Application of tensid mixed fog for seperation of organic/biologic aerosols

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Abstract

The purification process in the atmosphere by fog and clouds is the most effective way to remove aerosol particles even in industrial applications. We have developed a seperation device which imitated the natural process by artificial fog produced for industrial use. Tensids added to the water are coating the tiny fog-droplets. This coating enable the fog to absorb organic emissions as well as biologic active aerosols high efficiently. Within a very short time of contact the adsorbed material will be removed together with the fog-droplets. This presentation will show first application at an industrial site.

Keywords : adsorption aerosol, waste-air purification, germ reduction, germ seperation

Introduction

New emission rules for the release of organic and biological active aerosols lead many companies in the industrial and agricultural sector to serious problems. CFU, (colony forming units) by bacteria, fungus and virus are hard to be removed out of the airstream. Our technique will help these copnpanies to catch the limits.

By using tiny, floatable fog-droplets a very efficient adsorption medium at low costs is created.

Droplets produced with with special laser drilled nozzles at 50 – 70 bar pressure.

They have a diameter of 5 – 20 micron, like natural fog.

The fog is airborne and therefore remains in the air-mass up to several minutes (figure 1).

1 gram of water dispersed as fog has a surface area of approximately 0.5 m². Aqueous fog can be acidic and alkaline activated and is in this form very efficient to reduce gases like H_2S and NH_3 in the exhaust air. The time needed to neutralize pH active gases with pH activated fog and is less than 1 second.

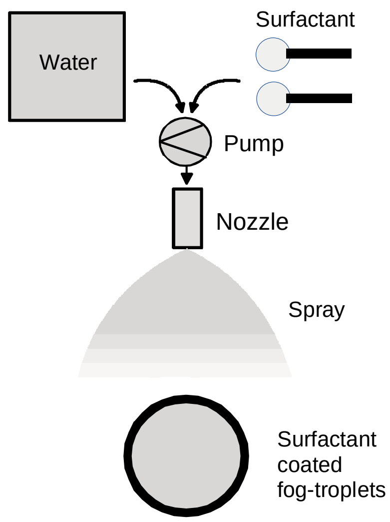

Figure 1:
Water containing an mixture of surfactants is sprayed by high pressure nozzles to generate a fog

The efficiency of adsoption of organic and odorus substances are strongly increased by mixing of only one percent of the patented additive tensids in fog droplets.

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Tensides are amphiphile molecules which combine a lipophilic and a hydrophilic part (figure 2).

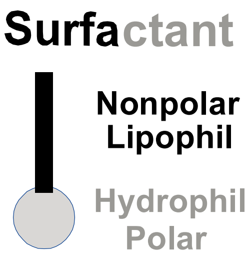


Figure 2:
Structure of a tensids

Tensids settle rather fast on the fog-droplets surface and cause an organic, lipophilic skin around the droplet.

The composition of tensids can be optimized for different types of emission „Tailer made Fog". Even high hydrophobic substances are adsorbed.

The adsorption efficiency relays on the total surface area of the fog. The surface area is controlled by the droplet size and the total mass of fog water

Aerosol particles and organic molecules are reaching the surface of fog droplets by turbulence and molecular diffusion motion, where they were adsorbed (figure 3).

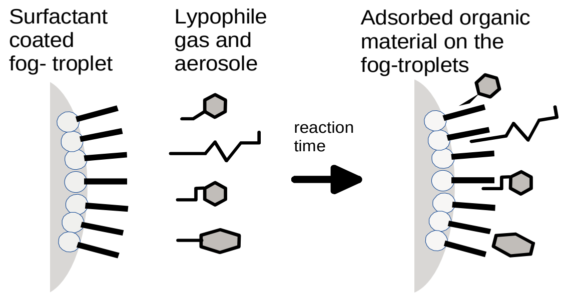


Figure 3:
Organic molecules and aerosol particles are connecting on the surface of the droplets where they are absorbed

Figure 4 shows the efficiency of the procedure as function of the droplet size and time of contact. So far tests were performed with fog droplets in the size range of 1 up to 1000 µm.

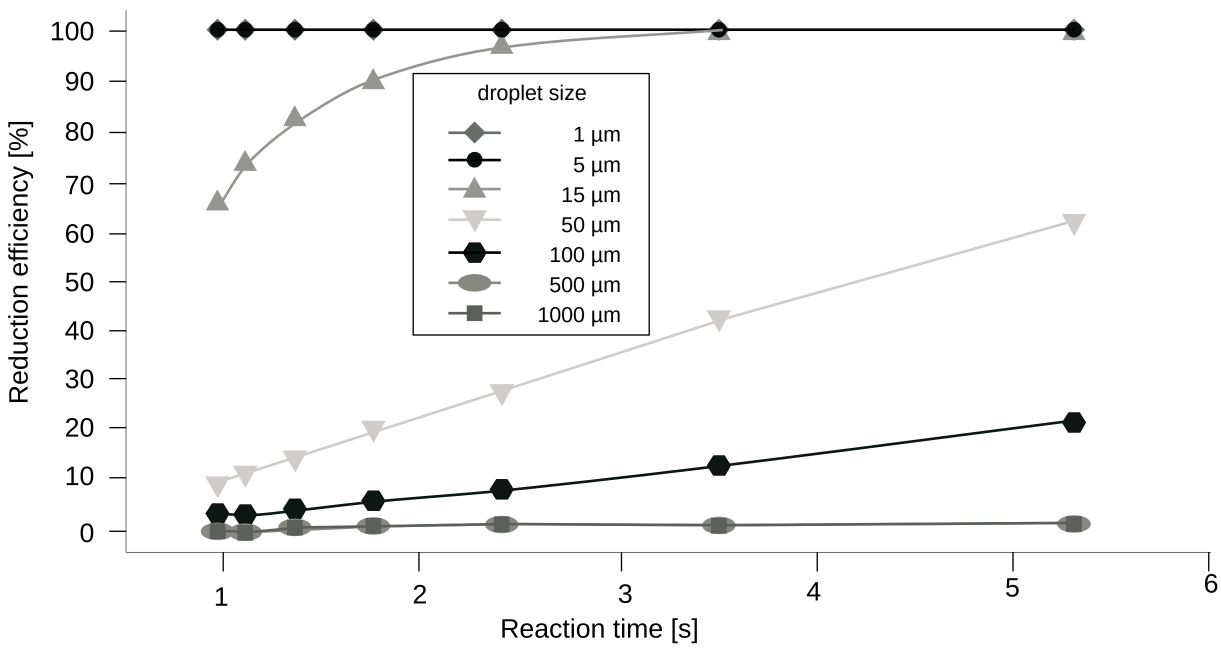


Figure 4:
Efficeiency of smell reduction as function of time of contact and droplet size

Pollutants absorbed by fog-droplets can be scavenged by the aid of demisters.

With this set up, air-pollutants are separated from the air together with the reagents (figure 5).

A sterilisation of the germs is not necessary they are washed out by the demistor.

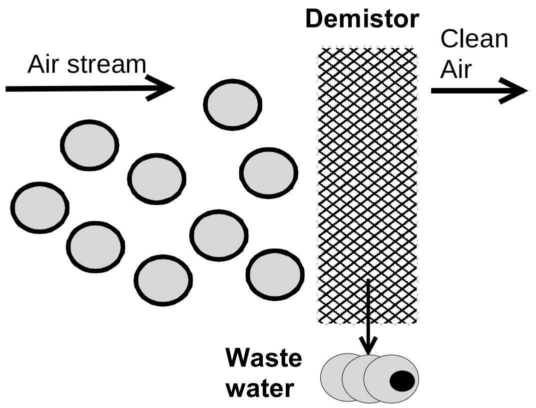


Figure 5:
Separation of fog and germs

10 g of fog activated with tensids per m³ waste air is able to eliminate more than 80 % of colony forming micro organisms within 5 seconds of contact. After contact the fog is separated with a demistor and all absorbed aerosols are removed. The result is a germ loaded liquid to be drained off in the reaction container and is run off into the sewagesystem (figure 6).

Sofar installed systems were build in customary containers. The fog is created by applying fog-nozzles at the air-inlet of the container. The containers are finished with stainless steel sheet-metal and can handle up to 50.000 m³ air flow per hour for germ reduction. Smaller units for tests are available (figure 7 and 8).

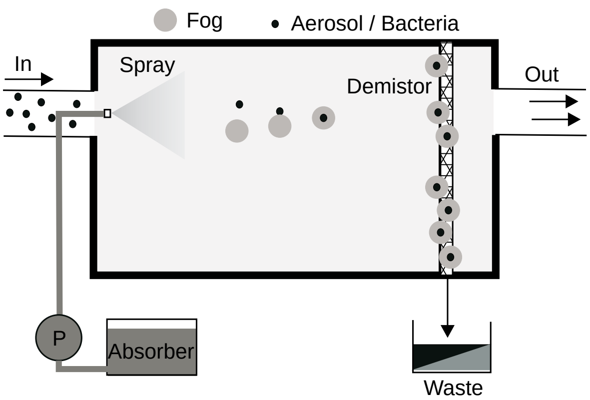
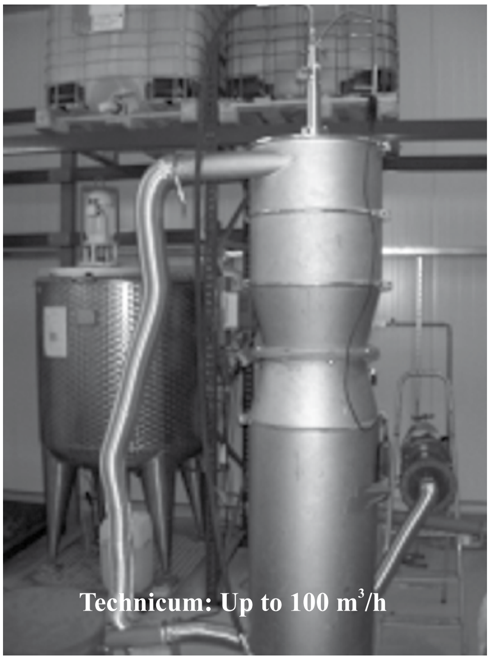


Figure 6:
Schematic diagram of the adsorption-container

Figure 7:
Setup with standard container (20 Feet), air flow 30 000 m³/h, water 300 l/h and 40 Nozzle; picture: Fog Systems

Table 1:
CFU number concentration taken before and after the separation container.
Values certificated by SGS Institute Fresenius

Before container		After container	
Cladosporium spp.	7500	Cladosporium	1375
Penicillium spp.	2500	Sterile colonies	63
Aspergillus flavus	1750	Acremonium sp.	25
Aspergillus fumigatus	1625	Alternaria sp.	25
Aspergillus niger	1250	Botrytis sp.	25
Aspergillus nidulans	375	Aspergillus fumigatus	<25
Sterile colonies	375	Aureobasidium pullulans	<25
Sum	**15375**	Penicilium sp.	<25
		Sum	**1558**



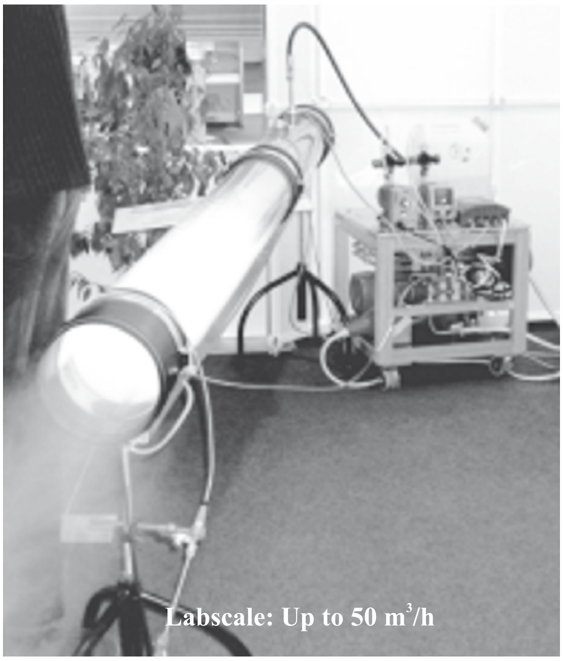


Figure 8:
Tests and measurements are possible in various fields of application and in different scales

The effectiveness of the procedure was shown predominantly so far in the field of smell reduction.

First results in the industrial and laboratory range show very high efficiencies of germ seperation.

Coming research projects shall show the efficiency of the system with virus infected waste air-treatment.

Table 2:
References and Projects

Life stock	Test in pig farms (>1000 animals) *pH <7 / 2% surfactants reduction 95% GE*
Textile processing	Burned cotton *pH mix / 2% surfactants reduction >94% GE*
Emissions from mixing vessels	Bitumen + Oil + mineral dust *pH >7 / 2 % surfactants reduction 96% GE*
Emissions from steel plants	Gaseous comp. from selective process steps *pH >7 / 2% surfactants reduction 96% GE*
Waste treatment site	Decomposition of gases (aerob and anaerob) *pH mix / 2% surfactants reduction 85% GE*
Waste treatment site	Germs in sorting area for waste goods *pH < 7 / 2% surfactants reduction KBE >90%*

GE = Odor Units

KBE = CFU

Acknowledgement

The support by the Deutsche Bundesstiftung Umwelt DBU and BASF AG Ludwigshafen, Germany is gratefully acknowledged.

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