

Dedusting with
Venturi scrubbers



Körting

THE EJECTOR COMPANY

Körting
Venturi scrubbers

The dedusting specialists

Venturi scrubbers

FROM PLANNING TO COMMISSIONING

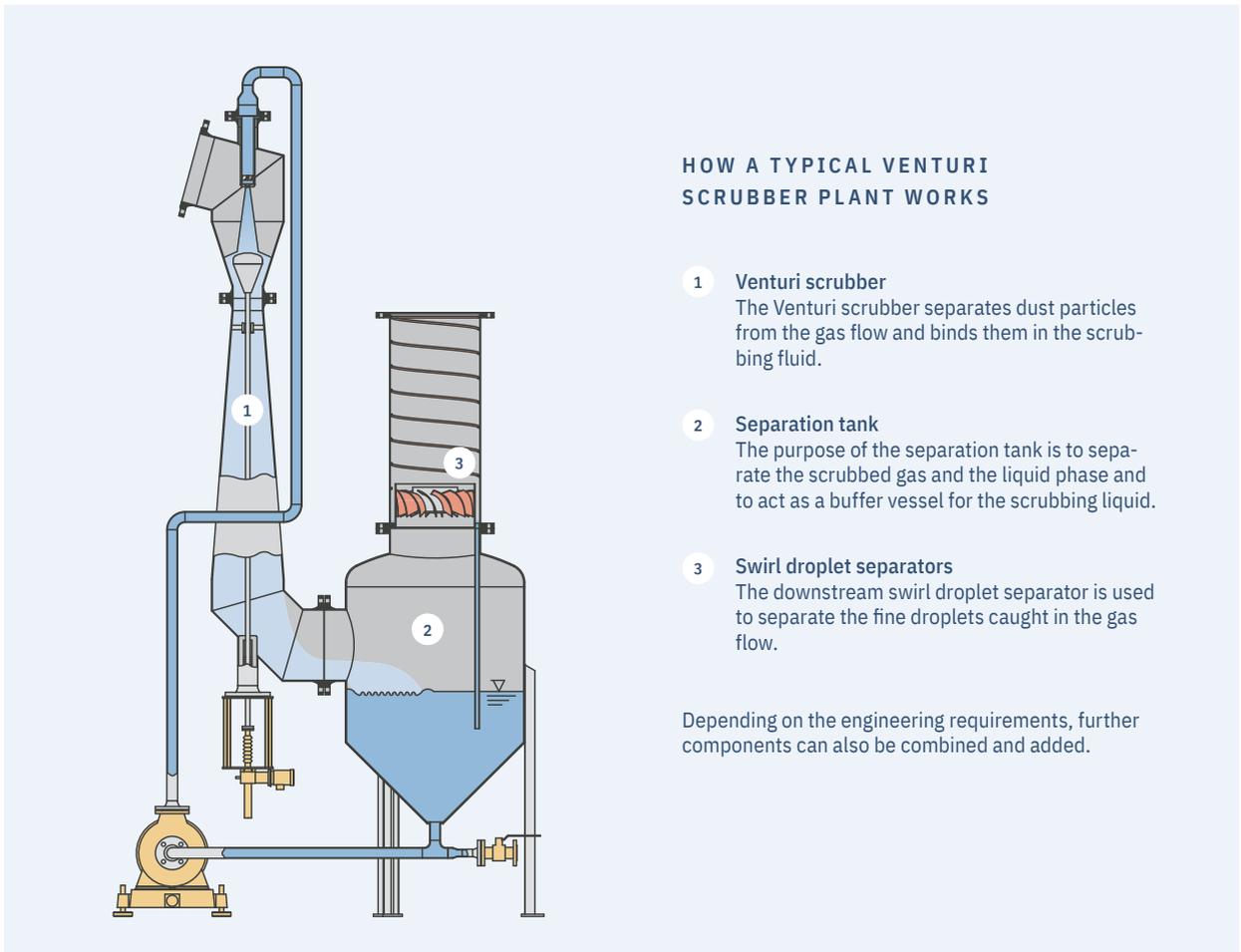
Venturi scrubbers are mainly used for: **Dedusting**

The gas enters the jet scrubber either from the side or from the top. In the same direction of flow as the gas, liquid is injected into the scrubber through a single nozzle or an evenly spaced array of nozzles at the top.

The combined flow is then massively accelerated because it's directed through the steadily narrowing Venturi throat. In contrast to the liquid drops, the gas and the dust particles quickly reach speeds of up to 150 m/s. Very high relative velocities between the gas, particles of dust and liquid occur.

The resulting shearing forces break up the liquid drops into tiny droplets. At the same time, due to their mass inertia, the dust particles in the gas flow can no longer follow the gas flows. They are hurled onto the droplets and separated out.

The level of energy transfer required to generate high relative velocities is expressed in the Venturi scrubber's pressure consumption. This is compensated for by a mechanical blower as the Venturi scrubber doesn't convey itself. The Venturi scrubber is ideal for **separating dust with particles of less than 3 µm**.



HOW A TYPICAL VENTURI SCRUBBER PLANT WORKS

- 1 **Venturi scrubber**
The Venturi scrubber separates dust particles from the gas flow and binds them in the scrubbing fluid.
- 2 **Separation tank**
The purpose of the separation tank is to separate the scrubbed gas and the liquid phase and to act as a buffer vessel for the scrubbing liquid.
- 3 **Swirl droplet separators**
The downstream swirl droplet separator is used to separate the fine droplets caught in the gas flow.

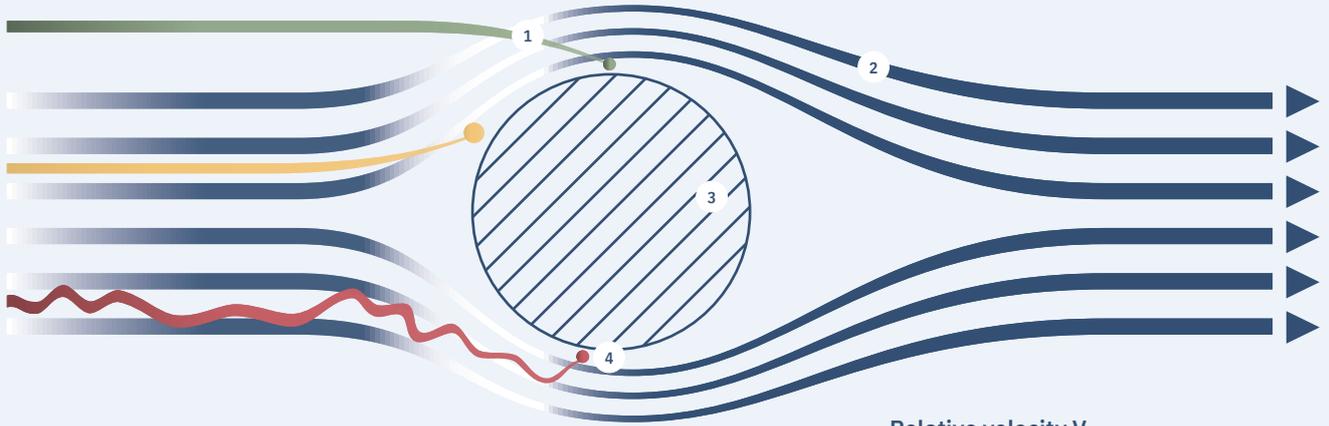
Depending on the engineering requirements, further components can also be combined and added.

Dedusting system at Beta Renewables for bioethanol production from agricultural waste. The Körting Venturi scrubber scrubs steam containing organic substances and ensures the process is very energy efficient.



BENEFITS OF THE KÖRTING VENTURI SCRUBBER

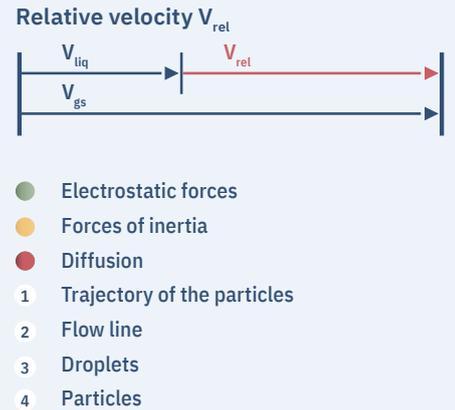
- Simple and compact designs
- Low maintenance
- High degrees of reliability and availability
- No fire risk in the scrubber
- Low investment costs and low maintenance



THE HIGHWAY EFFECT

The separation efficiency of the Venturi scrubber is gauged by the pressure consumption of the gas. This is proportional to the relative velocity. The higher the relative velocity and therefore the pressure consumption, the smaller the size of dust particles that can be separated. This process is comparable with

flies getting caught on a car windscreen on the highway. The higher the speed of the vehicle, the smaller the size of the flies that are caught on the windscreen. This is why this process is called the highway effect.



The highway effect reflects the principle of the Venturi scrubber's separation capability.

DEDUSTING AND SEPARATION EFFICIENCY

Dedusting depends on:

- The diameter and density of the particles
- The number and diameter of the droplets
- The relative velocity between the droplets and particles

The greater the density of the dust, the diameter of the particles, the relative velocity and the greater the number of tiny droplets, the better the separation efficiency.

If the particle size distribution is known, the energy consumption required (ventilator power) to achieve a certain total separation efficiency can be determined on the basis of fractional separation efficiencies. If the particle size distribution isn't known, the separation efficiency can't be calculated. In this case, further on-site investigations, or estimations and hypotheses are required.

In the table below, separation efficiencies of Körting Venturi scrubbers are listed depending on the scrubber's gas pressure consumption. Intermediate values can be approximated by linear interpolation.

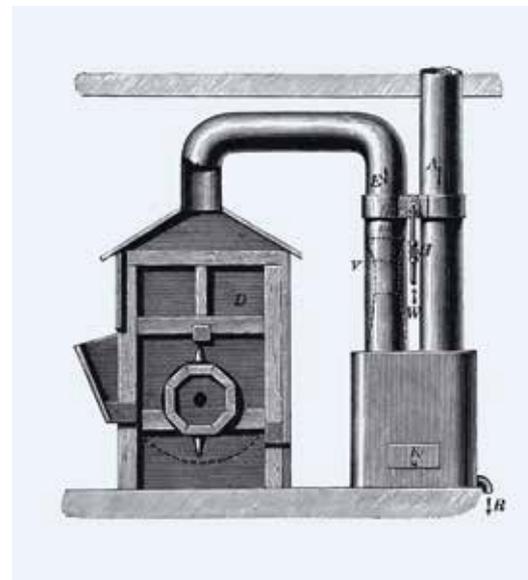
Separated particle size [µm]	Separation efficiency [%] Pressure consumption			
	- 10 mbar	- 20 mbar	- 50 mbar	- 100 mbar
0.01	0	0	0	0
0.05	0	0	0	60.0
0.1	0	0	30.0	90.0
0.5	60.0	80.0	94.0	98.0
1.0	90.0	92.0	96.0	99.1
2.0	95.0	96.0	98.5	99.5
10.0	99.2	99.4	99.5	99.5

APPLICATIONS

Wet operation enables separation of dust in the following cases:

- Where the dust has critical characteristics, i.e. it's hygroscopic, swells or is sticky, which rules out dry separation in bag filters
- After drying systems
- When it comes from steam systems with a hot condensate as scrubbing liquid
- After firing processes (e.g. soot) where the hot flue gas is cooled at the same time
- When it arises from filling mixing and stirring systems

Körting's first Venturi scrubber in 1885



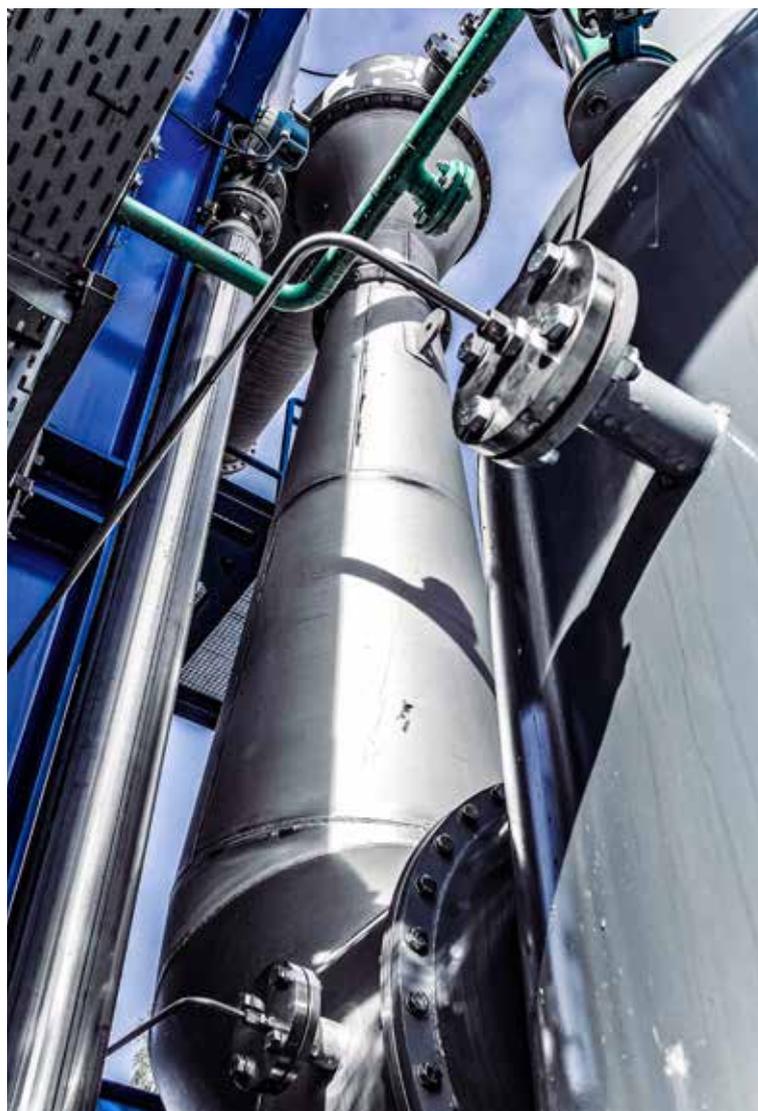
SIZES

Körting Venturi scrubbers are only supplied as customised solutions for gas flows of 1,000 to 125,000 m³/h, in single or multi-stage designs.

MATERIALS

The Körting Venturi scrubbers are supplied in:

- Carbon steel, stainless steel
- Coated steel: (rubber, Halar etc.)
- Plastics: fibreglass, PP, PVC, PVDF reinforced and non-reinforced
- Special materials



Venturi scrubber

ADJUSTMENT DEVICE

If gas loads vary, a height-adjustable displacer can be fitted in the Venturi scrubber's dedusting section. The displacer changes the cross-section of the Venturi throat to suit the actual gas flow. It maintains a constant relative velocity and difference in pressure required for the dedusting process.

Fitting a displacer has the following benefits:

- Consistent pressure ratios ensure consistent dedusting
- The ability to change the pressure difference to the degree of dedusting required

Pressure transmitters on the Venturi scrubber's gas inlet and outlet record the differential pressure which is changed by the adjustment device. The displacer in the Venturi scrubber is controlled via motorised lifting spindle gear and therefore adapted to the application concerned.

A purely manually operated adjustment device (a handwheel) is available on request.

KEY FIGURES

Gas volume flow	[m ³ /h]	1,000 ... 125,000
Liquid requirement per m ³ of gas	[l/m ³]	0.5 ... 2
Liquid pressure	[bar g]	2 ... 3
Relative velocity	[m/s]	30 ... 150
Pressure differential	[mbar]	- 10 ... - 150
Dust separation efficiency (0.1 µm / 1 µm)	[%]	90 / 99 (100 mbar)
Energy consumption	[kWh/1,000 m ³]	0.5 ... 6.5

PILOT EQUIPMENT

A transportable pilot scrubber for gas flows of 1,000 m³/h is available to investigate and try out new applications.

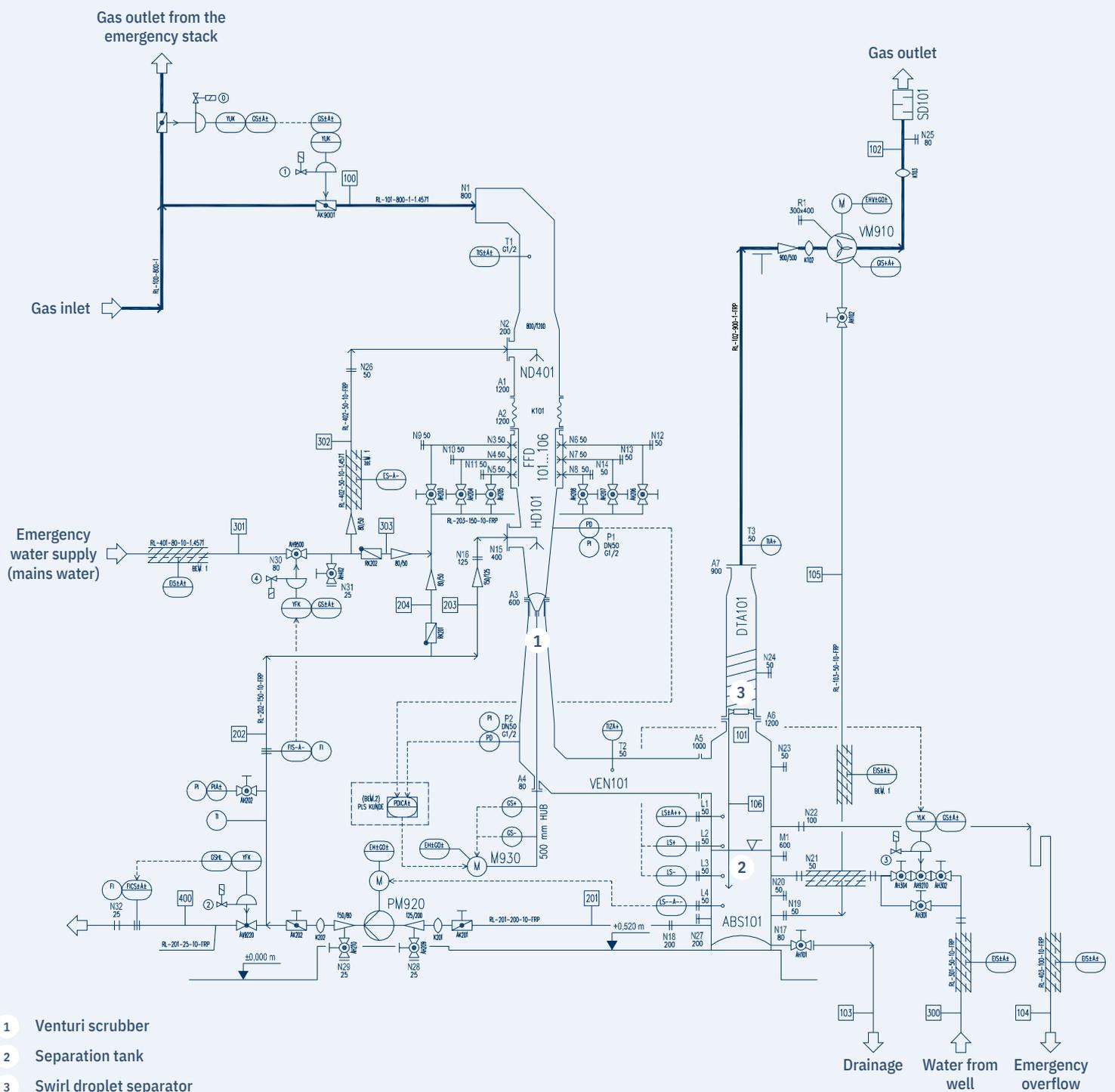
Mobile pilot Venturi scrubber





For a practical questionnaire to answer an enquiry for a quote quickly and more information, go to: koerting.de/en/venturi-scrubber.html

Flow diagram of an adjustable Venturi scrubber with internal rinsing and upstream emergency quench



- 1 Venturi scrubber
- 2 Separation tank
- 3 Swirl droplet separator



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