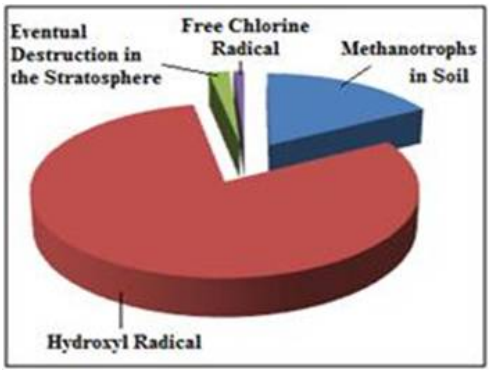
October 05, 2012

To date there are several different types of atmospheric hydroxyl generating devices. All claim the benefits of the naturally occurring hydroxyl radical. The hydroxyls' existence in Nature is ubiquitous. This structure occupies 500,000 – 2,600,000 per cubic centimeter (National Aeronautics and Space Administration- NASA). In fact, this radical sanitizes more than three quarters of the earth's entire atmosphere. There are simply no other atmospheric oxidizers that have the kinetic energy that is germane to the atmospheric hydroxyl radical.

Figure: Sources and sinks of atmospheric methane based on IPCC Intergovernmental Panel on Climate Change 1995 assessment.



A pie chart demonstrating the relative effects of various sinks of atmospheric methane (12.61eV).

HGI Industries Incorporated made a request to the Federal agencies responsible for the regulatory safety of the American public. The National Institute of Environmental Health Sciences searched the NIH files, PubMed and the National Library of Medicine and "cannot find any hard science or research indicating that hydroxyl radical generation is harmful to human health. That applies to both atmospheric and man-made generation" (Colleen Chandler, NIEHS Office of Communications and Public Liaison, 8-5-10). Further, at HGI's request, the CDC, FDA, OSHA and NIH researched their databases and did not find any data indicating that hydroxyls were unsafe. None of these agencies indicated that their approval was required for commercial use. Hydroxyl systems have been in use for over ten years and no adverse effects have been reported.

If life on Earth is shielded by the prolific distribution of atmospheric hydroxyls and the appropriate American federal agencies have given their comments on the matter, then it would seem that there are other methods of hydroxyl production that do not meet with the atmospheric standards of Nature.

Below are several methodologies that claim to produce hydroxyl radicals**:**

- TiO_2 – Titanium Dioxide coupled with 254 nm irradiation
- Single nanometer irradiation at the 365-385 nm range
- Single nanometer irradiation at the 254 nm range

The TiO_2 type has been extensively studied. No hydroxyl activity has, to date, been verified. The lower energy bond dissociation levels are not capable to fully decompose VOC's and therefore tend toward producing formaldehyde as is evident in the literature.

Recent testing has verified that the irradiation energy displayed at the 365-385nm range is simply not capable of producing any hydroxyl activity. When challenged with the introduction of n-heptane (Reacts only with hydroxyls) into a test chamber, there was no evident reduction with respect to the introduced gas.

Lastly there is the claim that irradiation at the 254nm range is sufficient to cause hydroxyl formation is likewise unfounded. The literature states that 254nm irradiation is capable of producing a one (1) Log reduction (90%) in bacteria, virus or fungal species if that organism is held stationary within one foot (12 Inches) of the lamp source energy for a period of 14.5 seconds. In essence, only the air passing within close proximity of the lamp will be affected, but only if the organisms are irradiated for a period equal or greater than 14.5 seconds.

Obviously there are claims made in these aforementioned technologies. In reference to the Belfor Technical Library document, it would be valid to ask what type of hydroxyl generating device was used and what was the square footage that the device was tested in?

In the Belfor Technical Library document it was stated that ' hydroxyl deodorization differs from ozonation, both are oxidation processes'. Let us have a look at how accurate this comment is.

The Table 1 below was compiled by the University of Southern California.

Table 1: Comparison of Various Oxidizing Potentials

Oxidizing Agent	Electrochemical Oxidation Potential, (EOP)V	EOP Relative to Chlorine
Fluorine	3.06	2.25
Hydroxyl Radical	2.80	2.05
Oxygen (Atomic)	2.42	1.78
Ozone	2.08	1.52
Hydrogen Peroxide	1.78	1.30
Hypochlorite	1.49	1.10
Chlorine	1.36	1.00
Chlorine Dioxide	1.27	0.93
Oxygen (Molecular)	1.23	0.90

Sources:

www-rcf.usc.edu/~pirbazar/group_homepage/resear/adv.html
www.iupac.org/publications/pac/1998/pdf/7012x2271.pdf

As we can see, there is a difference between the oxidation potential of ozone and that of the hydroxyl radical. The differential between ozone and hydroxyl would favor the potential of the hydroxyl radical. The hydroxyl would be over thirteen (13) times more effective and would be over one (1) billion times faster to react than ozone.

It is the Bond Disassociation Energy (BDE) that enables an oxidizer to cleave atmospheric chemicals. For example, ozone has an impressive BDE which registers at 12.53eV (Electron Volts). This potential enables ozone to neutralize/decompose most hydrocarbons due to the fact that hydrocarbons possess a lower BDE. Where the challenge comes into play is when ozone needs to work in an atmosphere that is charged with water vapor. There are sound scientific reasons behind the evidence that ozone will work well if the indoor atmospheric humidity is between 0 and 8%. The reason for this limitation is that ozone is challenged by water vapor. This is due to the BDE of water being at 12.62eV (H_2O). Ozone (O_3 = 12.53eV) simply does not have the kinetic energy necessary to break through water vapor in order to effect change. On the other hand, Odorox® hydroxyls have a BDE in excess of 14.01eV. This delivers more than sufficient energy to cleave noxious Volatile Organic Compounds (VOC's) even if they are found to be in an excessively damp environment.

Odorox® hydroxyls have been successfully deployed in a variety of commercial/industrial, food and beverage situations. Lets us examine the Wastewater Industry. Below is a graph from a Wastewater facility that has a throughput of 50.3 million gallons per day. Hydrogen sulfide (H_2S) levels were typically between 500-700 parts-per-million (ppm). (Note: The human nose can detect H_2S at half a part-per-billion (ppb) at a distance of five miles and be mindful that a lethal dose of H_2S would be 551.47ppm.)

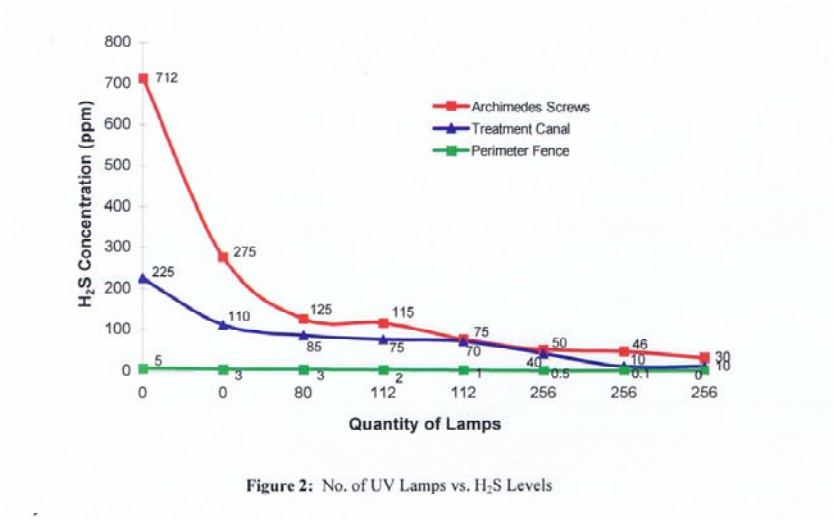


Figure 2: No. of UV Lamps vs. H_2S Levels

Based on the above measurements of H_2S, it is clear that the system reduced H_2S emissions that were monitored at levels between 500 and 700 ppm. After treatment began and the units were functioning, a corresponding reduction in both the trapped, treated air, and ambient air immediately adjacent to the treated area were also significantly reduced, with ambient air levels at the perimeter fence averaging close to zero ppm. Subsequently when the units were turned off, a corresponding increase in H_2S levels was observed.

Figure 2 visually illustrates the reduction in the concentration of H_2S with the number of ultraviolet lamps installed. The data is conclusive to show the operational equipments' capacity to successfully reduce the H_2S levels.

Note: The hydroxyls generated for this wastewater application entered the system a quarter of a mile away from the test collection apparatus. This effect is known as the hydroxyl cascade effect. This cascade reaction will have a positive effect on target gasses and organisms at a distance within a closed system.

Odorox® Safety:

- Odorox® technology is safe
  - Hydroxyls are all around us in the outside air and completely safe to humans
  - Leading toxicology research center, Comparative Biosciences, conducted FDA compliant animal toxicology study that showed no adverse effects even with continuous 24/7 Odorox® produced atmospheric hydroxyl exposure over 13 weeks

This test of Odorox® hydroxyl generation with respect to a live animal population was a world first. No other agency has completed such a study.

Odorox® Atmospheric Hydroxyl Production:

- Odorox® technology produces hydroxyls and creates a cascade effect . to effectively eliminate most chemicals.
  - Validated by premier US atmospheric research facility, Lovelace Respiratory Research Center, and atmospheric chemistry industry expert Dr. D. Crosley

Odorox® VS Indoor Air Pollution:

- Odorox® technology reduces pollutants in indoor air
  - Verified by Columbia Analytical Services

Odorox® VS Bacteria, Virus and Fungal Species:

- Odorox® technology kills bacteria, viruses and molds (fungi) in the air and on surfaces
  - Verified by ATS Labs which did studies on a range of clinically and commercially relevant micro-organisms (ATS Labs)

(NOTE: Only Odorox® technology can lay claim to these above specific benefits. Any competing technologies must produce their own data as the patented Odorox® process cannot be copied.)