



*Alpha Power*

Ozone

# CORONA DISCHARGE

# OZONE SYSTEMS

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## SWIMMING POOLS & Spas



*Alpha Power*

Ozone

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Profile...

Alpha Power is founded in 2006 by our parent Company M/s **Eterna Technologies** as dedicated direct marketing subsidiary for the promotion of Ozone Systems for Swimming Pool & Spas Water Purification/Sterilization.

Our parent company M/s **Eterna Technologies** is an Independent and world wide active company for Research, Development, Production, Sale and Exporter of High grade "Corona-Discharge" Ozone Generators & Systems with the perfect blend of German Engineering along with Top Quality Indigenous components which are strictly in compliance with the International Standards.

With the specialization in new dimensional approach in understanding the customer needs, demands and expectations we are fully equipped to cater right from designing to customer satisfaction for any custom based Ozone Applications either in Air or Water Purifications / Sterilization process where top grade Sterilization and Hygienic standards are demanded .

Our range of Ozone application is almost all types Air / Water Sterilization / Purification processes which consumes few mg/hr Ozone to Few Kg/hr Ozone requirement. Through the years we have more than thousands of satisfied customers with major portion of OEM's spreaded across Globally.

We hope Alpha Power would like to be a part of your quality team to enhance your services to your customers in an Eco Friendly way.



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## 1. Ozone Introduction.

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Ozone ( $O_3$ ), an unstable, gaseous *allotrope* of elemental oxygen (O), is a strong, naturally occurring oxidizing agent. When ultraviolet rays from the sun strike oxygen molecules in the upper atmosphere, Ozone is produced, thus creating the protective Ozone layer around Earth shielding us from high levels of UV radiation.

Several tones of Ozone is also produced in each Lighting Strike occurs during thunderstorm which sterilizes the atmospheric air leaving a "fresh-clean - spring rain" like smell which we normally notice after thunderstorm rain. More over the feel of Freshness observed in the atmospheric air in a forest or by the sea or a waterfall is due to the presence of Ozone up to 0.1ppm.

## 2. How Ozone is Produced ?.

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Two methods are commonly used for generating Ozone: *ultra-violet* radiation and *corona discharge*. Ultraviolet (UV) generators, used for low concentration air purification or on small water volumes with low demand, are relatively simple and economical but limited in output capacity. Corona discharge generators are required for use in commercial pools or other systems with high oxidizer demand.

### 2.1 Ultra-Violet Ozone Generator

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Historically most Ozone generators used on small residential pools and spas have utilized the UV Ozone generation method where Ozone is produced by irradiating ordinary air with UV light at wavelengths below 200 nanometers (nm). Longer wavelengths (around 250 nm) of UV light are more efficient at destroying Ozone rather than producing it. When enough UV energy is added to an  $O_2$  molecule, it splits, freeing two  $O_1$  atoms to collide with other  $O_2$  molecules creating Ozone ( $O_3$ ).



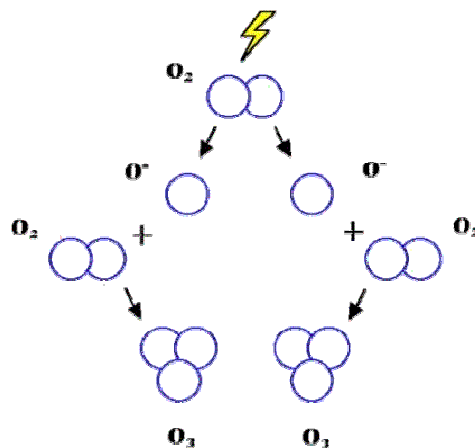
The Ozone output will depend upon the efficiency of the UV Radiation Tube practically the efficiency drops as the hours of operation increases so the Ozone production can be regulated only by adjusting the feed-gas flow.

## 2.2 Corona Discharge Ozone Generator

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In a Corona Discharge (CD) system, Ozone is produced by passing oxygen-containing gas through a high voltage electrical discharge, or corona. A minimum of about 4,000 to the maximum of 15,000 volts at High Frequency of electricity is necessary to create the corona (10,000V is a practical design maximum voltage). Oxygen passing through the corona absorbs energy, splitting the  $O_2$  bond and freeing two  $O_1$  atoms to re-combine with other  $O_2$  creating  $O_3$ .

Applying High Frequency & High Voltage



Ozone production can be regulated by adjusting either the applied power or feed-gas flow. By reducing the feed-gas flow, Ozone concentration is increased, but overall production rate decreases. Reducing the applied power decreases concentration.

Recent technological advances in high frequency electronic power supplies have allowed Ozone generator manufacturers to develop small, efficient, economical and controllable Corona discharge Ozone systems that displace UV technology altogether.



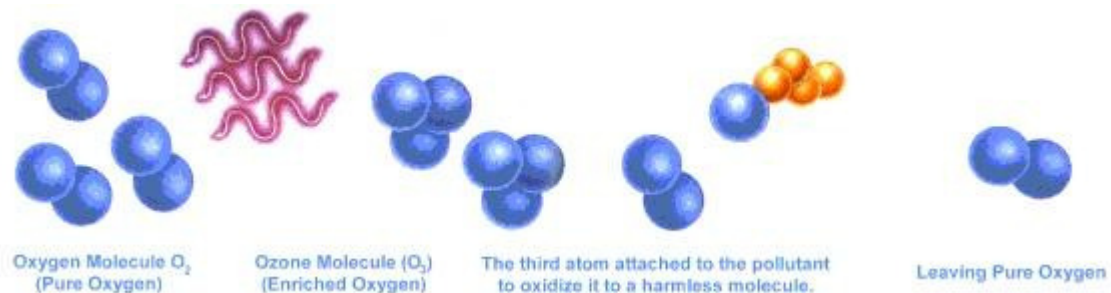
### **3. Ozone is a strong Eco Friendly Disinfectant.**

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Ozone ( $O_3$ ) is an unstable compound generated by the exposure of oxygen molecules ( $O_2$ ) to ultraviolet radiation or a high-energy electrical discharge. The weak bond holding Ozone's third oxygen atom is what causes the molecule to be unstable and makes the Ozone extremely Reactive & Vibrant Eco Friendly Oxidizing agent whose Oxidizing strength is 50 % greater & 3000 times faster than normal Chlorine.

Ozone will Oxidize almost all the Organic Oxidizable contaminants like Bacteria, Viruses, Moulds, and dissolved minerals such as Iron and Manganese present in the water.

Normally when ozone makes contact with the Organic contaminants such as Bacteria or Viruses molecules, the Ozone will attack the chemical structure (DNA) of the contaminants and destroy them permanently, accompanied by an eventual decomposition of Ozone into normal Oxygen as shown in the below schematic diagram .



Since the Ozone is generated electrically ( Corona Discharge process ) from Atmospheric Air / Oxygen air, no additional chemicals or consumables are required. Interestingly Ozone will automatically converts back into Oxygen (  $O_2$  ) after the function of Purification & Sterilization without leaving any chemical residue, and thus makes the Ozone rated as the best Eco Friendly Oxidant / Sterilizing agent in the world .



## **4. Ozone Has Multiple Applications**

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The Eco friendly nature of Ozone paves the way for multiple applications where high level Sanitization and Hygienic standards are required.

- Packaged Drinking Water ( Final Ozone treatment is ISI mandatory before the water is being filled in bottles or cans for drinking purpose – as a matter of fact we can able to notice the label of “ REVERSE OSMOSIS- UV TREATED – OZONISED” in all the packaged drinking water bottles ).
- Surface Sanitation in Food Processing Industries.
- Swimming Pools and spas water treatment.
- Aquatic Animal Life Support Aquaculture
- Cooling Tower Water Treatment
- Odor Control & Smoke Elimination
- Fresh-Cut Produce Washing
- Mold/Mildew Control in Produce Storage
- Pulp Bleaching
- Laundry Water Treatment.
- Waste Water Treatment





## **5. Ozone Application in Pools and Spas.**

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In Swimming pools and Spas water pollution is mainly caused by swimmers. This makes it a very dynamic pollution, which is dependent on the number and types of swimmers. Swimming pool pollutants can be divided up into the following three groups:

- **Undissolved pollutants** : Mainly consist of visible floating particles, such as hairs and skin flakes, but also of colloidal particles, such as skin tissues and soap remains
- **Dissolved pollutants** : Mainly consist of Urine, Sweat, Eye fluids and Saliva. Sweat and urine contain water, but also ammonia, ureum, kreatine, kreatinine and amino acids.
- **Microorganisms** : Each swimmer carries a large number of microorganisms, such as bacteria, fungi and viruses. Many of these microorganisms may be pathogenic and can cause disease.

When these substances are dissolved in water, they cannot harm swimmers. However, when Chlorine or Chlorine derivatives are used to sterilize the Pool water , the above said pollutants will react with Chlorine in the swimming pool water, incomplete oxidation can cause chloramines formation. This causes the so-called " chlorine-scent ", which irritates the eyes and respiratory system. Recent research has shown that children's immune systems may be affected by swimming in chlorinated swimming pools. The health risks are also increased for swimmers that train twice a day. In a number of cases, stable compounds of chlorine will be formed, which can only be removed from swimming pool water by water refreshment.



## **6. Benefits of Using Ozone**

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Swimming water quality can be sufficiently increased by Ozonization. This is not only a benefit when it comes to swimming, but it also guarantees Hygienic & Healthy swimming water.

- Ozone sterilizes the water by killing Bacteria's, Viruses, Cysts, Parasites and other Possible microorganism and chlorine resistant pathogens which usually causes deceases and spread over to others.
- Ozone Avoids the development of Fungal Growth in the Pool Water.
- Avoids Eye Irritation, Skin Irritation & Skin Rash to the Swimmers ( normally caused by the conventional Chlorine treatment )
- Ozone dissolved in water will not irritate skin, eyes, nose, or ears, nor will it dry out or leave a chemical film on skin.
- Ozone can significantly reduce levels of harsh chemicals such as chlorine. ( more than 80-85 % )
- Ozone oxidizes organic and inorganic matter in the water and prevents the scale formation in the walls , without the formation of unwanted byproducts, such as chloramines (which cause a chlorine-scent)
- Ozone oxidizes and destroys ammonia, oils and other bather wastes in pool waters.
- Ozone acts as a micro-flocculent aiding in the removal of minerals such as iron and manganese.
- Dissolved Ozone will improve the filter and coagulant capacities in the swimming pool water . This leads to a reduction of coagulant use and less backwashing of the filter is required
- Ozone is pH neutral and does not affect the pH balance of water like traditional pool chemicals.
- Ozone leaves no unpleasant chemical taste, smell or other contaminants.
- Ozone can reduce chlorine or bromine consumption to a minimum, saving money on maintenance.



- Ozone is generated "on site", no storage, handling or dispensing as with other chemicals.
- Ozone's effectiveness can be measured with a simple ORP meter.

<b>Process Parameters</b>	<b>Chlorine</b>	<b>Ozone</b>
Eco-Friendly	No	Yes
Eye Irritation	Yes	No
Skin Toxity & Irritation	Yes	No
Skin Rash	Yes	No
Effect on Bacteria & Viruses	Partially	Completely
Dosage Monitoring	Very Critical	Easy
Storage & Handling	Very Critical	No Storage Required
De – Odorize water	Partially	Completely
Capital/Initial Investment	Moderate	High



## **7. Swimming Pool Ozonisation .**

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For efficient, effective and safe operation of swimming pool Ozonization comprises two complementary process.

1. Ozone Generation System &
2. Ozone Distribution in the Pool Water.

### **7.1 Ozone Generation System.**

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Alpha Power Ozone Generation system includes Feed Gas supply system and Ozone generators

#### **7.1.1 Feed Gas Supply System ( Oxygen Generator)**

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In almost all cases our Swimming Pool Ozonization system includes an imported High efficiency Oxygen Generator Plant which works under Patented Advanced PSA Technique to separate 90 to 93 % pure Oxygen from the atmospheric air.

Oxygen fed systems is preferred for a number of reasons.

- First, the nature of oxygen preparation equipment ensures particulate and moisture-free feed-gas.
- Second, the oxygen environment increases generator efficiency by making more O<sub>2</sub> molecules available for conversion to Ozone.

The clean environment created by the oxygen preparation system increases the life of internal components by providing better operating conditions in the corona discharge cell prolonging its life and increasing its efficiency and significantly decreases the maintenance requirements of the system.



The advantage of this is that the clean, dry oxygen gas maintains better Small CD generators such as may be used in residential pools or portable spas ( less than 30,000 lts capacity ) generally use ambient air (containing 21% O<sub>2</sub>) as the feed-gas. For these small systems it is generally not practical to dry the air or use oxygen, which limits their capacity and cost effective.

The Ozone/gas mixture discharged from the our Ozone generator normally contains from 1% to 3% (by weight) Ozone when using dry air, and 3% to 6% (by weight) Ozone when using concentrated oxygen as the feed-gas.

### **7.1.2 Ozone Generator**

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Alpha Power Ozone Generators are inbuilt with the following characteristics for safe, consistent, low maintenance operation and long service life.

1. Ozonators are manufactured with the blend of Imported German Engineered & Top Quality Indigenous components strictly in compliance with the International Standards.
2. Manufactured in combination of for fully automatic operation consisting of all units and components necessary for the economic production of ozone from air/ oxygen-feed.
3. Micro controller based intelligent system with inputs, status, Alarm and outputs to take care of system operation, can be controlled through programmed sensors & Timers , Voltage Tapping on power transformer is provided to adjust power Ozone out put.
4. The ozone generator system is completely modular in construction. Generator modules are constructed of all non-combustible and Ozone resistant materials such as stainless steel, ceramic, glass re-in forced fibers , etc.
5. Water backflow protection must be included in the Ozone gas delivery line. Ideally this is interlocked to the control system causing an immediate shutdown of all high voltage circuits and isolating the generator module if water is detected.



6. Automatic shut down occur under any of the following conditions:

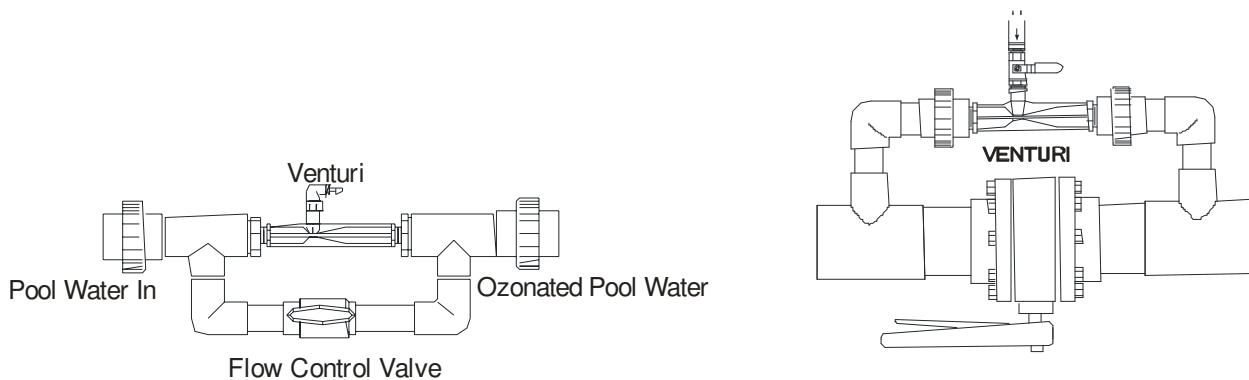
- a. Door open or cover panel removed from the generator cabinet
- b. High Voltage fluctuations.
- c. High temperature of the Ozone generator module and high voltage transformer

## **7.2 Ozone Injection System.**

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Ozone is soluble in water and thus efficient transfer of Ozone into the water is critical for effective disinfection of pools and spas. Only dissolved Ozone is able to oxidize contaminants in the water. Non-dissolved Ozone *off-gases* to the surface and is lost. One of the most effective means of introducing Ozone into a water stream is by use of a *Venturi injector*. The Venturi uses the water stream, *motive flow*, to produce a suction, which draws Ozone-containing gas into the water stream where it is violently mixed. This process produces very small bubbles of the Ozone-containing gas, enabling the Ozone to readily dissolve.

For proper operation, an injector must operate within a specific flow rate and pressure differential range. To accomplish this, it is usually necessary to provide a manifold assembly as shown in the figure enabling adjustment of the injector's *motive flow*. A properly installed Venturi injector can provide 99+% *mass transfer* of Ozone at the point of injection.





## 8. Ozone Monitoring

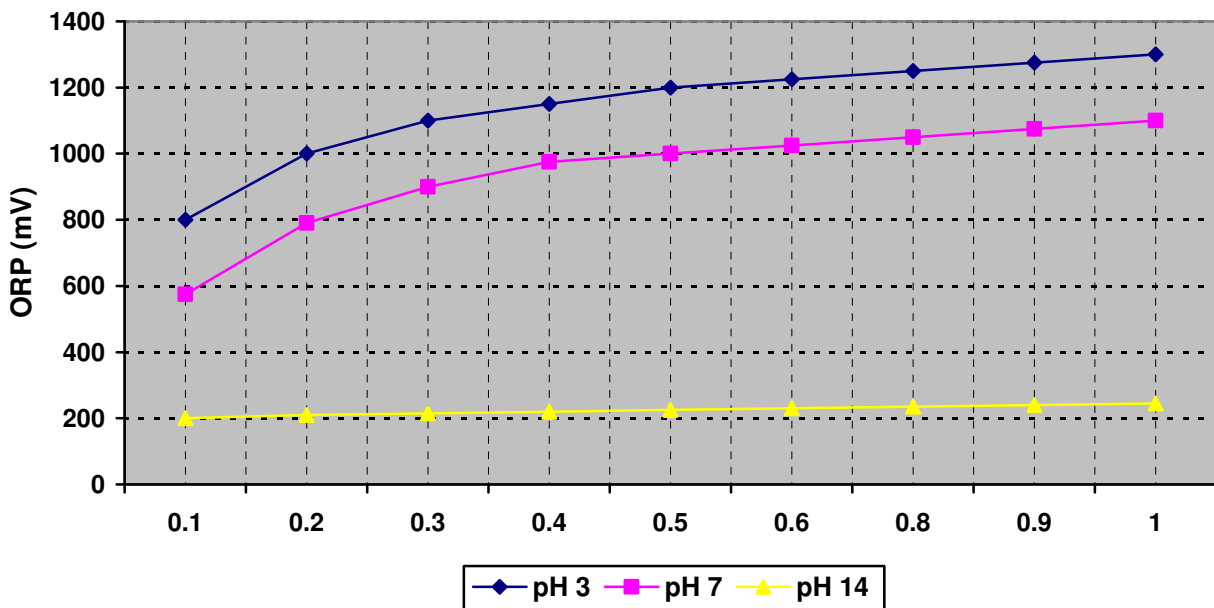
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Ozone concentration in water can be measured in two different ways.

### 8.1 Oxidation Reduction Potential (ORP) monitor.

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ORP is an effective tool to measure the effectiveness of the Ozone treatment system. ORP measures the effective bio cidal-activity of oxidizer (dissolved Ozone) in water in millivolts and can be converted to mg/l (ppm). ORP is the preferred method in pools and spas due to relatively low maintenance sensors and moderate cost. It is a well established fact that pool waters with an ORP of 650 and above are considered clean and sanitized. The below chart shows the relationship between ORP and dissolved Ozone concentration in water.





## 8.2 Dissolved Ozone monitors

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DOM directly measure levels of dissolved Ozone in water. These are relatively expensive and high maintenance. Recommended for use in critical applications where precise dissolved Ozone level control is necessary.

## 9. Ozonator Sizing.

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With respect to the Indian Climatic conditions the Ozonator Sizing for the desired Volume and type of Swimming Pools is very critical because of extreme change on the weather conditions across the seasons. Since the basic fact that the half life period of Ozone will exponentially vary with increase on thermal conditions for example at -20°C is the half life Ozone is 3 months , at 30°C is 20- 25 mins, at 50°C is 30 seconds only.

With respect to our experience we recommend the following steps to calculate the Ozonator Sizing in gms/hr

1. Determine the appropriate Ozone Dosage depends upon the type of pool
  - a. For Individual / Bungalow Pools 1 ppm of Ozone dosage (@ CT 1.6 where CT is the product of Injected Ozone Concentration C in ppm and Contact time T in minutes )has to be injected
  - b. For Commercial / Semi Commercial / Recreation Pools/ Club Houses 1.5ppm of Ozone Dosage (@CT 1.6 ) has to be injected.
2. Determine the Cycle time in hours/day for injecting the required Ozone to the Swimming Pool
3. Ozone Generator Sizing in gms/ hr =  $(V \times C) / (1,000 \times T)$

Where

V = Volume of the Pool in Litters

C = Required Ozone Concentration in ppm (either 1 or 1.5 ppm )

T = Total Cycle time in hrs

Please find below the following examples of Ozonator Sizing for better understanding.





	Particulars	Example 1	Example 2	Example 3	Example 4
1	Pool Capacity in liters	1,00,000	1,00,000	1,00,000	1,50,000
2	Type of Pool	Individual	Individual	Club	Club
3	Ozone dosage in ppm	1	1	1.5	1.5
4	Amount of Ozone to be injected / day	100 gms	100 gms	150 gms	225 gms
5	Cycle Time	5 hrs	10 hrs	5 hrs	10 hrs
6	Ozonator Size in gms/hr	<b>20gms/hr</b>	<b>10gms/hr</b>	<b>30gms/hr</b>	<b>22.5 gms/hr</b>

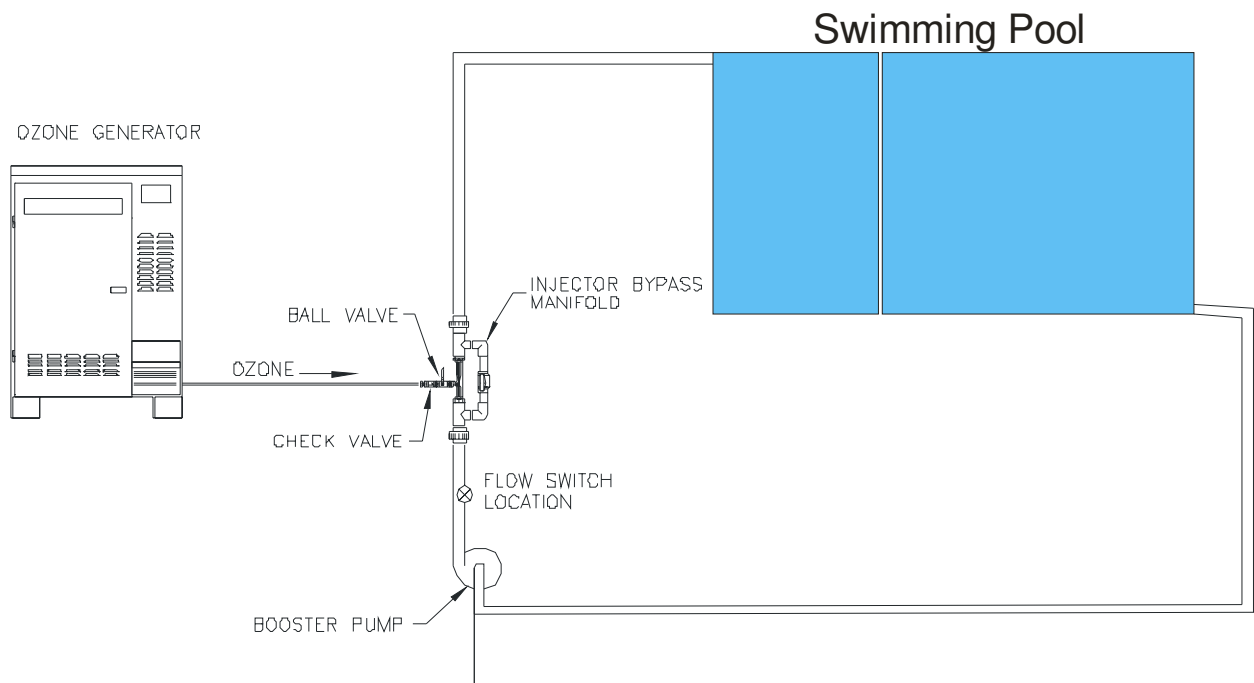
NB : Ozonator Size in gms/hr decreases as the circulation hrs/ day increases.

With our experience for better cost effective sanitation process we recommend a separate input and delivery line has to be provided from the pool. This will help us

1. To enhance the intimate contact between Ozone and water (CT Value >1.6 )
2. Provision to run Ozonization system independently from the filtration system will enables us to run the Ozone system alone for desired (more) cycle time which obviously reduces the Ozonator Size and the investment cost on system as well.



## Swimming Pool Ozone System Typical Lay out



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