STP / OWC Exhaust Odor Destruction:

Indoor / Basement STP:

H2S & NH3 are not only OWC & STP foul odor contributors, there are few more gases generated some contributes to odor & some do not, but out of whole lot many gases can react with ozone & consumes ozone.

Effectiveness of Ozone odor destruction system greatly depends on ozone dose, Ozone Gas Carrier & Integration Engineering.

In modern days, most of the sewage treatment plants (STP) are built in Building Basement area. The whole facility is enclosed in a single building. The STP system is a combination of Pre-treatment, primary treatment, secondary (biological) treatment and tertiary treatment.

Sewage Treatment Plants produce odorous compounds during the treatment process. These compounds are generated by biological processes at different steps within the plant. Typical areas with odor emissions are the inlet pump station with bar screen chamber, oil & grease trap, biological process, sludge handling, sludge drainage.

There is a wide spectrum of possible inorganic and organic molecules, which can create unpleasant odors. The most common are ammonia, amines, aldehydes, ketones, sulphur compounds, hydrogen sulphide and mercaptans. Especially for treatment plants located in or nearby residence/commercial buildings with exhaust lead to nuisance to residents & causes air pollution. Therefore, regulations are in place to reduce/control the emissions and set limits for selected parameters/compounds.

Hydrogen sulphide and ammonia are two main parameters restricted by regulations.

The concentration of Hydrogen Sulphide (H_2S) in Sewage Treatment Plant can be in the range of 5 - 15 ppm.

The concentration of ammonia (NH3) is typical in the range of 25 to 50 ppm.

Threshold limit of H_2S = 0.002 - 0.15 ppm

Threshold Limit of NH_3 = 5 ppm

Ref : German guideline

Due to existing limits, it is typically required to gather the polluted air via exhaust equipment and to install a treatment system.

Normally for Reduction of Odorous gas outside air is required for dilution. For this large capacity of fresh air supply duct is required which will dilute the polluted air. Generally, 25 – 50 fresh air changes are required for STP Exhaust.

The integration of Air Ozonation System and injection of Ozone into Air Handling System is the latest and most popular technology to reduce H_2S and NH_3 from enclosed STP Exhaust.

Role of Ozone:

Ozone is a powerful oxidant which rapidly oxidizes odorous gases such as **Hydrogen sulphide and ammonia.**

Ozone Reactivity with Hydrogen Sulphide and Ammonia:

$$H_2S + O_3 \rightarrow SO_2 + H_2O$$

$$2\,NH_3 + 4\,O_3 \rightarrow NH_4NO_3 + 4\,O_2 + H_2O$$

Advantages:

- Ozone is the strongest oxidant available for the treatment of odors.
- Ozone kills airborne pathogen & viruses.
- Although ozone is the strongest oxidizing agent commercially available, it is safe to handle.
- Ozone generators are in Mild Steel cabinet & are easy to install.
- Ozone is easily generated onsite with oxygen & electricity (both are readily available).
- Easy to control ozone concentration by sensors.
- Compact in design combined with high efficiency.
- Adjustable ozone sensor (1.0 - 5000 ppb**) (Optional)**
- In large systems, Oxygen is used as a feed gas with oxygen generator to give constant ozone outputs without any Nitrogen compounds like (nitric acid & nitrous oxides by products).
- Saving Intake of Fresh Air from outside for dilution is significantly reduced. This makes ozone system more effective & efficient.

Salient Features:

- Ozone generator system is suitable for achieving reduction in volatile organic compounds, organic odors in indoor environment. Ozone Generator system does not produce any hazardous by-products.
- For large systems, medical grade oxygen gas having 90 – 92 % purity is used as a feed gas to ozone generator.
- When oxygen is used as a feed gas, extremely low concentration NOx (Oxides of Nitrogen) & nitric acid, is produced.
- MOC of Ozone Cell is Stainless/Aluminum with high dissipation heat sink design.
- Dielectric Tubes is fabricated of Quartz/ceramic for high efficiency.
- Both electrodes are either air cooled or water cooled (for large capacities).
- Inverter is IGBT based resonant converter.
- The Ozone Generator is suitable for operation on 230V- 50Hz Single phase input power.

Sizing Ozone Generator:

Capacity of ozone generator, ozone gas carrier & integration engineering depends on many factors which are listed below:

1. Capacity & treatment technology of STP.
2. Area & volume of OWC / STP.
3. Constituent of exhaust gases.
4. Magnitude of each gases from exhaust.
5. Efficiency of STP operation.
6. Identification of testing locations. {One may be inside(Indoor) the OWC & STP & other outside (Outdoor)}.
7. Air changes per hour [ACPH]
8. Length of the Exhaust duct / contact chamber.
9. Distance between testing / sampling & exhaust duct opening.
10. No. of sample testing & their mean/average.
11. Ambient temperature, humidity
12. Air flow & direction – Laminar, static and breeze. For dilution level.
13. Constant Variation in the quantum of odorous gases. Today we are sampling, it is most likely after few days quantum may increase. (Due to time, efficiency, performance, etc.)
14. Fresh air & exhaust air quantum.
15. Ozone integration technique.

Most of the time many of the above data are not available. Chemtronics has established ozone dose on the bases of following parameters / input data & few design considerations.

List of Parameters:

1. Basic site information – CFM Of exhaust air.
2. Length of the exhaust Duct.
3. Literature review
4. Past installation experience
5. Ozone & exhaust gases stoichiometric calculation.

List of Design Considerations:

1. H2S levels in STP room – 5.0 – 15.0 ppm
2. NH3 levels – 25 – 50 ppm
3. Air Changes Per Hour [ACPH] - > 30 ACPH
4. Exhaust duct length – minimum of 30 meter
5. Exhaust duct opening – minimum 8 meters from ground level
6. Exhaust air temperature - < 40^0 C
7. Exhaust air velocity – 20 – 30 m/s
8. **Ozone Dose – 0.08 – 0.2 mg/m3**

Formula & Calculation: For example

For 15,300 CMH of STP exhaust air

Ozone Generator Capacity = **Exhaust Air** [m^3/hr] **X** **Ozone dose** [mg/m^3] **X** **2.14**

2.14 is density of Ozone

In Present case of 15,300 CMH :- Exhaust Air – 15,300 m^3/hr

Ozone Dose – 0.08 mg/m^3

Ozone Generation Capacity = 15,300 x 0.08 x 2.14 = 2,570 mg/hr

Proposed Model : EXO-OXY-300

Proposed Capacity : 3,000 mg/hr

Deliverables of Ozonation System:

Ozone generator is placed in STP Plant room & connected to Exhaust duct line through ozone injector.

Ozone will be injected at entry point of exhaust air duct, and minimum duct length should be 30 meters.

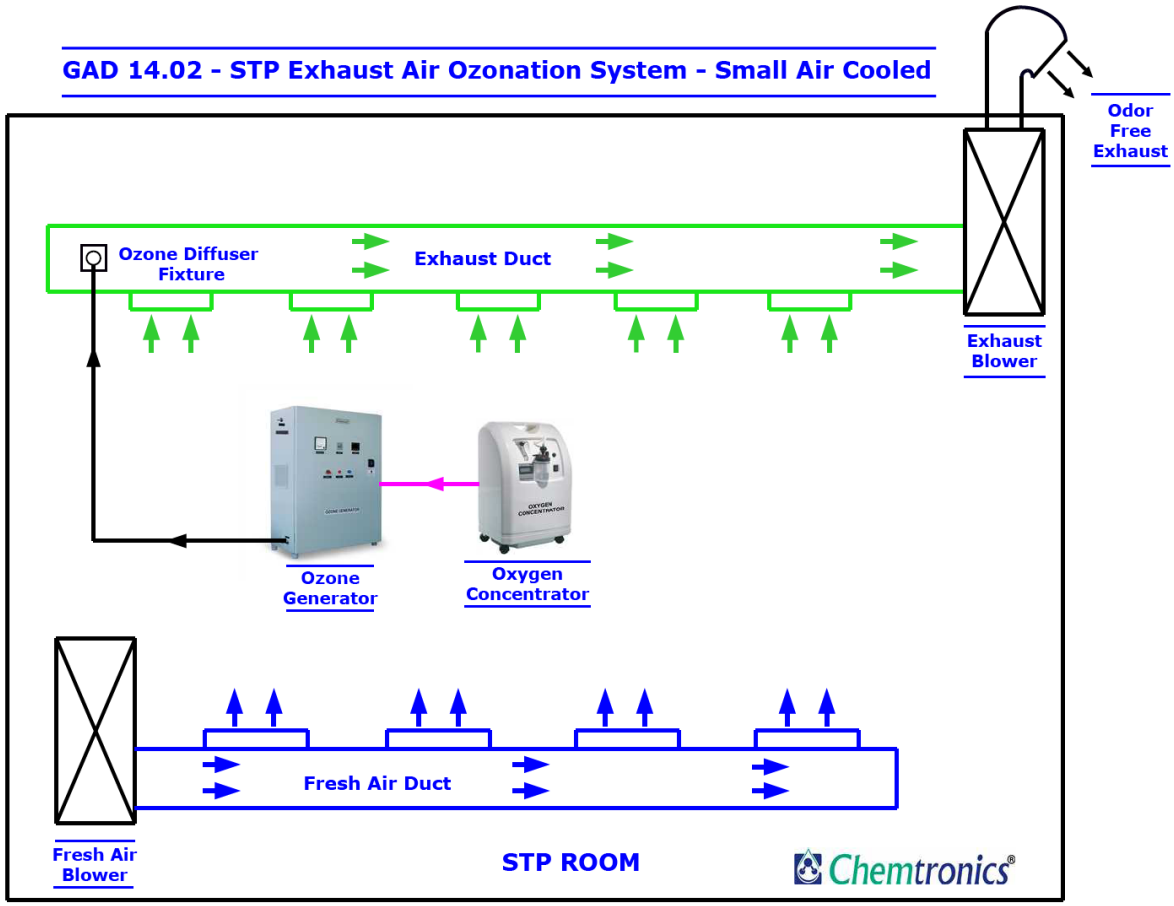
Ozone will be dosed between 0.08 – 0.2 ppm @ 30 – 45 ACH

The ozone generator is floor/skid mounted with integrally piped & wired.

The ozone generator system is designed for continuous operation with auto ON/OFF mode.

Cooling System is provided for cooling of ozone cell.

Flow Diagram:



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