture – atomizing nozzles designed exactly to meet the needs of modern pollution control systems.

Criteria for the design of such nozzles include:

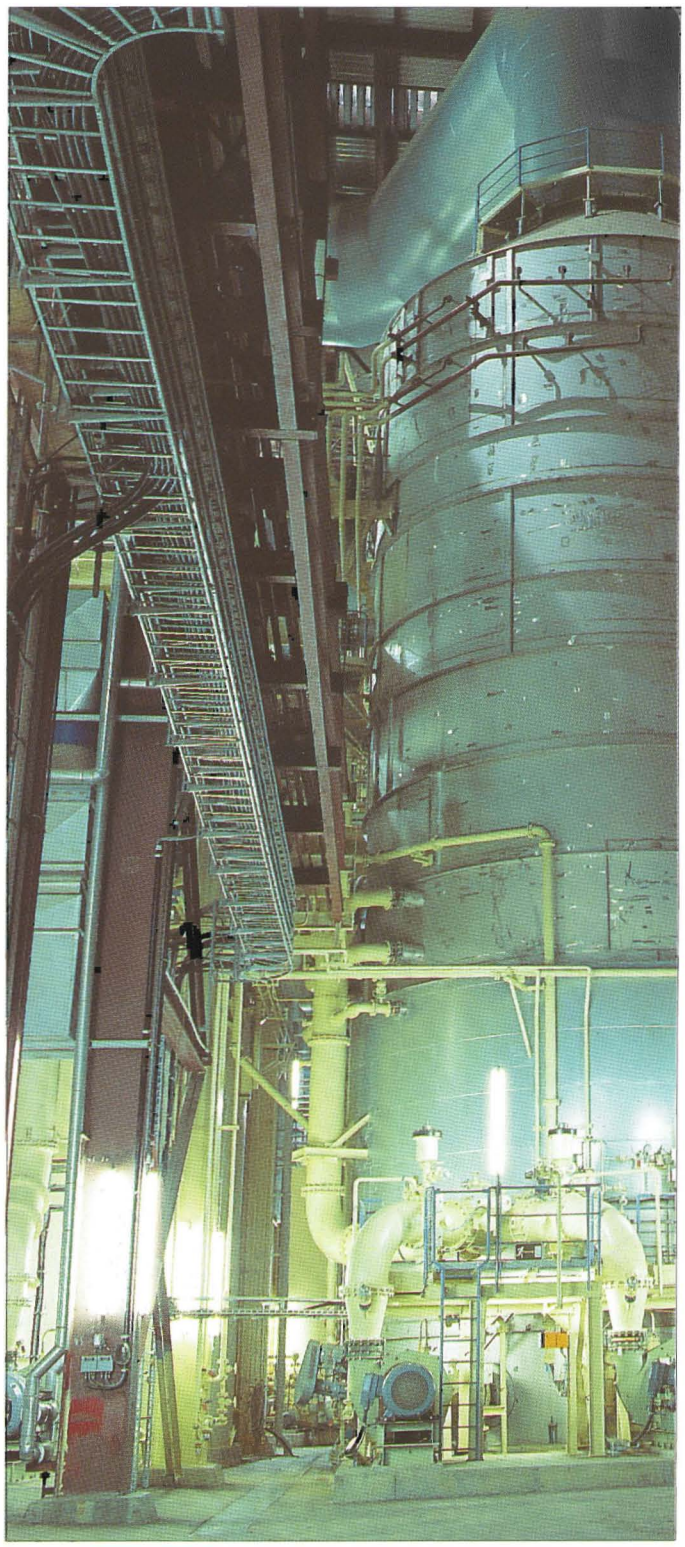
- Tower cross-section
- Flue-gas analysis
- Gas-flow rate
- Gas temperature
- Installation conditions
- The nature of the liquid to be sprayed and its composition

This Lechler brochure aims to give you a brief picture of what is to be expected nowadays of modern atomizing systems, for which we offer proven products for practically all fields of air-pollution control:

- Flue-gas desulphurization
- Flue-gas cleaning
- Gas washing
- Gas cooling
- Gas conditioning
- Spray absorption

Lechler precision nozzles for long-term maintenance of specified characteristics

Apart from differing functional characteristics, our offering of more than 20.000 different nozzle types ensures that we are able to meet your requirements for atomizing nozzles exactly. Many of the materials used are machineable, some are thermoplastic, some castable and - in view of the often extremely abrasive and agressive environmental conditions in which they work, Lechler nozzles are often constructed of the hardest ceramic materials to ensure they maintain the utmost precision over a long service life:
Precision nozzles of silicon carbide.



Your requirements determine the material

A chain is only as strong as its weakest link.
A weak link in any processing plant, particularly in flue-gas cleaning plant, can all too easily be the atomizing nozzles. The problem is inherent in the process concerned. With solid particles varying in size from 20 to 90 µm in the wash suspensions used in flue-gas scrubbers, with the relatively high acidic or basic concentrations that can arise within the washer, and with contaminated water being reused, such nozzles are subjected to severe erosive, abrasive, corrosive, and chemical stresses that can appreciably reduce their service life and thus result in frequent plant shutdowns.

The use of high-alloy steels led to no satisfactory results. Only nozzles constructed of ceramic materials withstand such severe working conditions. The following are among the ceramic materials now used for the construction of the nozzles used in flue-gas cleaning plant:

- Aluminium oxide ceramics
- Nitride-bonded silicon carbide
- Siliconized silicon carbide
- Reaction-bonded silicone carbide

Aluminium oxide ceramics have a limited application in fluegas washing plant in view of their toughness, their limited resistance to chemical attack, and the difficulty that exists in shaping them satisfactorily.

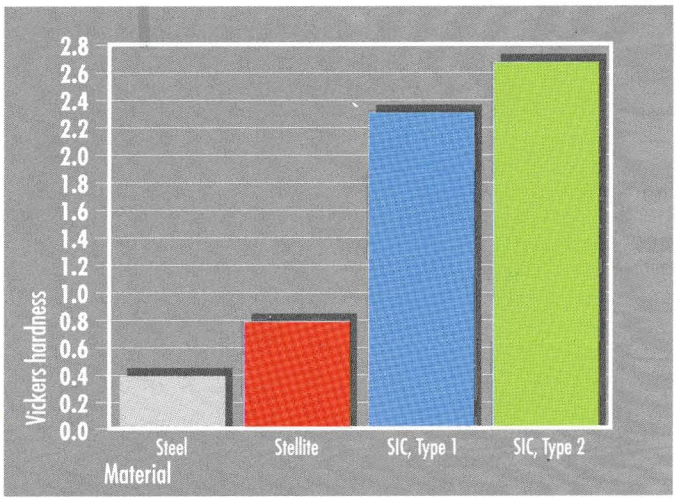
But for nozzles to be able to withstand the exceptionally severe operating conditions, it was essential to find a material with the best possible mechanical strength.

As a result of constant research and development work, and of a regular exchange of experience among experts in the field concerned, it became possible for Lechler to offer an extensive range of nozzles constructed of one of the hardest materials available – the ceramic material silicon carbide.

Lechler precision nozzles of silicon carbide have now been used most successfully for many years in flue-gas desulphurization plant where they have frequently achieved a service life of around 30.000 operating hours without appreciable wear, and with minimal deviation from their original functional characteristics under such severe conditions over a very long period.

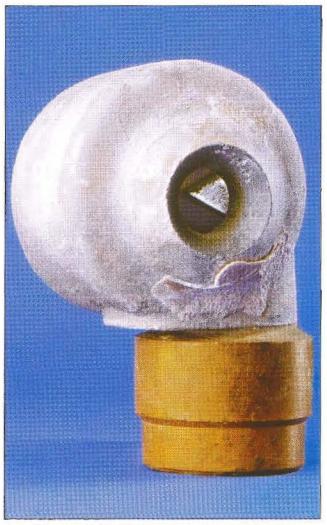
It follows that the use of such nozzles reduces the frequency of shutdowns and can thus increase the effectiveness of your plant. It is not without reason that the use of silicon carbide atomizing nozzles is the current state of the art throughout the world.

Our engineers are always pleased to assist in the selection of the most suitable material for the construction of the nozzles needed for your application.



Wear of nozzle materials


Alloy steel nozzles after about 300 operating hours


A silicon carbide nozzle after about 25.000 operating hours

Precision nozzles of SIC and SISIC

Lechler precision nozzles of nitride-bonded silicon carbide SIC

Nitride-bonded silicone carbide (SIC) has proved an extremely satisfactory material for the construction of nozzles that are primarily subjected to the stress that occurs under straight-flow conditions. The material is particularly resistant to wear resulting from impact and abrasion, it is highly resistant to attack from the more common chemicals and its high mechanical strength is maintained almost unchanged at temperatures of up to 1500° C.

Lechler precision nozzles of siliconized silicon carbide SISIC

The outstanding properties of SISIC ensure that nozzles constructed of this material will achieve a long service life and maintain their original functional characteristics over a very long period under the most extreme operation conditions, i.e. when subjected to severe abrasion, high temperatures and agressive chemicals. Downtime is thus reduced and the reliability and effectiveness of your plant is increased.
SISIC can be formed in many shapes and therefore it is possible to reduce the weight of nozzles enormously.

Nozzles of SIC

Nozzles of SISIC

Particular features of Lechler precision nozzles of SIC:

- long service life
- considerable resistance to erosion, corrosion and oxidation
- resistance to high temperatures
- resistance to impact
- particularly robust construction

Particular features of Lechler precision nozzles of SISIC:

- long service life even under the most extreme conditions
- highly resistant to erosion, corrosion and oxidation
- resistant to high temperatures
- gastight
- low weight
- capable of being formed in many shapes

Lechler precision nozzles of ReSIC and Stellite

Lechler precision nozzles of reaction-bonded silicon carbide ReSIC

The particular properties ReSIC make it especially suitable for use in such applications as demand the utmost resistance to wear, extreme hardness, and a high degree of resistance to oxidation and corrosion.
Lechler precision nozzles of ReSIC are moulded parts that are 100% gastight and have outstanding resistance to mechanical and chemical stress.
As is the case with SISIC, nozzles of ReSIC can be constructed in a wide variety of shapes and can be so designed as to achieve a considerable reduction in weight.
A further advantage is their high ultimate strengh, some four times greater than with SIC. The material maintains its strength from room temperature to up to as much as 1500° C.

Lechler precision nozzles of Stellite

Lechler precision nozzles of Stellite are frequently used for applications where resistance to damage from impact is of particular importance. It goes without saying that nozzles made of this material are resistant to corrosion, erosion and attack from more common chemicals.
Not without reason have nozzles constructed of this material proved extremely satisfactory in flue-gas desulphurization plant.

Nozzles of ReSIC

Nozzles of Stellite

Particular features of Lechler precision nozzles of ReSIC:

- long service life even under the most extreme conditions
- highly resistant to erosion, corrosion and oxidation
- resistant to high temperatures
- gastight
- capable of assuming many shapes
- high ultimate strength

Particular features of Lechler precision nozzles of Stellite:

- long service life
- highly resistant to erosion, corrosion and oxidation
- resistant to high temperatures and to sudden temperature fluctuations
- impact resistant

Your requirements determine the nozzle design

The following are the major factors to be considered in selecting the most suitable nozzle for a particular application:

- the droplet spectrum necessary to achieve the best possible mass transfer and a suitable dwell time for the process concerned
- even distribution of the droplets over the full area of the tower
- intensive water vorticity to achieve reliable process results
- satisfactory internal geometries to avoid nozzle blockages and ensure reliable operation
- the choice of wear-resistant material best suited to ensure a long service life and low operating and maintenance costs
- reliable means of mounting the precision nozzles

Being optimally designed from a fluidics viewpoint, Lechler nozzles meet all the demands of modern technology for nozzles used for the cleaning of outgoing air - narrow droplet-size spectrum and even droplet distribution over the tower cross-section - as essentials for intensive mass transfer between the gas and liquid. The types of nozzles offered are as widely varied as the materials used for their construction.

The various nozzle types differ in respect of:

- spray form
- inflow
- method of mounting

Spray form

The nozzles most commonly used for pollution control are hollow -cone nozzles and full-cone nozzles. Hollow-cone nozzles apply a ring of droplets while fullcone nozzles distribute the droplets over a circular area. Helix nozzles are a special form of fullcone nozzle that combines small dimensions with a relatively large free passage diameter and absence of such internal parts as swirl vanes or baffles. They are, therefore, highly resistant to blockage.

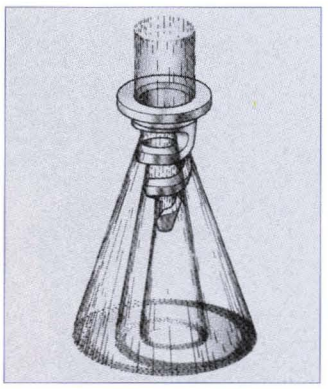
Inflow

The majority of hollow-cone and full-cone nozzles with tangental inflow have no internal swirl inserts. Their hydrodynamic characteristics result in a selfcleaning effect and thus plant operation is undisturbed by nozzle defects. But the advanced design of swirl generator in the various ranges of axial-inflow full-cone nozzles provides such nozzles also with the maximum possible free passage.

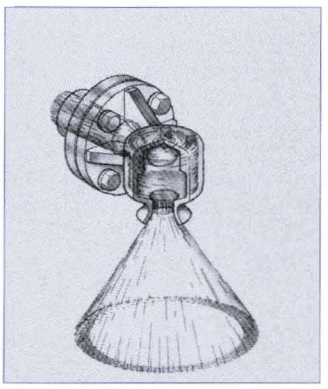
Mounting methods

An important factor in the choice of nozzles is the time required for their removal and replacement, since this determines the length of downtime. Thus for your plant, made to measure to meet requirements, Lechler offers nozzles with various means of mounting to save both time and expense during maintenance. Depending on the type of piping used in your plant Lechler offers the following alternatives:

- for rubber-sprayed piping: flange-mounting nozzles, including a mounting set
- for threaded stainless steel piping: threaded FRP adaptors
- for FRP piping: FRP flange or threaded connections
- special designs to meet special requirements



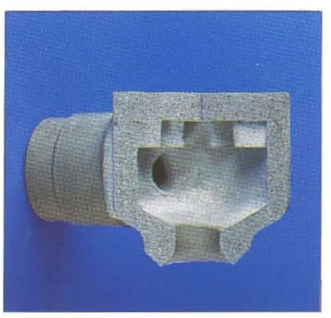
Full-cone spray pattern from an axial flow nozzle



Hollow-cone spray pattern from a tangential-flow nozzle

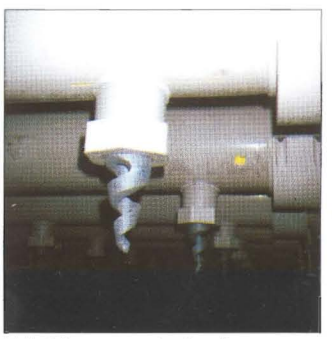
Full-cone nozzles in a flue-gas desulphurization plant

Tangential-flow hollow-cone nozzle



Tangential-flow full-cone nozzle (pat.)

Axial-flow full-cone nozzle



Helix full-cone nozzles in a flue gas cleaning plant

Lechler precision nozzles in flue-gas desulphurization plants

In fossil-fuel power stations perhaps the most important antipollution measure is the desulphurization and denitration of the flue gas.

Both wet and dry flue-gas cleaning plant is used for this purpose and it is particularly in the field of wet flue-gas treatment that Lechler precision nozzles play such an important role.
With awareness of exact function data and by a suitable choice of geometric design and construction material, it is possible to achieve optimal process results and maximum reliability.

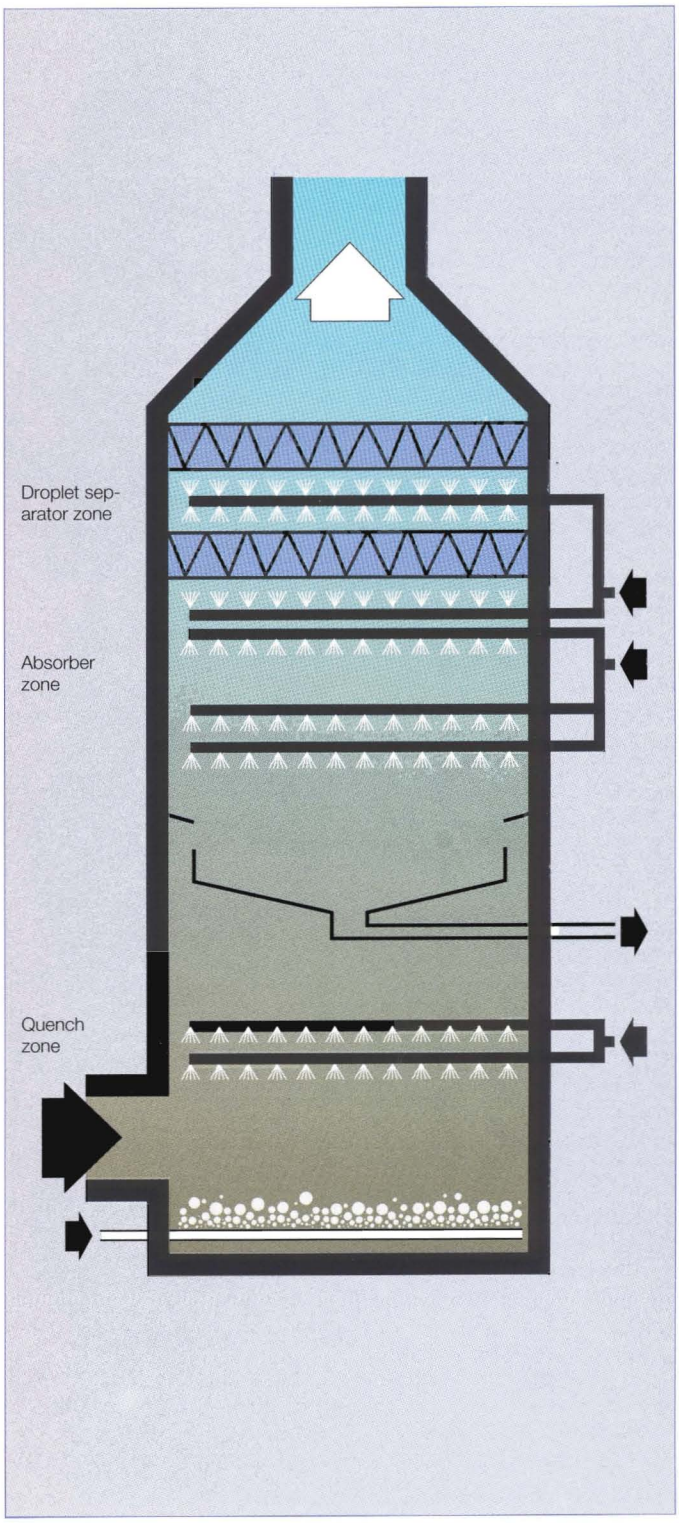
In view of the constant technical developments in the field of flue gas desulphurization processes, exact knowledge of the functional characteristics of spray nozzles is essential to ensuring their correct selection. Apart from having such knowledge, Lechler's engineers have a wealth of general experience that they will be glad to share with you in seeking solutions to your problems.

In the adjacent sectional view of a flue-gas desulphurization plant it can be seen what an extremely important role is played by Lechler precision nozzles:

- in the quench zone
- in the absorber zone
- in the droplet separator zone

In a great many desulphurization plants around the world, Lechler precision nozzles, selected to suit the desulphurization process concerned, have been installed to provide a reliable solution to the problems involved.

View in the absorber zone of a flue-gas desulphurization plant



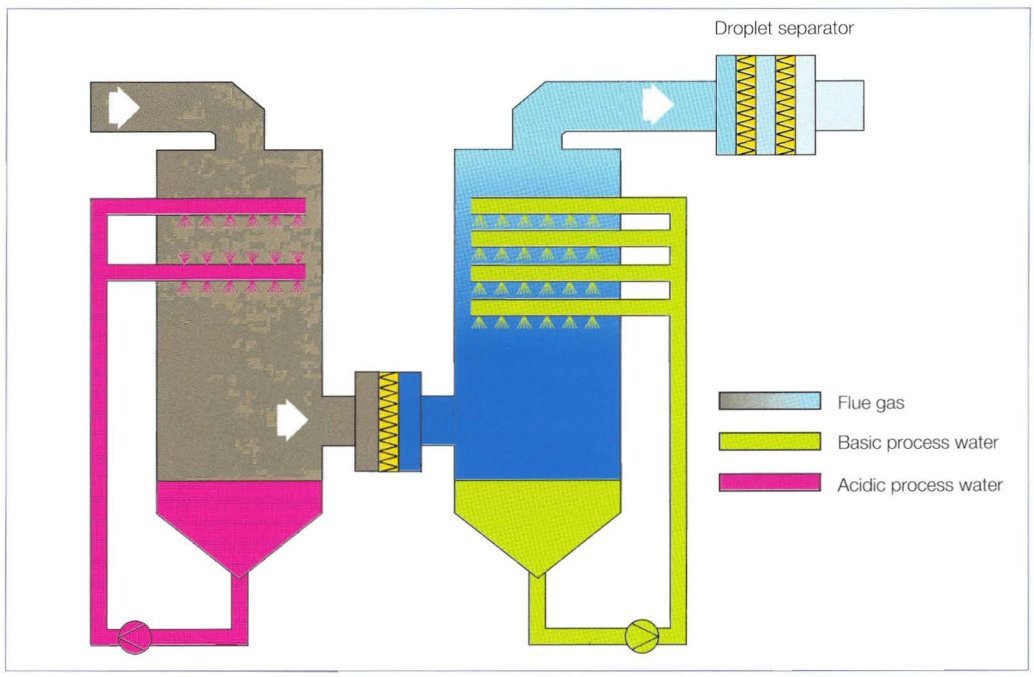
Diagramatic sectional view of a flue-gas desulphurization plant

Lechler precision nozzles in flue-gas cleaning plants

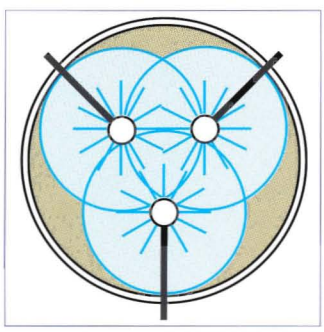
The incineration of garbage, noxious waste, and sewage sludge results in various undesirable emissions such as SO2, HCL, HF and flue dust particles, as well as traces of heavy metals. To avoid such substances polluting the environment, they are absorbed in single-stage or multi-stage flue-gas cleaning plant.
In such plant, over very many years, Lechler precision nozzles have assisted in achieving outstanding process results and a maximum of operational reliability.
Many different materials are used for the construction of such nozzles, ranging from high-alloy steels and Stellite, through to such hard-wearing ceramics as SISIC and ReSIC.

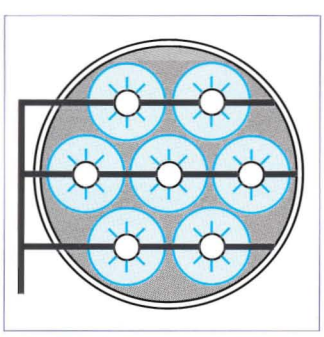
By being aware of each nozzle's exact functional data it is possible to select the most suitable geometric dimensions and material for the application concerned and thus to ensure optimum process results and the utmost operational reliability.

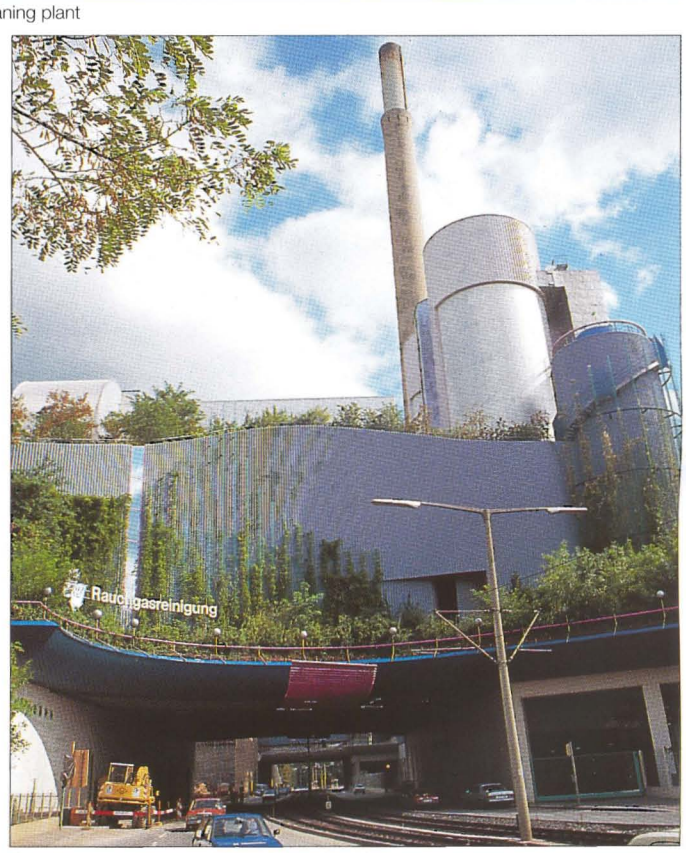
To facilitate compliance with ever more stringent statutory requirements and to keep pace with the rapid advances that are being made in the field of flue-gas desulphurization, a complete understanding of the process concerned is necessary for the selection of the most suitable nozzle types. Because of this our development engineers who are concerned with atomization technology are in constant contact with those responsible for tomorrow's solutions.
Evidence of our experience is apparent in the many flue-gas cleaning plants throughout the world that are fitted with Lechler precision nozzles.



Diagramatic view of a 2-stage flue-gas cleaning plant




Typical nozzle arrangements in flue-gas cleaning plants


External appearance of a flue-gas cleaning plant

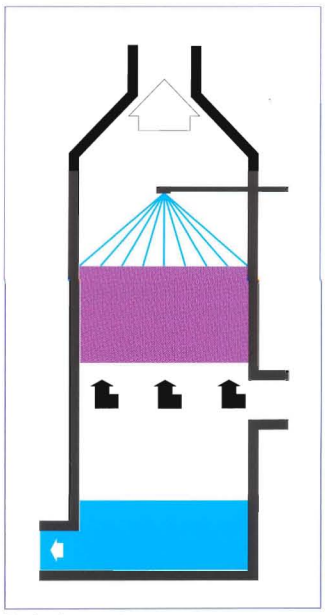
Lechler precision nozzles in gas treatment plants

In the chemical industry, for example, various systems are used for the removal of particles and for gas cleaning generally, such as:

- Venturi scrubbers
- Cascade spray towers

It is frequently sought to combine the removal of particulates with some other purification process. This can greatly affect the choice of nozzle type, droplet size, and arrangement of the spray system, but a major factor remains the operational reliability of the spray nozzles and thus of the plant concerned.

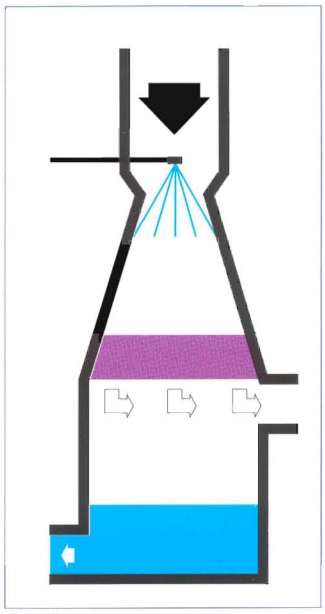
Packed spray towers...
...are particularly suitable for applications where, apart from the removal of dust particles, it is mainly undesirable gaseous components that have to be absorbed in order to extract them from the gas flow. Such plant often serves also as a dryer, to remove moisture by condensation from saturated waste gases.
The requirements that the nozzles have to meet depends on whether the plant concerned works on the uniflow or counterflow principle.
Most packed gas-washing towers work on the counterflow principle with mass transfer being chiefly effected within the packed beds. In such cases the nozzles used have both to spray the bed surface evenly, working at relatively low pressure, and to provide a droplet spectrum with an adequate component of large droplets. With the counterflow principle an excessive component of fine droplets can itself result in environmental polution by overloading the tower's mist eliminator. Working at a low pressure of as little as 0.3 bar, Lechler full cone nozzles distribute the liquid evenly over the bed surface. Since the exact performance characteristics of the nozzles is known, it is possible to find an ideal nozzle arrangement that will ensure the best possible use of the suspension used and that as little of the liquid as possible will be applied to the tower wall.



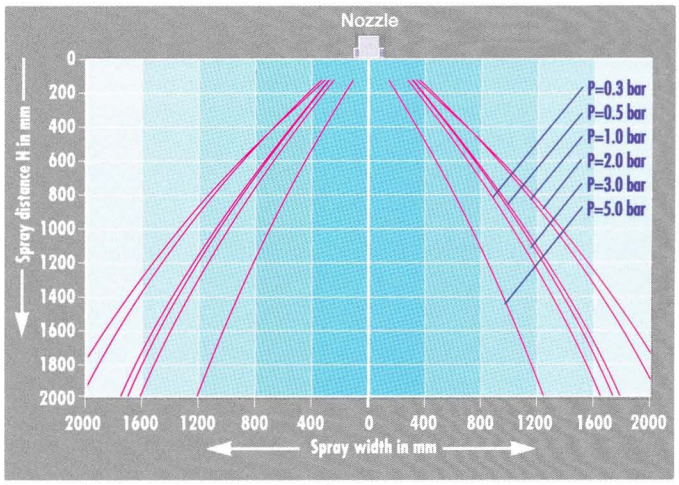
Packed spray tower

Full-cone nozzle, type SZ

Venturi washers...
...are chiefly used where it is required to remove the finest dust particles and where a high-degree of separation is called for. Here it is particularly important to be aware of the spray cone diameter at a specific working pressure. Since we can predict the spray pattern exactly we can provide exact spray distribution curves.



Venturi washer



Spray width diagram for a full-cone nozzle

Lechler precision nozzles for dry flue-gas desulphurization and denitration, gas cooling, gas conditioning

Gas cooling

Wherever it is necessary to cool hot gases before they enter a filter, such as the bag filters, cloth filters or electrostatic precipitators used in waste incineration and other combustion plant, substantial fluctuations in temperature and rate of gas flow make it necessary to vary the amount of liquid sprayed and this in turn makes it difficult to maintain consistantly fine atomization over the full range of operation.
In seeking to solve this problem, Lechler engineers developed the Lechler Hydraulic Spillback Nozzle Lance. This ingenious spray lance automatically adapts to changes in gas flow and temperature and maintains consistantly fine atomization over the plant's full operating range.

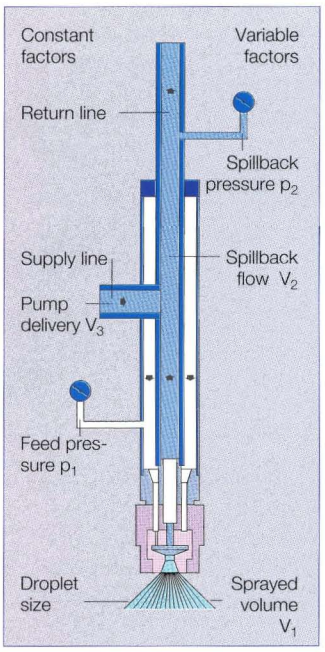
Gas conditioning

The most economic means of removing solid particles from gases is to employ an electrostatic precipitator. This method of filtration has established itself in almost all branches of the industry since it makes it possible to treat flue gases with a high percentage of fine dust particles while still relatively hot, although the gases have first to be passed through a heat exchanger or evaporative cooler to bring them to an acceptable working temperature.
Apart from the working temperature, the moisture content of the gas also plays an important role. By affecting the specific electrical resistance of the dust particles and the speed at which they pass between the electrodes it appreciably affects the efficiency of an electrostatic precipitator and thus it is often necessary to first dry the gas.
For this application also, the Lechler Spillback Nozzle Lance has been employed for many years with considerable success but use is also made of Lechler Twin-fluid Supersonic Nozzles. In both cases atomization is effected with the aid of compressed air or compressed gas. Both systems result in an extremely narrow spectrum of fine droplets.
Our specialist engineers will be pleased to give you more detailed advice concerning these systems.

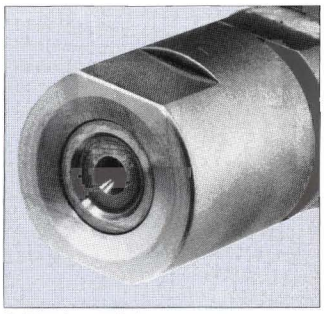
Dry flue-gas cleaning and denitration

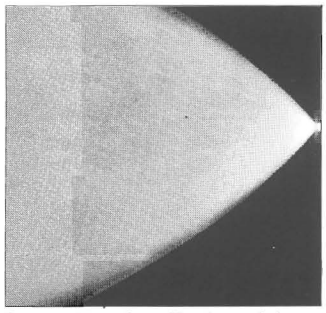
Depending on the size of the plant, the composition of pollutants, and other factors, it is sometimes also necessary to subject dry or semi-dry flue gases to further treatment and here again the atomizing elements are of principal importance.
For this application, Lechler offers a full range of twin-fluid supersonic nozzles that provide a fine droplet spectrum most economically with the aid of compressed air.
To reduce downtime to a minimum, Lechler twin-fluid supersonic nozzles are designed to minimise the possibility of blockage and are made of materials that are particularly resistant to wear and corrosion.
By combining an exact awareness of the nozzle parameters with the know-how gained over many years, Lechler's process engineers can assist you appreciably in designing the plant needed for your application.

We will be pleased to send you further information concerning Lechler Hydraulic Spill Back Nozzle Lances and Lechler Twin-Fluid Supersonic Nozzles on request.

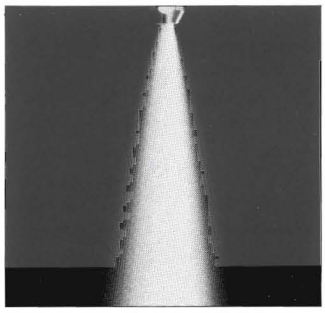


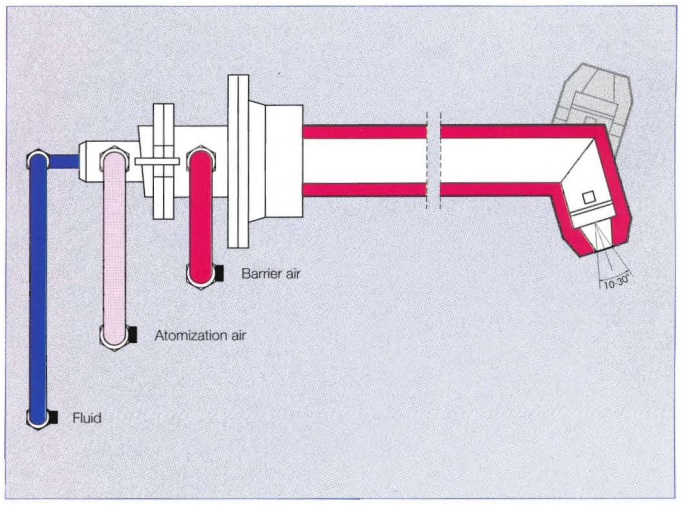
Scheme of a spillback nozzle lance


Spillback nozzle lance


Spray pattern of a spillback nozzle lance


Pneumatic supersonic nozzle


Spray pattern of a pneumatic nozzle



A twin-fluid supersonic nozzle with barrier air

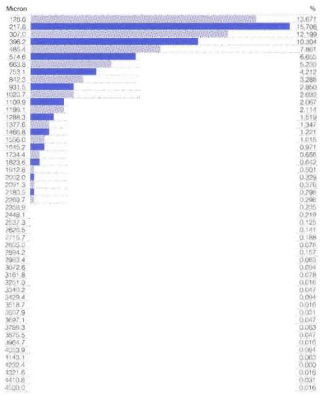
Documented precision

To assist you in the design of your plant you need a great deal of information concerning our nozzles on which you can rely with assurance - information concerning volumetric flow, spray widths, droplet spectrum and droplet speed. We use the most modern measurement equipment to determine these most important nozzledesign parameters and are always pleased to pass on such information on request

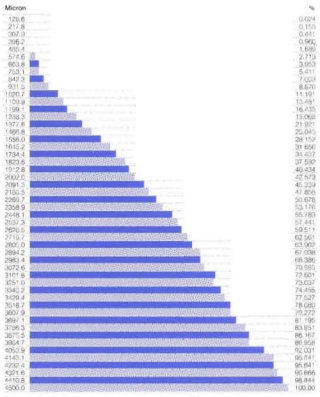
Measurement equipment

- **Volumetric flow**
  Inductive-magnetic flow meters
- **Spray width**
  Spray photography and plotter printouts
- **Droplet size**
  Phase-Doppler droplet analyser
- **Liquid distribution**
  Lines of measurement flasks with electronic evaluation

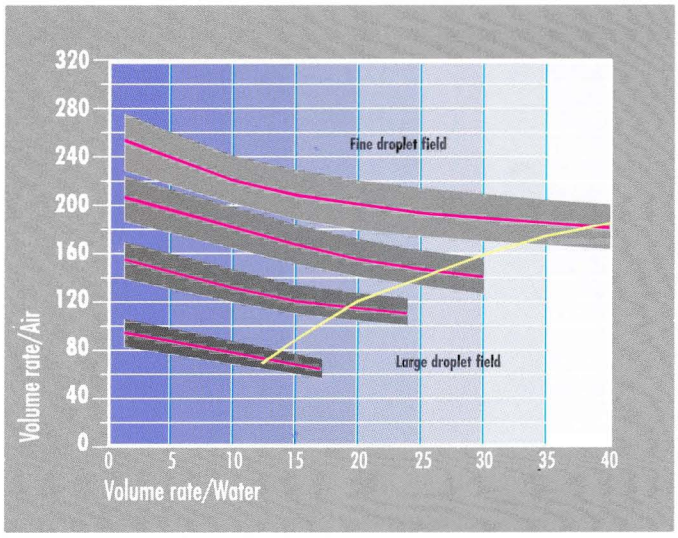
Examples of droplet measurements made with a Lechler precision nozzle for flue-gas desulphurization



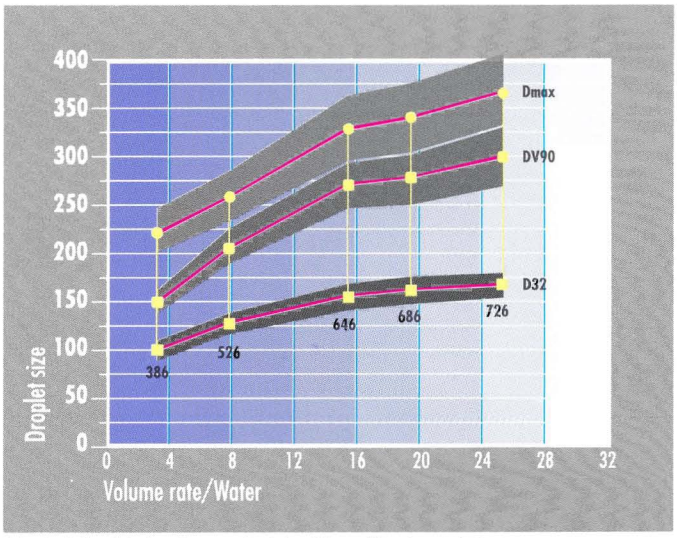
Droplet frequency distribution



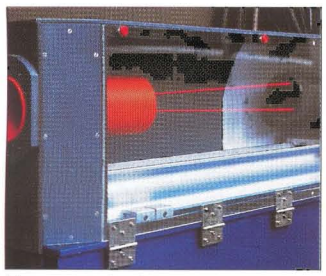
Cumulative volume distribution



A typical droplet size diagram for a Lechler pneumatic supersonic nozzle



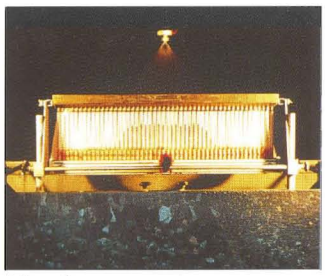
A typical droplet size diagram for a Lechler spillback nozzle lance



Measurement set-up
Laser-Doppler particle analyser

Liquid film desintegrating into droplets

Computer aided data acquisition



A line of measurements flasks with electronic evaluation for measurement of liquid distribution

Contact us now

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