English	Definition
Acid scrubber	Belonging to the category of chemical air cleaners, this is a trickling filter in which the pH of the washing liquid is kept at low levels (pH < 5) through the addition of acid (usually sulphuric acid) in order to remove ammonia from the contaminated air. The ammonium ions produced by the chemical reaction between NH_3 and the acid is removed from the system with the discharge water. Due to the low pH-value, microbial degradation does not take place. Therefore, odour reduction is relatively insignificant and subject to considerable fluctuations.
Additive (directly added)	A product or substance, manufactured or naturally occurring, that is added to manures with the purpose of modifying their biological, chemical, or physical properties. Examples: Acids and acidifying compounds, Adsorbents, Bacterial enzyme preparations, Disinfectants, Masking agents, Oxidising agents, Plant extracts, Polymers, Urease inhibitors
Air cleaner	An end-of-pipe installation for cleaning the exhaust air of forced-ventilated animal housing systems from specified contaminants, such as odour, ammonia, and dust.
Air flow	The volume flow of exhaust air in $m^3\ h^{-1}$ can be given for the entire animal house or per animal (place). If the system is based on **partial air cleaning**, the total airflow is split into two airflows: an airflow going through the air cleaner and an untreated airflow blown directly out into the surroundings. When the external dimensions of a filter are evaluated, or when the air filter is subsequently up/downscaled on another farm, the air flow per area of front filter in $m^3\ h^{-1}\ m^{-2}$ is a basic parameter. The air flow can also be given per filter volume in $m^3\ h^{-1}\ m^{-3}$, which is the reciprocal value of the retention time.
Air purifier	See 'air cleaner'.
Ammonia (NH_3)	A gas derived from livestock manure by the transformation of urea excreted by livestock or uric acid excreted by poultry; it is implicated in the acidification and nitrogen enrichment of sensitive ecosystems.
Ammonia emission	The process by which ammonia gas (NH_3) is released from a solution.
Animal category	The type of animal according to their species (pigs, cattle, chicken, ducks, turkeys, etc.), sex, age, and scope of production (e.g. breeding, rearing, growing, and finishing for meat; and milk or egg production).
Animal housing system	See 'livestock housing system'
Application rate	This refers to the mass (tons or Mg) or volume (m^3) of manure applied per unit area of land (ha).
Background concentration	The concentration of aerial pollutants in the incoming air.
Biofilter	Installation in which the exhaust air is led through a filter bed, usually consisting of organic material such as root wood or wood chips. The filter material has to be kept moist so that gaseous contaminants are absorbed by the moisture film of the biofilter material and generally oxidised or degraded by microorganisms living on the filter material. In order to compensate for evaporation losses, and to guarantee proper functioning, the exhaust air has either to be pre-humidified, e.g. by a washer, and/or the filter has to be moistened by controlled intermittent irrigation. Biofilters are mainly used to eliminate odours in housings with no bedding material. They can also be used for dust separation if coarsely structured filter material, which does not tend to clog, is used, at least on the crude gas side. Biofilters, as a sole process stage, are not suitable for ammonia separation.

Biotrickling filter	A trickling filter for the removal of dust, ammonia, and odour by means of absorption of the contaminants in the liquid phase and degradation by microorganisms settling on the filter elements as a bio film. Ammonia is degraded by a bacterial conversion to nitrite and nitrate, a process called nitrification. The accumulated nitrate, especially nitrites that may be toxic to microorganisms, has to be removed with the discharged water.
Broadcasting	A type of manure spreader that spreads the manure over the whole surface of an area of land.
Chemical scrubber	A trickling filter that removes pollutants by means of absorption of the contaminants in a liquid phase with specific chemical properties. In the case of using pH to facilitate pollution removal, the pH value could be obtained by the addition of an acid, e.g. sulphuric acid (see acid scrubber), or by the addition of a base.
Compartment	The separate part of an animal house with its own ventilation and manure system.
Cover technology	Cover systems for manure storage facilities can be divided into cover systems that float on the manure surface - **floating covers** - and roof systems covering the manure storage facility - **roof systems**. See below.
(Deep) injection in uncropped land	The application of liquid manure by direct incorporation into the soil. This can be achieved by vertical slots, typically about 150 mm deep, cut into the soil by specially designed tines. Deep injection tines may be fitted with lateral wings in order to increase the lateral dispersion of slurry into the soil. To directly incorporate the manure, different kinds of tillage implements may be used. It is mainly used to reduce the emission of ammonia but it also reduces the emission of odour.
Denitrification unit	Biological denitrification units are used for removing oxidised nitrogen species originating from NH_3 in polluted air. Denitrification is a biological process in which bacteria use one or more of the oxidised nitrogen species, i.e. nitrate NO_3^-, nitrite NO_2^-, nitric oxide NO, and nitrous oxide N_2O, for respiration under anoxic conditions while degrading organic material. The ultimate end product of denitrification is atmospheric nitrogen, N_2, which is harmless in the environment, and N_2O which must be minimised through the controlled denitrification process. Prior to denitrification, NH_3 has to be oxidised within the air cleaner or in a separate unit external to the air cleaner. The growing of nitrifiers strictly depends on temperature. Therefore, it is recommendable to avoid energy losses as far as possible. Good operational results will be achieved at temperatures above 15°C, otherwise the growing of the nitrifying bacteria and nitrification rates are very low.
Downtime	The period of time when the system tested is not operating as a result of malfunctions.
Dust	Also referred to as 'particulate (or particular) matter'.
Emission value	The emission level of a given pollutant from an animal house into the atmosphere, which can be expressed as the integrated mass emitted per time interval and animal produced (e.g. kg $year^{-1}$ $animal^{-1}$), livestock unit (e.g. OU_E s^{-1} LU^{-1}), or per m^2 floor (e.g. kg $year^{-1}$ m^{-2}). It may also be expressed as a percentage (e.g. % total ammoniacal nitrogen or total nitrogen).
Enrichment factor	The ratio of the concentration of a compound in a specific output fraction to its concentration in the input fraction.
Feed composition	A description of the individual ingredients and their nutritional value that constitute a feed formula/diet.
Feeding technique	A description of the technical installations for mixing, transporting, and dispensing the feed to the animals, which can be applied in solid or liquid form.
Filter area	The front area of the filter where the air flows in is based on the external dimensions of the filter (m^2). The specific filter area is the area of the filter material per volume of filter element (e.g. m^2 filter or m^3 filter element).

Floating covers	<u>Fabric membrane:</u> • floats directly upon the slurry surface. Water collected on the membrane needs to be pumped away; • is suspended from the rim of the store and floats on the slurry surface. Water collected on the membrane needs to be pumped away. <u>Floating layer:</u> • natural crust, which may be formed by the content and residues of the slurry; • chopped straw, which is applied upon the surface of the slurry; • solid manure, which is applied upon the surface of the slurry; • LECA pebbles, which are applied upon the surface of the slurry; • granules or structures made of degradable or non-degradable floating elements, which are applied upon the surface of the slurry.
Floor design	The floor type, e.g. a solid (concrete) floor, including the use of bedding material, or a slatted floor. The slats can be made of metal, concrete, or plastic.
Greenhouse gas (GHG)	Gases that contribute to the 'greenhouse effect' and global warming, primarily including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).
Heating system	An installation for the production, transportation, and distribution of heat in the housing system.
Incoming air	This is preferred to the term 'background' (air) to distinguish the effects of nearby emission sources from the 'clean' background.
Land application	The distribution of manure onto land by any method.
Liquid fraction	The liquid or thin fraction derived from the mechanical separation of slurry.
Livestock housing system	A unit with the primary function of providing housing for a specified animal category and with a specific design, equipment, and management that determines its environmental performance. This includes the way that a certain animal category is stocked (e.g. floor and pen design), the manure storage and management system, the ventilation system installed to control the indoor climate in the building, and the type and regime used to provide feed and water to the animals. In addition, it can be divided into separate compartments or different functional areas.
Livestock unit (LU)	A unit used to compare or aggregate numbers of animals of different species or categories. Often 1 Livestock Unit = 500 kg live weight of an animal category. Other equivalences are defined on the feed requirements (or sometimes nutrient excretion).
Manure	A general term denoting any organic material containing excreta from the digestive system of livestock that supplies organic matter to soils and nutrients to plants, usually in lower concentrations when compared to inorganic fertilisers.
Manure system	The collection and removal of slurry or manure out of the housing system, e.g. by gutters, channels, and scrapers.
Multi-stage cleaning system	Multi-stage exhaust air cleaning systems, usually consisting of two or three stages, combine different cleaning principles and their advantages (see Table 1), e.g. an improved ammonia separation by an acid scrubber with an optimal odour degradation in a biofilter.
Norm emission factor	The description of an emission factor for a standard housing system, which is used as a reference standard factor in individual countries.

<table>
<tr><td>Odour</td><td>A pleasant or unpleasant smell caused by different odorants with very different chemical, physical, and biological properties. The odour concentration is given in European Odour Units per cubic metre of air (OUE m^{-3}), and the concentration is measured by olfactometric analyses in accordance with European CEN standard EN 13725.</td></tr>
<tr><td>Particulate matter (PM)</td><td>Often also called dust.
Fine solid or liquid particles suspended in a gaseous medium.
Different fractions are specified by the aerodynamic diameter as well as by the sampling and evaluation method as defined in the respective standards; for example:
<table>
<tr><th>Term</th><th>Definition</th><th>Standard</th></tr>
<tr><td>PM10</td><td>‘Particulate matter that passes through a size-selective inlet with a 50% efficiency cut-off at 10 µm aerodynamic diameter.’</td><td>EN 12341</td></tr>
<tr><td>PM2.5</td><td>‘Particulate matter that passes through a size-selective inlet with a 50% efficiency cut-off at 2.5 µm aerodynamic diameter.’</td><td>EN 14907</td></tr>
<tr><td>Inhalable dust (ID)</td><td>Total airborne, finely divided solid and liquid particles, which are inhaled through the nose and mouth, generally with an aerodynamic diameter of more or less equal to PM100.</td><td>ISO 7708
EN 481</td></tr>
<tr><td>Total dust (TD)</td><td>Airborne particles that can be collected using 37-mm filter cassettes.</td><td>NIOSH 0500</td></tr>
<tr><td>Total Suspended Particles (TSP)</td><td>Archaic term used by US-EPA before PM10 was introduced: ‘Particles up to 25-50 µm, depending on wind speed and direction’. Relates roughly to a PM35.</td><td>40 CFT 50
appendix B</td></tr>
</table></td></tr>
<tr><td>Pen</td><td>A small enclosure for livestock, either within a house or outdoors.</td></tr>
<tr><td>Pen design</td><td>The structuring of a pen with separate areas for lying, feeding, and defecation. Single area pens are not structured.</td></tr>
<tr><td>Physical air cleaners</td><td>Experimental installations where odorants are intended to be oxidised with the aid of UV-radiation, ozone, or a plasma reaction technology. Since the effectiveness of these techniques and others that are currently being developed have not yet been proven in practice to reduce the emission of dust ammonia and odour at a reasonable cost, they are not described in detail here.</td></tr>
<tr><td>Point extraction</td><td>See ‘air flow’</td></tr>
<tr><td>Pressure drop</td><td>The pressure drop [Pa] across the air cleaner or across the entire system (animal housing and air cleaner) could be presented as a curve or table for different airflow rates ($m^3\ h^{-1}$). The ventilation fans must be sufficiently pressure stable so as to be able to overcome the flow resistance of the animal housing and the exhaust air cleaning system at all times in order to supply the animals with the required air rates, in particular under summer conditions.</td></tr>
<tr><td>Processing</td><td>Treatment</td></tr>
<tr><td>Recovery factor</td><td>See separation efficiency</td></tr>
<tr><td>Retention time</td><td>The retention time [s] is the time period or length wherein the air penetrates the filter of the air cleaner.</td></tr>
<tr><td>Roof systems (cover technology)</td><td><u>Tent roof:</u>
Tent roofs have a central supporting pole with spokes radiating from the top. A fabric membrane is spread over the spokes and is tied to a rim bracing. Tent roofs need to have ventilation openings in order to avoid the risk of methane accumulation.</td></tr>
</table>

	<u>Rigid covers:</u> A rigid cover can be a flat deck or a conical roof. It is usually designed at the outset and is erected at the same time as the store. A flat deck is usually made of concrete, while conical roofs can be made of fibre glass. A flat deck usually has to be supported by bars.
Separation efficiency	A measure of the efficiency (recovery factor) of a separation process. Several expressions exist, e.g. the enrichment factor: $SepEf_P = (M_{output1} \cdot C_{P\_output1})/(M_{input} \cdot C_{P\_input})$ $SepEf_P$ = separation efficiency for a specific compound P [%] M = mass flow [kg/h] C_P = concentration of a specific compound P [g/kg] The separation efficiency specifies the proportion of a compound that ends up in a specific output stream (recovery factor).
Separation technologies	Technologies that divide liquid livestock slurry or digestate from biogas plants into one or more solid fractions and one or more liquid fractions, examples of which are screw presses, mechanical screen separators, gravity sedimentation techniques, decanting centrifuges, chemical treatment, and reverse osmosis.
Set of samples	A set of samples includes a sample of the outlet air and a sample of the inlet air, taken simultaneously.
Shallow Injection	A shallow injection comprises a boom that supports a number of injection devices that cut ca. 50 mm slots into the soil into which livestock slurry is placed. It is mainly used to reduce ammonia emissions, but it may also reduce odour emissions.
Slurry	Faeces and urine produced by housed livestock, usually mixed with bedding material and water during management. The dry matter content of slurry is usually in the range 1-10%. Slurry is a mixture of liquid and solid materials, where the majority of the solid material is typically undissolved in the liquid phase, therefore precipitating or floating (depending on weight) in the liquid during longer periods of storage. The water content of slurry is usually higher than 85%.
Solid fraction	A fraction from separation with a higher content of solid material (e.g. dry matter and phosphorus) than the input material. The solid fraction is normally stackable.
Solid manure	The manure produced by housed livestock, which is normally applied with a large amount of bedding material. Solid manure does not flow under gravity and cannot be pumped. There are several different types of solid manure arising from different types of livestock housing systems.
Spreading evenness	The evenness of manure spreading. Spreading evenness has to be considered both in the transverse of the driving direction and in the longitudinal direction.
Spreading width	The width of spread by one pass of a manure spreader.
Standard error	Standard error (SE) of the mean is calculated as follows: SE = SD/√n, were standard deviation (SD) is calculated with the following equation: $SD = \sqrt{\frac{\sum(X_i - \overline{X})^2}{(n-1)}}$. If several measurements of gas emissions from a manure heap have been carried out during the same time interval, one can calculate the SE of the average emission from this storage during the specific time interval. If the emission of ammonia during the same time

	interval has been measured from more than one manure storage containing manure from the same source and stored with the same technology, then one can calculate the SE of the average emission from this 'treatment' and use this SE in the assessment of significant differences between this treatment and another treatment.
Standard housing system	The standard housing system describes the most common animal housing systems in a country.
Trailing foot/shoe applicator	A type of band spreader used for the land application of livestock slurry. It may, for example, comprise a boom that supports a number of hoses, at the opening of which are attached foot- or shoe-shaped devices. The trail shoe applicator distributes livestock slurry in bands on top of the soil, moving away the crop or grass and allowing for the placement of manure underneath the crop or grass foliage. It is mainly used to reduce ammonia emissions and to ensure an even spreading of manure, but it may also reduce odour emission.
Trickling filter	Also called a trickle bed reactor or, more commonly, an air scrubber or air washer. An installation in which the polluted air is passed either horizontally (cross-current) or upwards (counter-current) over filter elements that are continuously or intermittently sprinkled with a washing liquid. Due to an intensive contact between air and washing liquid, the components contained in the contaminated air change from the gas to the liquid phase. Currently, water and diluted acids are used as washing media. The decisive factor for the proper operation of these installations is that the separated substances contained in the exhaust air, as well as the reaction products, are removed from the system by de-sludging, i.e. the draining of polluted wastewater, so that, usually, a fraction of the washing liquid is continuously recirculated; another fraction is discharged and replaced by fresh water and/or diluted acid. The reactor (filter) elements are usually made of an inert or inorganic packing material that has a large porosity, or void volume, and a large specific area in order to improve mass transfer. For the prevention of aerosol emissions into the environment, drip separators are needed in any case. Three types of trickling filters are common: acid scrubbers, biotrickling filters, and water scrubbers (see the individual definitions).
Uptime of the system	The period of time when the tested system is in operation.
Ventilation rate	The ventilation rate gives the volume flow of air (e.g. m3 h-1) through an animal house. It can be given for the entire animal house, per compartment, or per animal (place).
Ventilation system	A system to provide fresh air and to remove gaseous products, heat, and moisture in order to ensure a suitable climate in a livestock building. Ventilation can be designed either as a forced or a natural ventilation system.
Verification	Confirmation that a test has been performed according to a standard.
Water scrubber	A trickling filter that uses water as an absorbent.