

## General Description of the Plant

### Counter-Current Scrubber

#### 1. Wet Separation

In the air treatment, it is usually matter of components harmful to environment and health, which should meet very low clean gas values. One particularly cost-efficient solution for this task is the counter-current scrubber.

The principle of the counter-current scrubber is wet separation of contaminants from the gas phase into the liquid phase. The waste gas and its malodorous particles arise through a packed bed from the bottom to the top of the scrubber while washing liquid flows from the top downwards. Thus, the gas to be cleaned flows in counter-current of the washing liquid.

Through this contact between waste gas and washing liquid, the contaminants and solid particles are separated by physical or chemical absorption, oxidation or condensation. The contaminants accumulate in the liquid phase and can be eliminated after a while. When high concentrated contaminants are present in the waste gas, chemicals such as oxidants, acid or caustic are added to the washing liquid to increase the separation.

#### 2. Function Principle

The scrubbing liquid streams from top to bottom passing through the packing bed and accumulates in the built-in sump. On the other hand, the untreated air flows upwards through the packing media. Through counter-current principle the highest scrubbing efficiency of toxic and malodorous gases can be achieved. In this fashion, gases such as chlorine, ammonia, vapors of hydrochloric acid can be eliminated with efficiency of more than 99 %.

We use high performance packing material, which can warranty optimal mass transfer by lowest pressure lost. The special geometry and arrangement of them force the constant splitting and formation of scrubbing liquid droplets, which boost the transfer of air pollutants to the liquid phase. Depending on the type of contaminants acidic, alkaline or oxidative scrubbing liquid will be applied. The chemicals will be dosed automatically through pH-regulated Dosing pumps. Our scrubbers can be fabricated either from GRP or Thermoplastics depending on the type of washing liquid.

Typical application are the separation of inorganic and organic acids (HCl, HF, SO<sub>2</sub>, NO<sub>x</sub>, Acetic acid) as well as H<sub>2</sub>S, Ammonia and water-soluble organic compounds such as acetone, alcohols and etc.

Counter-current scrubbers are used mainly for waste gases with only few components of similar physical quality. One application is the treatment of NH<sub>3</sub> with acid washing liquid or H<sub>2</sub>S with alkaline washing liquid.

Counter-current scrubbers are generally operated with overpressure. Therefore, the fan can be installed in parallel height with the washing scrubber. The scrubber housing itself leads to a good noise protection.

The emission point at the top of the scrubber can be set even higher by installing a stack on top of the scrubber.

Counter-current scrubbers are in particular applied in the following industries: chemical industry, food industries, metal processing, composting plants, sludge dryers, wastewater treatment plants, and mechanical-biological solid waste treatment.

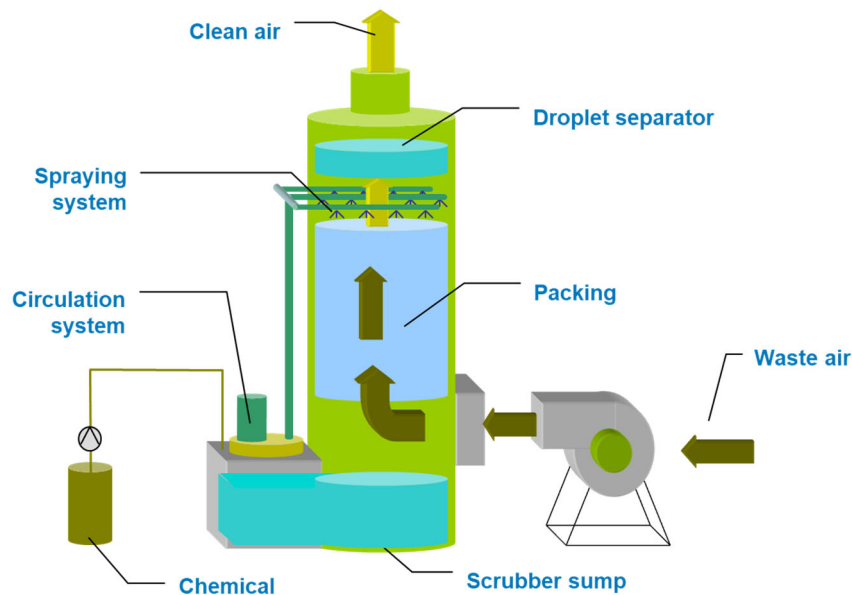


Figure 1 Function principle

### 3. Components of plant

#### 3.1 Washing liquid circulation / Packing bed

Generally the washing liquid is recirculated. A recirculation pump extracts the scrubbing liquid from the integrated scrubber sump providing a constant liquid flow through the pipeline and the spraying nozzles. The full cone spiral nozzles are very widely opened, nearly plugging-free and ensure homogenous spraying of liquid on the packing bed. The washing liquid then trickles from the top to the bottom of the packing bed and washes out contaminants from the counter flowing air stream.

##### 3.1.1 Recirculation pump

We use very robust and corrosion-free vertical or horizontal chemical recirculation pumps made of thermoplastic. All parts in contact with the liquid are very resistant and well suited for the aggressive and abrasive washing medium as well as for the contaminants and chemicals transferred into the liquid phase.

##### 3.1.2 Packing material

Main function of the packing material is to increase the transfer of the contaminants from the gas phase into the liquid phase. This is mainly possible due to the very high active surface able to hold up a big amount of washing liquid.

We use packing material with over 100 m<sup>2</sup> surface per m<sup>3</sup> filter bed. Through the special construction of the packing material (open structure, widely spaced and therefore high free volume) plenty of washing water droplets are built on the surface. These droplets are segmented and re-shaped constantly allowing the absorption process of the contaminants in the liquid phase to be renewed continuously.

### 3.1.3 Droplet separator

Following the packing bed the air is led into a droplet separator. Its function is the separation of the washing water droplets from the pre-cleaned gas. Our droplet separators are nearly plugging-free with high efficiency and low pressure loss.

### 3.2 Measurement and control of the plant

The standard measurement and control of our scrubber includes:

- Level control of the scrubber sump with automatic water re-fill
- Protection against dry running of the recirculation pump
- Pressure gauge to indicate the pressure upstream of the spraying nozzles
- pH-value-control when acid or caustic is added
- Water meter to register the fresh water consumption
- Sump heater with thermostat against frost

The following optional measurement can be offered:

- Temperature monitoring to prevent possible danger originating from hot waste gases
- Fan speed range monitoring
- Analytical measurement of the untreated and clean gas
- Operating hours counter for all electrical drives
- Flow monitoring for the recirculation line
- Pipe heating for outside installation
- Measurement of the air volume

### 3.3 Dosing system

The dosing of acid, alkali or oxidative chemicals will be carried out through suitably dimensioned dosing pumps. Solenoid diaphragm pumps include our standard configuration. The parts in contact with chemicals will be selected accordingly.

The pumps will be controlled through measuring sensors and transmitters. Via this automatic operation, chemicals are be dosed controllably leading to an optimal dosage and cost-effective operation.

## 4 Materials of the plant

The scrubber shell, the recirculation pipeline and all other equipment in contact with the washing liquid (packing material, grids etc.) are built of corrosion-resistant plastic.

The scrubber shell - our scrubber type - G - is manufactured from corrosion-free glass fiber reinforced plastic (FRP/GRP). The shell is produced as a laminate by a filament winding machine. This laminate consists of high quality polyester resin, woven roving and chop strand mat.

The inner side of the scrubber shell is coated with a special chemical protective layer. The outside is provided with a pigment layer containing UV-absorbers (colour according to customer's request). This method allows a durable protection as well as a long lifetime of the scrubber.

## 5 Delivery / Installation

We deliver our scrubbers mostly in one module. Our well-practiced installation staff installs the complete scrubber on site as follows:

- Supervision of the positioning of the plant equipment
- Installation of the recirculation pump
- Filling-in of the packing and installation of the grids
- Installation of the recirculation pipe
- Connecting of the supply and disposal lines which are provided by the customer
- Installation of the measuring equipment

## 6 Characteristics at first sight

- Air stream from the bottom to the top
- High separation results / high efficiency
- Low investments and operation costs
- High flexibility against variable waste gas amount
- Optimal consumption of fresh water and added chemicals
- Little space demand / compact size
- Low pressure loss
- Corrosion resistant
- Weather resistant
- Low risk of plugging due to the structure of the packing material
- Easy overview and easy handling of the display
- Possible use as a bio-scrubber



Figure 2 two stage counter-scrubber