Chemtronics®

Integrated Ozone System For STP Tertiary Treatment:

- **Chlorine Free Treated Waste Water**
- **Safe for disposal & Ideal for Reuse**
- **Lethal on Microorganisms**
- **Removes Color & Odor**
- **Lowers COD & BOD**
- **Oxidizes H_2S, Ammonia & Organics**

Design Basis:

Ozone Generator sizing calculations:

Ozonator Capacity = **Flow rate** [m3/hr] **X** **Ozone dose** [gm/m3]

$$\textbf{Flow Rate} = \frac{\textbf{Peak STP capacity Per Day (m3)}}{\textbf{Average Operating Hours (hr)}}$$

Example :- **Flow Rate** = 200 (m3/Day) / 20 (hrs of operation)
= 10 m3/hr

Ozone Dose: Ozone dose is decided on the basis of two major factors

A. Characteristics of Treated Waste Water

- Microbiological load
- COD
- BOD
- Total Organic Carbons
- Inorganic Load
- Odor
- Color
- pH
- Temperature

B. Ozone Implementation Technique

- Required dissolved Ozone
- Ozone Concentration
- Ozone Injection Pressure
- Ozone diffusion technique
- Ozone dissolution efficiency [in %]
- Oxygen Purity [in %]
- Retention Time

Note: As per Chemtronics Design Standard Applied Ozone Dose is 3.0 to 6.0 ppm (gm/m3)

Example :- **Ozonator Capacity** = Flow rate (m3/hr) **X** Ozone dose (gm/m3) ppm

= 10 m3/hr x 4.0 gm/m3

= 40 gm/hr

1.	Applied Ozone Dose	:	4.0 ppm
2.	Ozonator Capacity	:	40 gm/hr
3.	Ozonator Model No	:	OG/HC – 50
4.	System Model No.	:	IOS/WW- 50 S

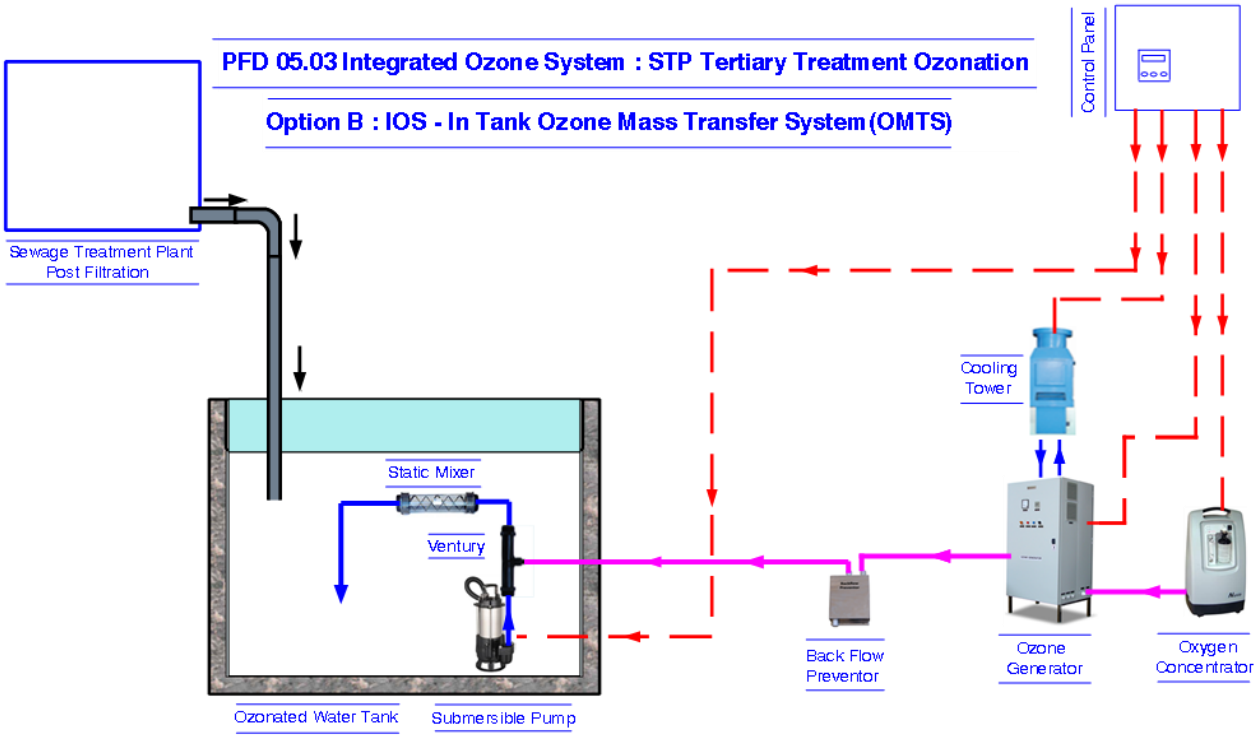
Process Description of Ozonation System in STP

Ozone plays very important role in Sewage Treatment Plants. When biological treatment Is use in secondary stage, there is a carryover of micro Organisms in tertiary stage. Ozone being very strong oxidizing agent can effectively & quickly disinfects the Treated sewage water. Post reaction by product & unused residual ozone are safe to be disposed without any further treatment. Ozonation in waste water treatment is universally accepted & new mended by pollution control boards.

The effectiveness of the ozone depends on multiple factors e.g target organisms load, Ozone contact time, ozone concentration, induced ozone dose, ozone mass transfer (dissolving) efficiency, purity of feed gas etc..

In waste water Ozonation the amount of ozone gets dissolved in waste water is the only reactive ozone & effective on pollutants & contaminants. This reactive ozone when reacts with the pollutants in waste water get consumed. So efficiency of Ozonation process also depends upon the efficiency of core waste water treatment & effective reduction in pollutants.

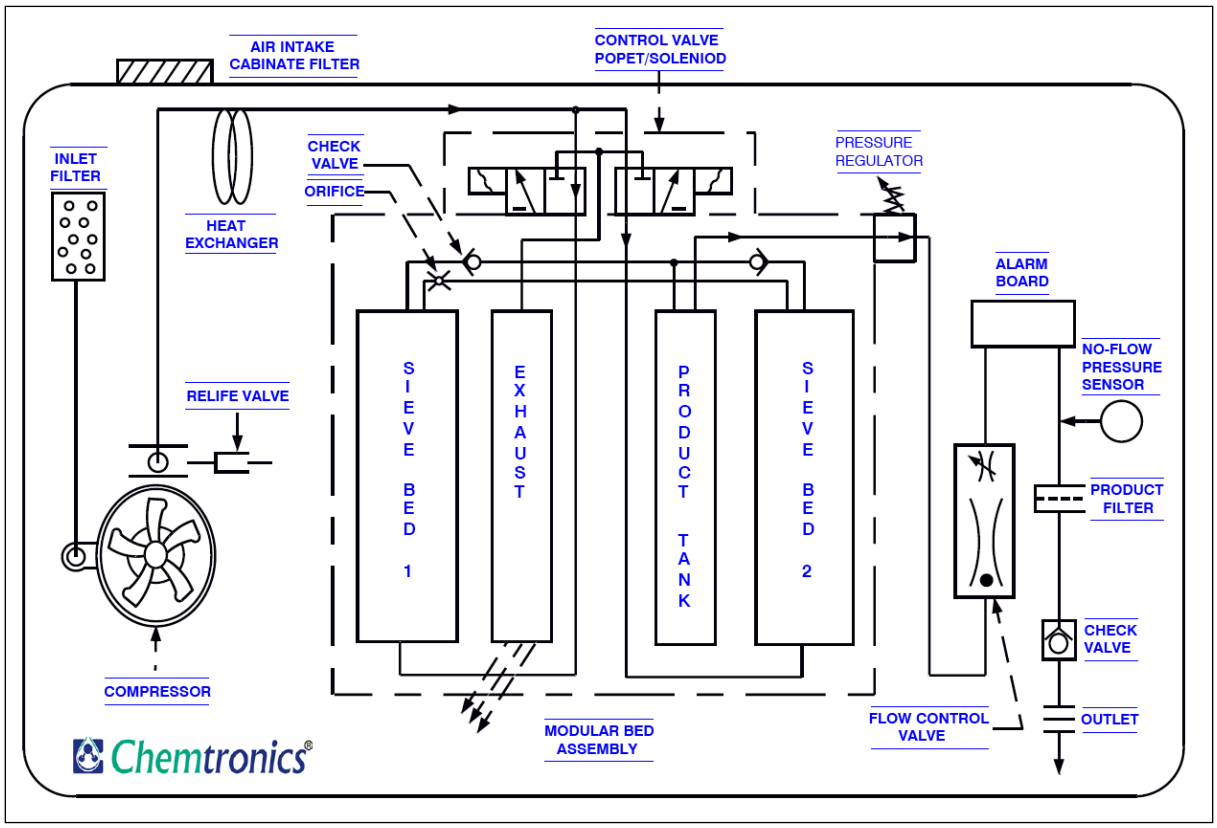
Generally waste water contains diversified constituents out of them ozone reacts with many of them in the process gets consumed. The ozone reacts on micro organism, colour, odour, COD, BOD, organics, inorganics, heavy metals, oil & grease, total organics carbon(TOC), volatile organics compound(VOC) etc..



Oxygen Concentrator

Air enters in oxygen concentrator through cabinet air intake filter. This filtered air enters the compressor via a suction resonator and fine filter, which quiets the suction sounds made by the compressor. Pressurized air then exits the compressor and passes through a heat exchanger, which reduces the temperature of the compressed air. Next, an electronic valve (control valve) system directs the air into one of two sieve beds that contain molecular sieve. The special characteristic property of molecular sieve is that it physically attracts (adsorbs) nitrogen when air passes through this material, thus enabling the separation & production of high purity oxygen.

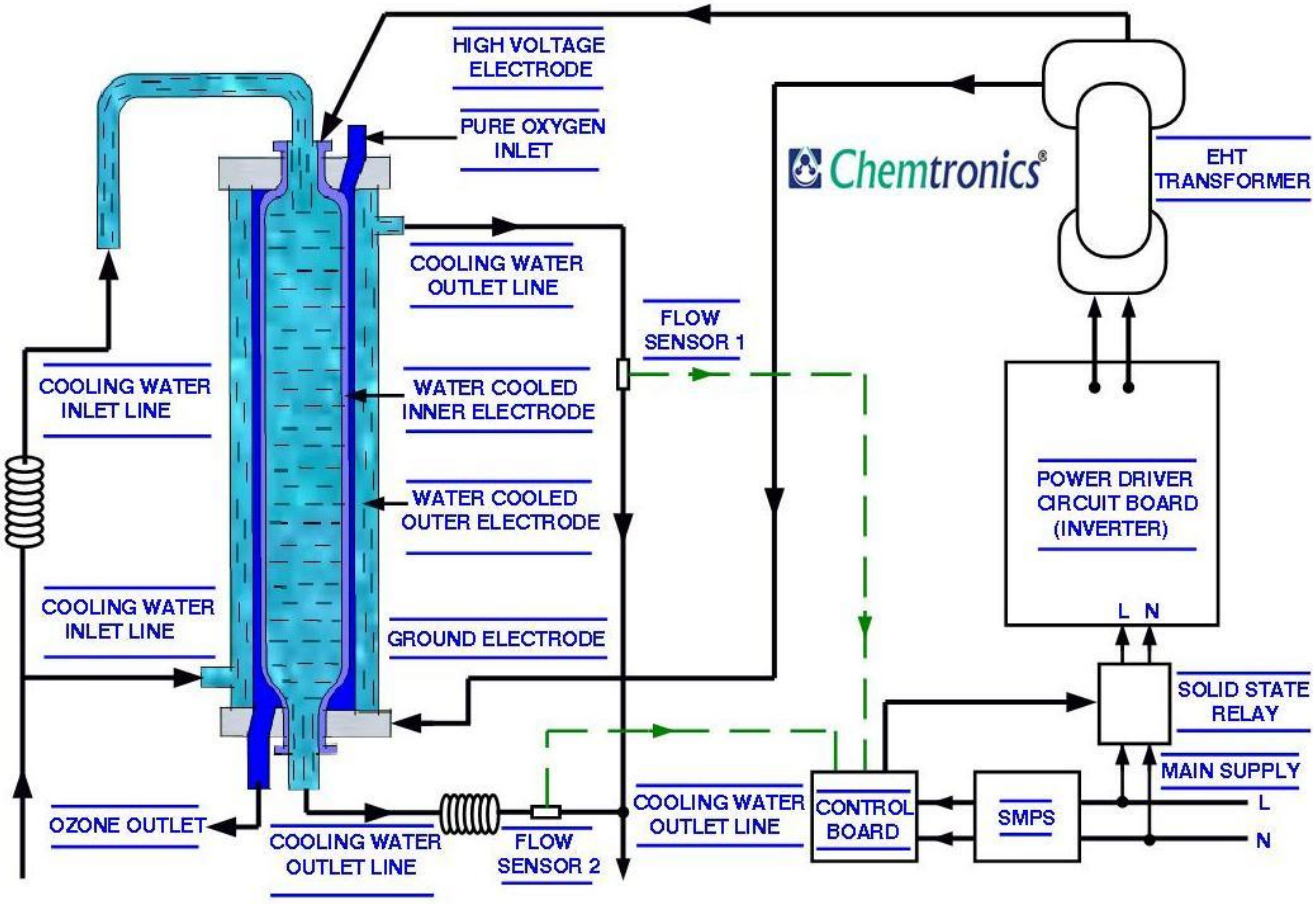
There are two sieve beds or adsorbent columns; while one produces high purity oxygen (sieve1), the other (sieve 2) is purged of the nitrogen it adsorbed (collected) while it was producing oxygen. Each column produces oxygen for approximately 5.5 seconds and delivers it to the product storage volume in the end of the column. Oxygen exits the adsorbent column through a pressure regulator, flow control valve, flow meter, and final product filter. The flow control valve, which is part of the flow meter, controls the flow rate of oxygen delivered to the ozonator. The Concentrator unit delivers upto 93% - 88% oxygen concentration at flow rates from 2 to 5 l/min. The remaining constituents of the product gas stream are nitrogen and argon, both of which are part of the air which are exhausted out from the system.



Ozone Generation

Industrial ozone generator uses corona discharge technique to produce ozone. A spark (corona discharge) is used to split the diatomic oxygen molecule into valant oxygen atoms. These oxygen atoms have a negative charge and will bond quickly with another oxygen molecule to produce ozone! For each split oxygen molecule, 2 ozone molecules are produced.

To produce corona two electrically conducting material is selected. High voltage with high frequency is applied to one of the electrode & other is connected to low voltage i.e. ground. Both these electrode are very precisely and uniformly separated by dielectric material. To produce high voltage & high current an electronic inverter circuit called ozone power/ driver board is used. In this board line voltage of 230 V AC is converted into DC voltage. This DC voltage having 50Hz frequency drives pulse width modulation (PWM) type inverter, converting this applied DC voltage into high frequency A.C. This A.C. voltage is fed to high voltage step up called EHT transformer to generate 3 kV to 7 kV of high voltage. This step up voltage is applied to internal electrode of ozone cell.



There are three main factors when generating ozone from corona discharge:

- **Power supply**
  1. Operating voltage
  2. Operating frequency
- **Dielectric**
  1. Glass
  2. Ceramic
  3. Mica
  4. Quartz
- **Corona Cell**
  1. Tube – cylindrical style
  2. Flat plate

When generating ozone from corona discharge there are a few factors that will affect performance that must be evaluated.

- **Cooling of the corona cell**
  1. Water cooled – Single cell electrode or both electrodes
  2. Air cooled - Single cell electrode or both electrodes
- **Feed gas**
  1. Oxygen
  2. Dry Air

Ozone Mixing:

Ozone Mixing Pump:

Ozone Mixing is the process in which ozone gas is dissolved into water or waste water and the ozone-mixed water is applied to the target application. This is done with the help of ozone mixing pump where target liquid is pumped to venturi & static mixer.

Venturi:

A venturi is used to create negative pressure or vacuum by accelerating liquid through a narrowing constriction in a pipe or tube. **Higher the water velocity and larger pressure drop, greater the suction capacity.** In an integrated ozone system, the injector pump drives process water through the venturi, which creates a suction that draws in the ozone gas produced by the ozone generator. When ozone gas is sucked in venturi it also start dissolving/ mixing in fluid. The

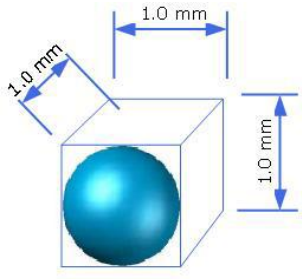
efficiency of mixing ozone gas depend upon few factors among which importance are ozone concentration, ozone gas pressure & ozone gas bubble size.

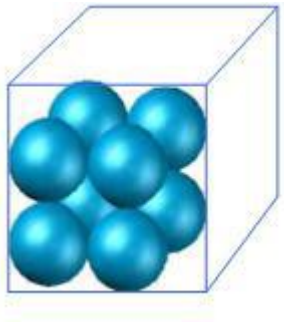
When using a venturi injector it is necessary to use back flow preventer to ensure water dose not flow from the venturi injector back to the Ozone Generator.

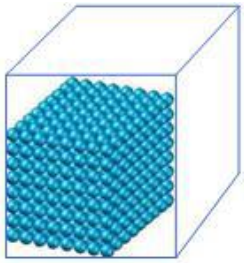
Static Mixer:

After venturi, static mixer is installed where its internal bled vigorously breaks the ozone gas bubbles in smaller bubbles which increase the total surface area of the cumulative bubbles. This increases the ozone gas to liquid mass transfer surface area. Which in turn increase the efficiency of the ozone mixing.

Ozone Bubble Size Calculation:







Cube	**: 1.0 mm3**
Bubble Dia	: 1.0 mm
Nos. of bubbles: 1.0 no.	
Surface Area	: 3.14 mm2
Total S. Area	: 3.14 mm2

Cube	**: 1.0 mm3**
Bubble Dia	: 0.5 mm
Nos. of bubbles: 8.0 no.	
Surface Area	: 0.786 mm2
Total S. Area	**: 6.29 mm2**

Cube	**: 1.0 mm3**
Bubble Dia	: 0.1 mm
Nos. of bubbles: 1,000.0 no.	
Surface Area	: 0.0314 mm2
Total S. Area	**: 31.43 mm2**

Back Flow Preventer (BFP):

Back Flow Preventer is one of the state of art innovated by Chemtronics, where ozone gas is protected from water giving back to ozone generator from ventury. Ozone generator is connected at high pressure end of the pump. Under adverse condition water can enter ozone cell & damage the cell & circuit. By installing BFP reverse flow of water is diverted drain. When reverse water from pump entered to ozonator & damage the ozonator.

Cooling Water System:

When ozone is produced by corona discharge, the cell electrodes become very hot. This temperature can limit the production of ozone gas concentration & life of the cell. To maintain/ regulate the ozone cell temperature both electrodes are water cooled by flowing water around internal & external electrode. The flowing water regulates the temperature of the both electrode. Approximately of around 200 – 300 LPH water is required for cell cooling.

We use low conductivity filtered fresh water for cell cooling. One can use single pass water through the cell & drain the water or collect & use for some non potable application. If plant is operated for 20 hrs we need to drain 6,oo liters per day.

We offer small cooling tower of 3 TR to continuous reuse the water for cell cooling. When water passes through ozone cell, temperature of water is elevated by 2 – 3^{o}C this water when passes through cooling tower drops the same elevated water temperature & this was over and over same water can be used. For this purpose we require 2 – 3 Liters of water per day as makeup water. Cooling Tower water is circulated through a cartridge filter by circulating pump.

STP or STP treated water cannot be used for ozone cell cooling. This water is corrosive & has poor heat exchange capacity, also due to higher turbidity it clogs the cell cooling nozzle again reduces flow of water & cell cooling efficiency.

ORP Automatic Controller:

ORP stands for Oxidation-Reduction Potential. ORP measure the pre set high & low level of oxidation potential in water. When in water ORP reaches preset high level the ORP controller cut off the ozonator, preventing excess ozone dosing. Similarly when ozone dosing is halted the ORP level slowly goes down. When it reached to preset low level ORP controller will restart ozone generator.

For more information please visit : http://www.chemtronicsindia.com/