

SOLAR ECLIPSE



Ozone + Germicidal UV Advanced Oxidation Process (AOP)

A Synergistic Sanitation Approach
for Residential Pools


DEL **ozone**[™]
natural pool sanitation

- Formed in 1975; Headquartered in San Luis Obispo, CA
- DEL Ozone has manufactured NSF verified and UL/CUL listed ozone systems for the Pool and Spa Industry since 1985
- Over 1 million ozone systems have been sold
- Expert in ozone technology, ozone applications, research & design, engineering and manufacturing
- Offering a complete family of ozone products for:
 - Residential and Commercial Pools & Spas
 - Food Safety & Sanitation Industries
 - Aquaculture, Aquatic Life Support and Industrial Applications

- Advanced oxidation processes (AOPs) have been in use for about 30 years to remove harmful pollutants in various commercial and municipal water treatment applications
- AOP is typically used in the removal of different kinds of toxic pollutants from wastewater, including microorganisms, aromatic compounds, dyes, pharmaceutical compounds, and pesticides
- The use of ozone gas dissolved in water and passed through a chamber with a germicidal ultraviolet lamp is one form of AOP
- When ozone and germicidal UV are combined in a single system, the UV light interacts with the ozone, and the resulting chemical reaction generates hydroxyl free radicals. Hydroxyl free radicals have even more oxidation potential than ozone, the power of the whole system is increased; creating the synergy of AOP
- AOP can be effectively utilized in swimming pools to significantly enhance water quality and swimmer safety while further reducing chlorine use

- Ozone gas can be produced by passing air (or oxygen) through a light energy field or electrical energy field in a chamber
- **UV Ozone** is ozone produced with light energy (~185 nm wavelength); the quantity and concentration is very limited and the energy cost is high
- **CD Ozone** is ozone produced with electrical energy (high voltage/ low amperage); the quantity and concentration is substantially higher and the energy cost is low; CD Ozone is utilized in AOP applications
- **Germicidal UV** or **Ultraviolet Sterilization** is created by passing water over an Ultraviolet (UV) lamp which, in a low pressure type system, produces ~254 nm wavelength of UV radiation which passes through the water and the energy cost is low

- **Ozone** is a gas that when dissolved in water kills pathogens and microorganisms, destroys organics, and breaks down chloramines by oxidation. This occurs immediately at the ozone gas injection point, and continues through the main return. A small residual (< 0.1 PPM) of dissolved ozone will enter the pool, providing further oxidation of contaminants.
- **Germicidal UV** light when exposed to water passing through a chamber, inactivates (effectively killing) microorganisms and breaks down chloramines with light energy. This happens while the water is in the UV chamber, and as long as the water has no turbidity. No further process occurs once the flow leaves the chamber. UV light alone, provides effectively no oxidation.

Properties of Ozone

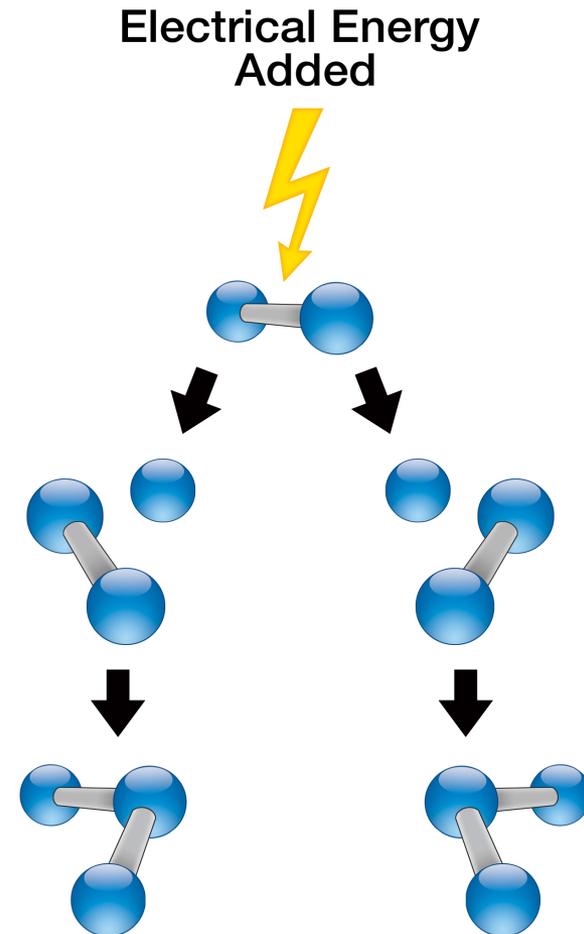
- Ozone (O₃) is a gas derived from oxygen which can be readily dissolved in water
- Gaseous Ozone dissolved in water is referred to as Aqueous Ozone (which has no odor or color); easily dissolved in pool water
- Ozone is an EPA approved antimicrobial oxidizer, sanitizer and disinfectant
- Aqueous Ozone is an effective micro-flocculent and effective anti-foaming agent
- The disinfecting capability of 1 PPM Aqueous Ozone is equivalent to many times (10 to 15,000 times) the concentration of free available chlorine (Morris, 1975 – Disinfection: Water & Wastewater), depending on pH, temperature, and on the specific microorganisms to be destroyed
- Ozone is compatible with Chlorine in Swimming Pools
- Ozone is produced by an ozone generator at the point of use (utilizing only air and electricity) and converts back to oxygen leaving no harmful byproducts making it both a green and sustainable technology

Benefits of Ozone

- Ozone's strong oxidation helps to rid the water of organic and inorganic contaminants brought into the pool by people and the environment
- Ozone kills all harmful microorganisms including chlorine-resistant *Cryptosporidium parvum*
- Ozone noticeably improves water clarity
- Ozone destroys biofilm (surface slime)
- Ozone helps control the chloramine levels in the water, reducing “shock-oxidizing” for chloramine reduction
- Chlorine consumption is typically reduced by 50-75% while still maintaining a low free available chlorine residual

How Ozone is Produced

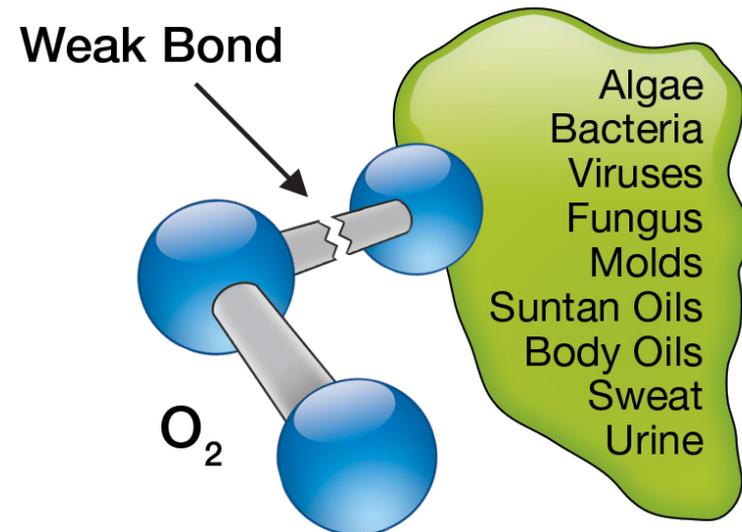
- Ozone is produced in an Ozone Generator with the use of electrical energy and oxygen from ambient air
- Oxygen molecules (O_2) split by adding energy, resulting in two individual oxygen atoms (O_1)
- Oxygen atoms (O_1) unite with other oxygen molecules (O_2) to produce Ozone (O_3)
- $(O_1) + (O_2) = (O_3)$



How Ozone Works

- The third oxygen atom is held by a weak single bond.
- An oxidation reaction occurs upon any collision between an ozone molecule and a molecule of an oxidizable substance
- The weak bond splits off, leaving oxygen, O_2 , as the only by-product.
- During an oxidation reaction, organic molecules are destroyed & dissolved metals are rendered insoluble.

Oxidizable Substance

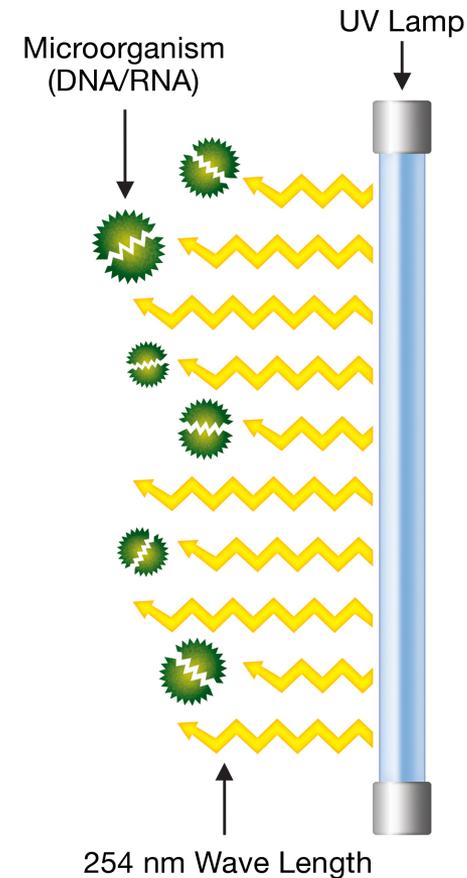


- Germicidal UV systems are EPA approved water sanitizing devices
- Germicidal UV (or Ultraviolet Sterilizer) uses specific UV light rays (254 nm has the greatest germicidal action) to sanitize water
- This high intensity germicidal light ray alters or disrupts the DNA or RNA of microorganisms including algae, bacteria, viruses, mold, spores and protozoa when they pass through the UV chamber (effectively killing them)
- UV is compatible with Chlorine in Swimming Pools
- UV light is produced by a chambered UV lamp at the point of use (utilizing only electricity) leaving no harmful byproducts making it both a green and sustainable technology

- UV inactivates all harmful microorganisms including chlorine-resistant *Cryptosporidium parvum*
- UV inactivates algae spores and provides very effective algae control
- UV systems are very effective at reducing chloramines, reducing “shock-oxidizing” for chloramine reduction
- Chlorine consumption is typically reduced by 25-50% while still maintaining a free available chlorine residual

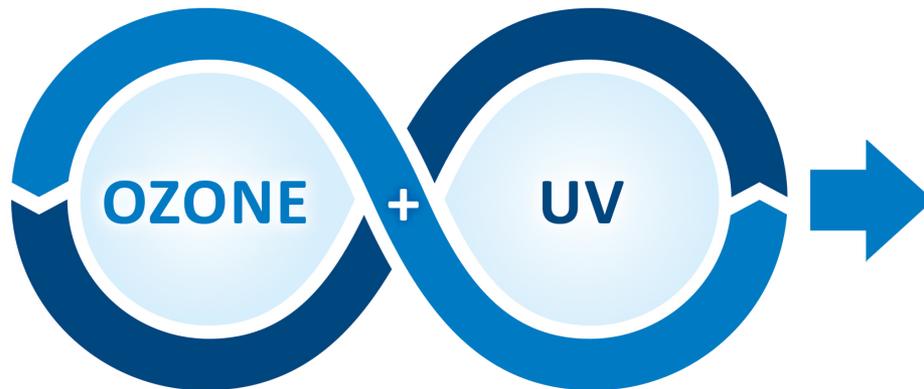
How Germicidal UV Works

- The UV lamp radiates 254 nm wavelength of light through the water in the UV chamber
- When the UV light contacts a microorganism (bacteria, virus, algae, protozoa, spore etc.) it disrupts the DNA or RNA effectively killing the microorganism
- UV also breaks down chlorine byproducts, reducing chloramines



Ozone and Germicidal UV Working Together in a Safe, Sustainable and Simple Low-Cost Self-Contained Pool Sanitation System

Synergistic Sanitation



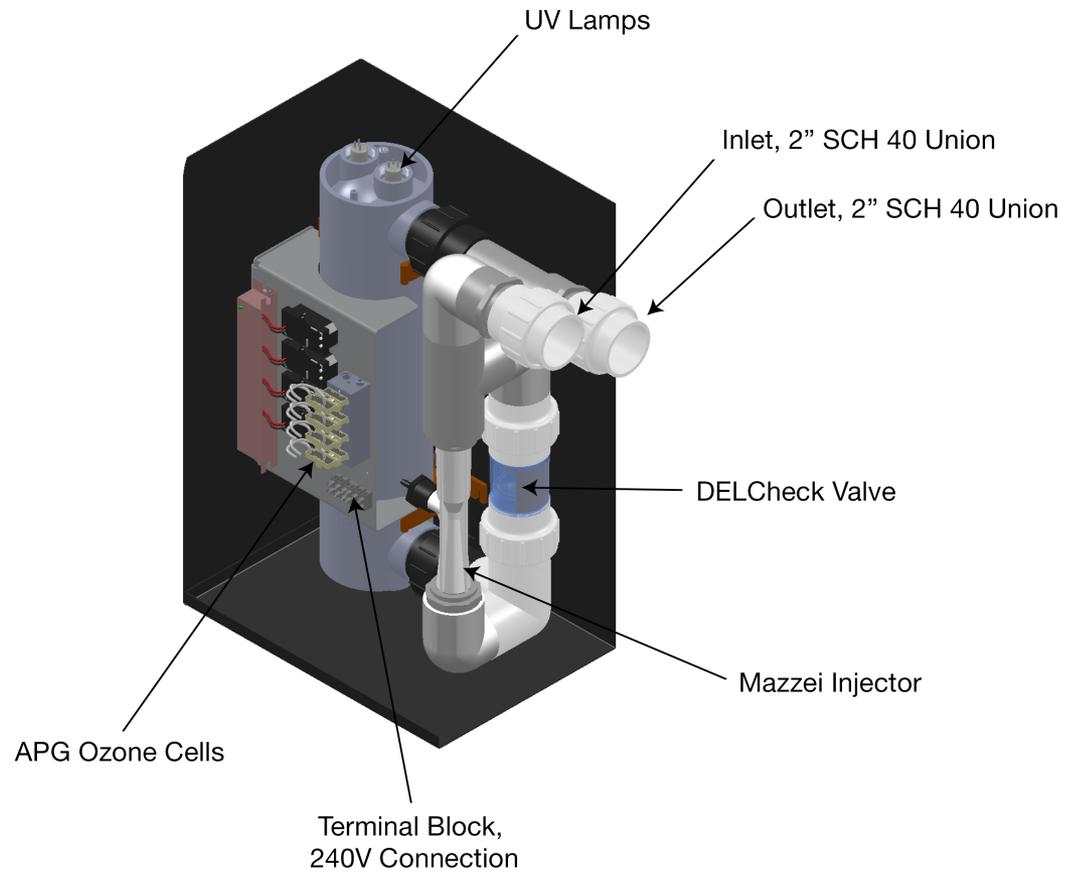
Advanced Oxidation
Process (AOP)

Maximized disinfection, clarity
and chloramine removal. **All in
one DEL Ozone system.**

Solar Eclipse

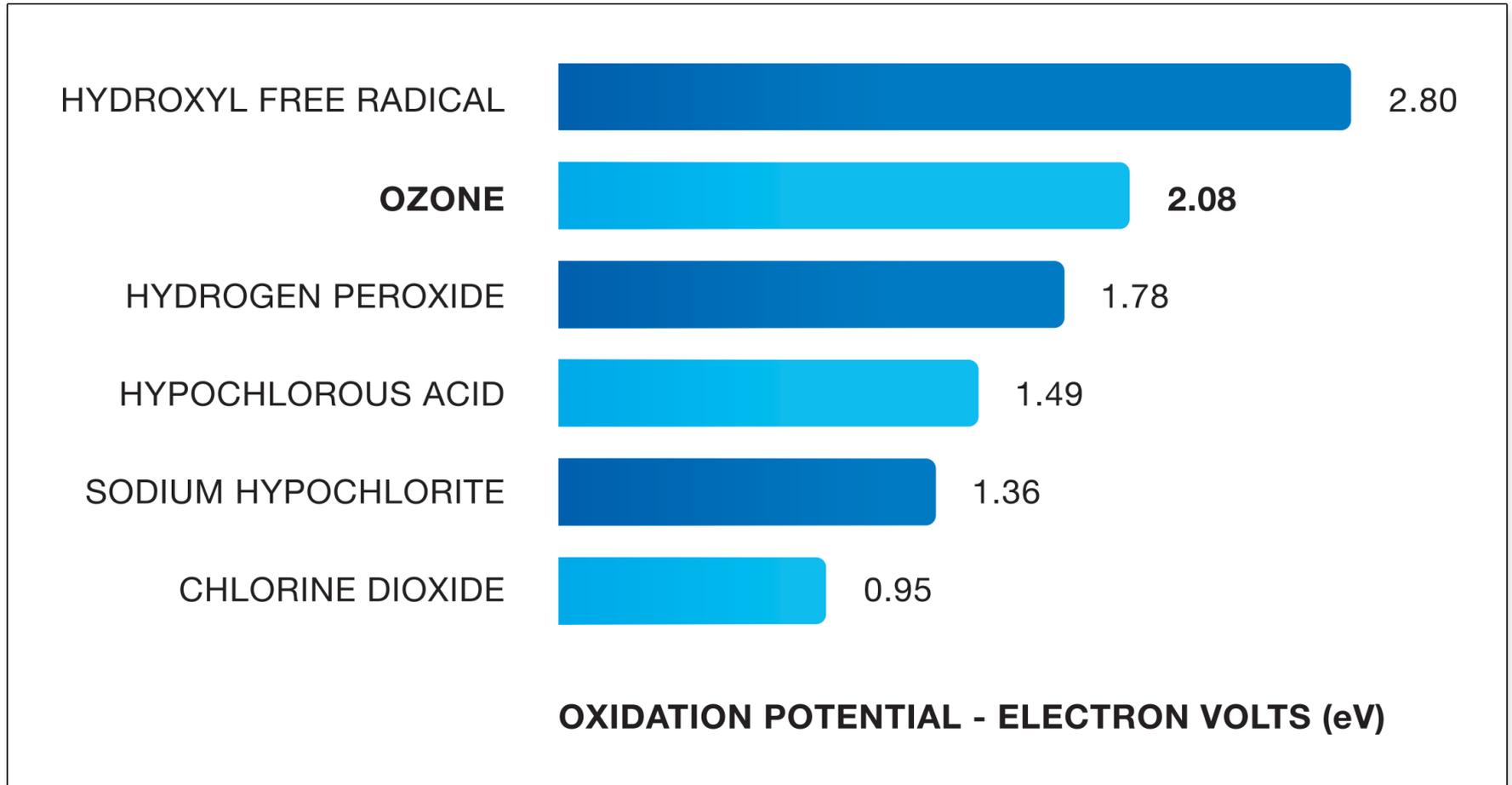
Advanced Pool Sanitation System

SOLAR ECLIPSE



- Ozone and Germicidal UV are packaged together in one simple and compact unit providing the benefits of both technologies plus the advanced oxidative reaction also known as AOP
- When aqueous ozone is passed through a UV Sterilizer, most of the ozone molecules are instantly converted into hydroxyl free radicals
- Hydroxyl free radicals are significantly stronger oxidizers than ozone, and are continuously being formed as the water flows through the system
- Hydroxyl free radicals are extremely short lived, but very powerful oxidizers, contacting and killing pathogens and other microorganisms, and oxidizing contaminants in the water flow and quickly converting back to oxygen

Oxidation Comparison Chart

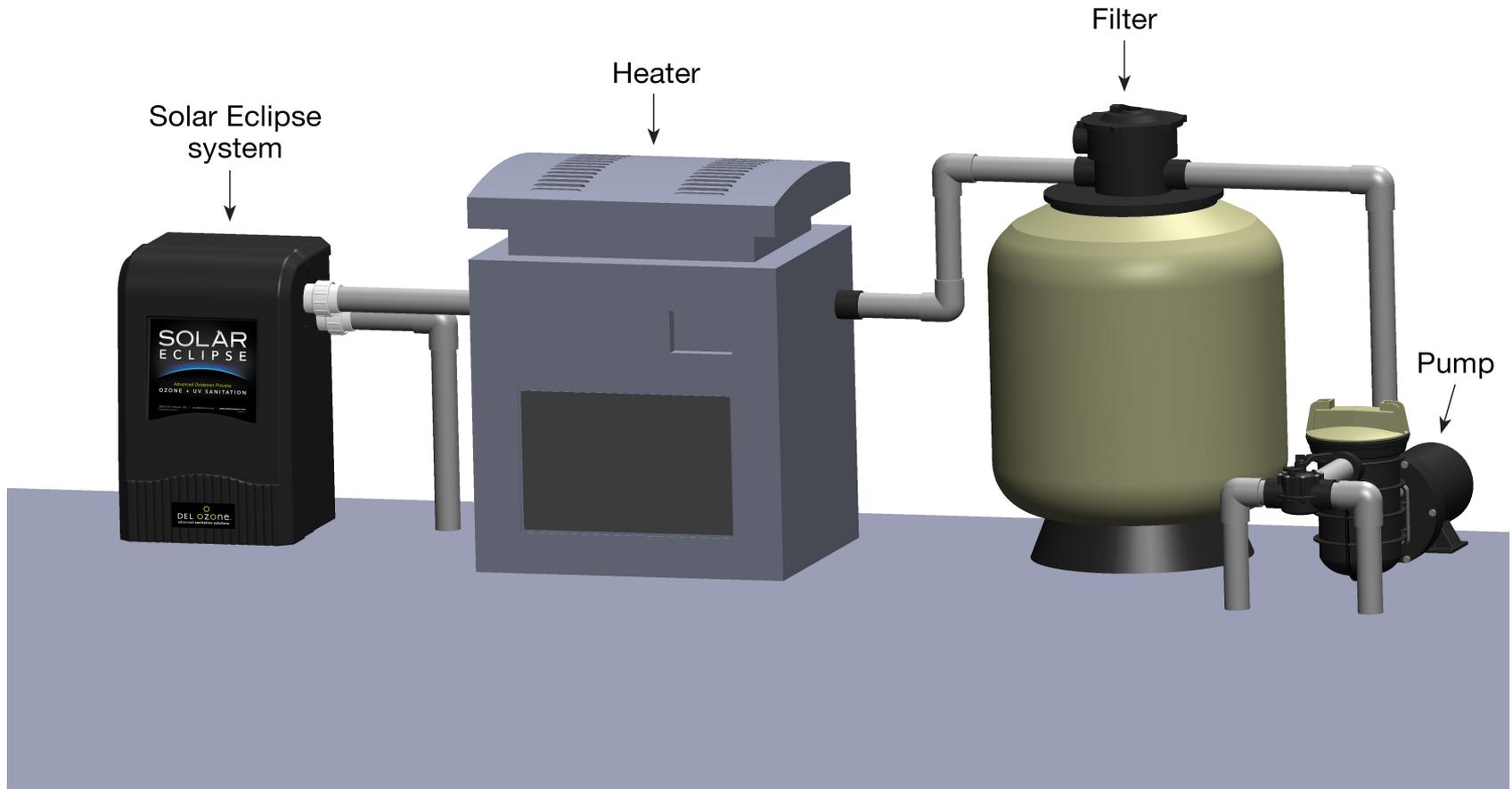


- Hydroxyl free radicals in combination with Ozone and germicidal UV, maximize disinfection and chloramine reduction, while clarifying the water (AOP)
- All three processes are safe, sustainable and green technologies
- AOP in addition to low residual free available chlorine, provides the strongest and safest pool water sanitation available
- AOP provides the cleanest, clearest, safest pool water with the absolute lowest chlorine use of any system available today for residential pools
- Affordably priced and easy to install, with automatic operation and a very small footprint

- The Solar Eclipse is installed on the pool's recirculation system after the filter/heater in the full flow
- Installation consists of a simple inlet and outlet plumbing hook-up and power connection (240 VAC)
- The Solar Eclipse uses the same amount of energy as a 100 Watt Light Bulb
- The system operates automatically during the recirculation cycle

Solar Eclipse Typical Pool Installation

SOLAR
ECLIPSE



- The Solar Eclipse is an innovative, powerful and practical design. It will substantially alter and improve residential pool sanitation programs, with benefits that pool owners will appreciate immediately
- Pool water disinfection will become more effective and more reliable, covering the broadest spectrum of contaminants of any system to date
- With correct installation and operation, the system will allow the smallest chlorine residual of any safe sanitation method
 - Pool owners will be able to follow simplified sanitation programs, improving both water quality and clarity
 - Pool professionals will find that the Solar Eclipse is easy to install using standard methods
 - A clean, easily-maintained pool improves owner satisfaction. Pool professionals benefit from that

For more information
www.delozonepool.com
jjones@delozone.com
(800) 676-1335 ex.291
DEL Ozone
San Luis Obispo, CA