Technical Details for Ozone Generator for STP Exhaust Air Treatment

Picture for Illustration purpose only, may vary as per selected Model.

1. Introduction

The problem of bad-smelling odours emanating from sewage treatment plants is turning out to be one of the most serious problems related to the operation of the same, especially when they are located within a residential environment.

The substances responsible for odours into sewage treatment plants are:

- Inorganic products
- Highly volatile organic compounds.

Chemical compounds responsible for odors are:

- Mercaptans,
- Skatoles,
- Indoles,
- Inorganic acids,
- Aldehydes,
- Ketones,
- Organic compounds containing nitrogen or sulphur atoms (Originating from the anaerobic decomposition of compounds with a greater molecular weight, especially proteins)
- Among the inorganic compounds, ammonia and sulphuric acid are the main cause when the sewage comes from mainly household origins because of putrefactive phenomena in reducing environments, leading to generation of H_2S and other smelling by-products.

The following are some of the more widely used parameters to express the concentration of odours:

- Perceptibility threshold (ATC: Absolute Threshold Concentration), defined as the minimum concentration that can be detected by 100% (in some cases by 50%) of the persons involved with an olfactory analysis. In some cases, the geometric mean of the measurements of the single members is used.
- Odour number (TON: Threshold Odour Number), or the number of dilutions needed to reduce the concentration of the sample to the ATC.
- Maximum exposure concentration (TLV: Threshold Limit Value). This represents the maximum concentration at which persons can be exposed for a period of 8 hours a day, 5 days a week and 50 weeks a year (weighted average over 8 hours), for a work life of 40 years.
- Maximum allowable concentration (MAC: Maximum Allowable Concentration), Maximum concentration which should never be exceeded.

Bad smelling compounds released from STPs include:

Hydrogen Sulphide

- Chemical formula : H_2S
- ATC : 0.00047 ppm
- TLV : 10 ppm
- MAC : 50 ppm (USA), 20 ppm (UK)
- Olfactory sensation : Smell of rotten eggs

Ammonia

- Chemical formula : NH_3
- ATC : 46.8 ppm
- TLV : 25 ppm
- MAC : 37.5 ppm (UK)
- Olfactory sensation : Pungent

Methyl Mercaptan

- Chemical formula : $H_3C – SH$
- ATC : 0.0021 ppm
- TLV : 10 ppm
- Olfactory sensation : Smell of rotting cabbage

Carbon Disulphide

- Chemical formula : CS_2
- ATC : 0.21 ppm
- TLV : 20 ppm
- Olfactory sensation : Sweetish, Pungent

Biphenyl Sulphide

- Chemical formula : $(C_6H_5)2 – S$
- ATC : 0.0047 ppm
- Olfactory sensation : Smell of burnt rubber

Dimethyl Sulphide

- Chemical formula : $(CH_3)2 – S$
- ATC : 0.0010 ppm
- Olfactory sensation : Rotting vegetables

Considering such a variety of sources and types of odours, technology today offers basic systems to clean-up the bad-smelling air, such as:

- Chemical oxidation
- Thermal oxidation
- Chemical scrubbing

Sometimes the above processes are used in combination too.

The first category includes treatments with chlorine compounds

- Hypochlorite – (organic by-product formation)
- Chlorine dioxide – (organic by-product formation)
- Chlorine – (organic by-product formation)
- Ozone – eco-friendly technology

OZONE, with the chemical formula O_3, is a highly reactive gas (oxidizer), for which the instability is useful since during the subsequent decomposition process, its oxidizing action is exerted on the organic and inorganic substances, bacteria, viruses, spores, etc. It implements additive, ozone analysis and catalytic mechanisms.

Regarding bacteria and viruses, it acts through a catalytic oxidation of the proteins, brutally destroying their structures (ANTI-MICROBIAL ACTION).

For what concerns the organic and inorganic substances, it acts on the groups which bear the odours using an oxidizing action due to the atomic oxygen or through the information of unstable compounds (ozonoids) which break-up the molecules as they decompose (DEODORISING ACTION).

As an example of the first action, we can illustrate the effect of ozone on urea.

$$NH_2 - CO - NH_2 + 3O_3 \rightarrow N_2 + CO_2 + 2H_2O + 3O_2$$

While for the second action, it is sufficient to recall the elimination of phenyls.

Other typical reactions of Ozone with bad-smelling compounds are:

$$CH_3 - SH + O_3 \rightarrow CH_2 - SO_3H$$

$$R_2 - C{=}CH - R + O_3 \rightarrow R_2 - C{=}O + R - CO_2 - H$$

Ozone produces no harmful by-products since all components are either oxidized to carbon dioxide and water or precipitated out. Main by-product of ozone is oxygen which is a desirable component.

Ozone destroys bacteria and other bio-fouling completely resulting in 100 percent disinfection of water/air.

$$CH_3 - S - CH_3 + O_3 \rightarrow CH_3 - SO - CH_3 + O_2$$

(Sulphur) (Sulphoxide)

$$(CH_3 - CH_2 - CH_2 - CH_3) - N + O_3 \rightarrow (CH_3 - CH_2 - CH_2) - NO + O_2$$

$$CH_4 + O_3 \rightarrow CO_2 + CO + H_2O + \text{small amounts of formic acid \& methanol}$$

(Methane)

$$R_3N + O_3 \rightarrow R_3NO + O_2$$

(Amine) (Amine oxide)

$$H_2S + O_3 \rightarrow S + H_2O + O_2$$

(Hydrogen sulphide)

2. Application of Ozone in STP Exhaust

Ozone is a natural component of the environment, which is acting as a protective shield for the Earth in the stratosphere at a concentration of 2 ppm and partially absorbing the ultraviolet rays emitted by the sun.

Industrially, it is produced by passing a dry air current through the electric filed produced by a high potential difference (Corona Effect or Silent Discharge). What is obtained, and proportional to the applied silent electric discharge, is a concentration of ozone in the air of 1-2% vol.

An essential part of ozone production process is drying the air for which all the humidity must be removed to obtain high ozone production yields and to avoid technical problems during the silent discharge (with possible interruption of the dielectric). From here it is necessary to achieve low dew points (even – 60°C / – 70°C).

3. Ozone System

Special Features

- Modular system with comprehensive monitoring of functions and operations according to DIN 19627
- HMI with LCD text display for easy reading of each operating system
- Highest possible operation safety due to the use of serial components of leading manufacturers
- Construction and materials designed for highest availability and long life span
- Easy access to critical components
- Safe pressure operation
- Ease of operation
- Low space requirement

Perfected, Modern Technology

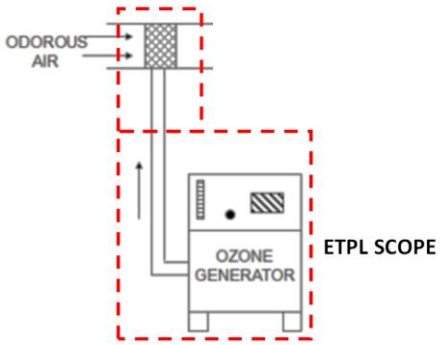
- Ozone generator modules of Stainless Steel 316Ti consisting of individually fused electrodes.
- Resin embedded high-voltage transformers with thermal switch.

Automatic Ozone Production Control

- Various ozone production control by variation of frequency and voltage.
- HMI with LCD text display for monitoring and control of operating equipment.

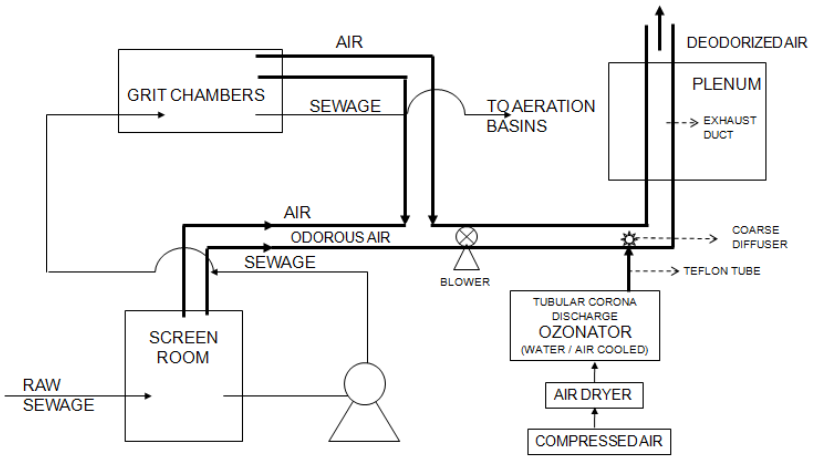
General Arrangement Drawing

See below schematic drawing – 2.

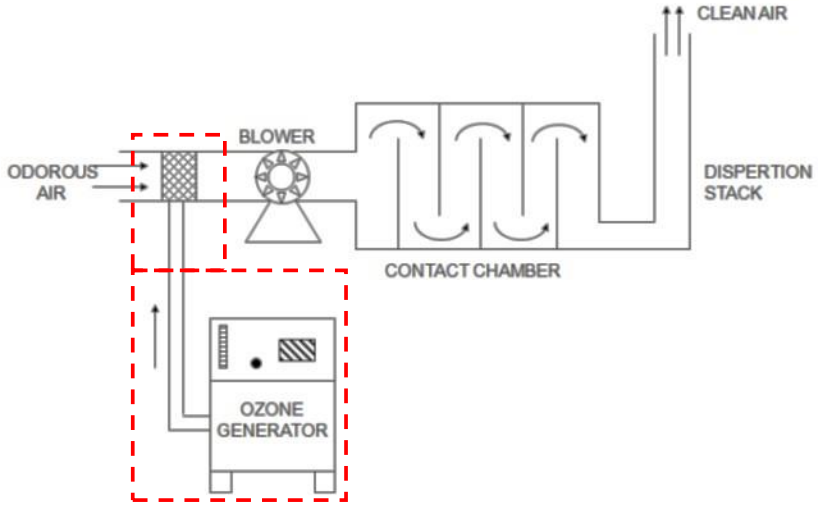


4. Schematic Diagrams

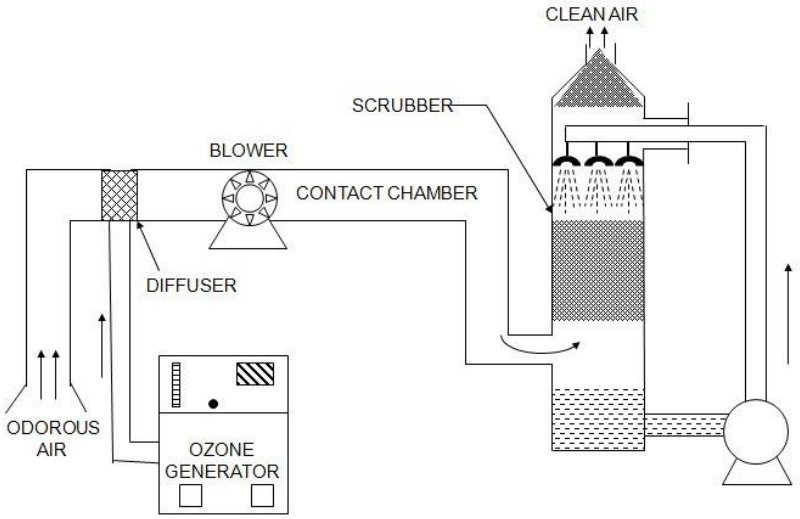
Following schematic diagrams show how ozone is dosed in an existing STP Exhaust System:



Typical STP Exhaust System



Direct Ozone Odour Control System



Ozone Scrubber Odor Control System

Technical Specifications

PARTICULARS	OZONE GENERATOR
Model	EOG–40 AF
Feed Gas	Dry Air
Dew Point	– 40°C
Type	PSA
Air Compressor	1 NO.
OZONE PRODUCTION CHAMBER	
Ozone Generation Capacity	Approx 40 gm/hr @0.8 kg/cm^2
Type	Tubular, Vertical
Process	Corona Discharge
Dielectric	Quartz
MOC of Ozone Cell	SS-316L
No. of Ozone Electrode	8 Nos.
Length of Ozone Cell	250 mm
Cooling Type	Air-Cooled
Power Consumption	0.4 kW
FREQUENCY INVERTER	
Capacity	300 VA
Operating Frequency	5 kHz (±5%)
Operating Voltage	110 VAC
Input Voltage	230 V, 1Φ, 50 Hz
Full Load Current	2.5 A
HIGH TENSION TRANSFORMER	
Capacity	350 VA
Input Voltage	110 VAC, 5 kHz
Secondary O/P Voltage	6 kV
POWER TRANSFORMER	
Capacity	300 VA
Input Voltage	230 VAC
Secondary O/P Voltage	110 VAC
DIFFUSER	
Coarse Diffuser	1 No.
PANEL ASSEMBLY	
Dimensions (L x B x H)	600 x 300 x 650 mm*2
MOC	MS Powder Coated
Weight	120 Kg
Feed Gas Inlet Pipeline	Polyurethane
Ozone Outlet Pipeline	Teflon
End Connections	6 mm

Ensavior Technologies Pvt. Ltd.
Plot No. 17A, Block-A, Sector-19
Dwarka, New Delhi – 110075
Phone : +91 9658 373 373
Email : info@ensavior.com
Web : www.ensavior.com