

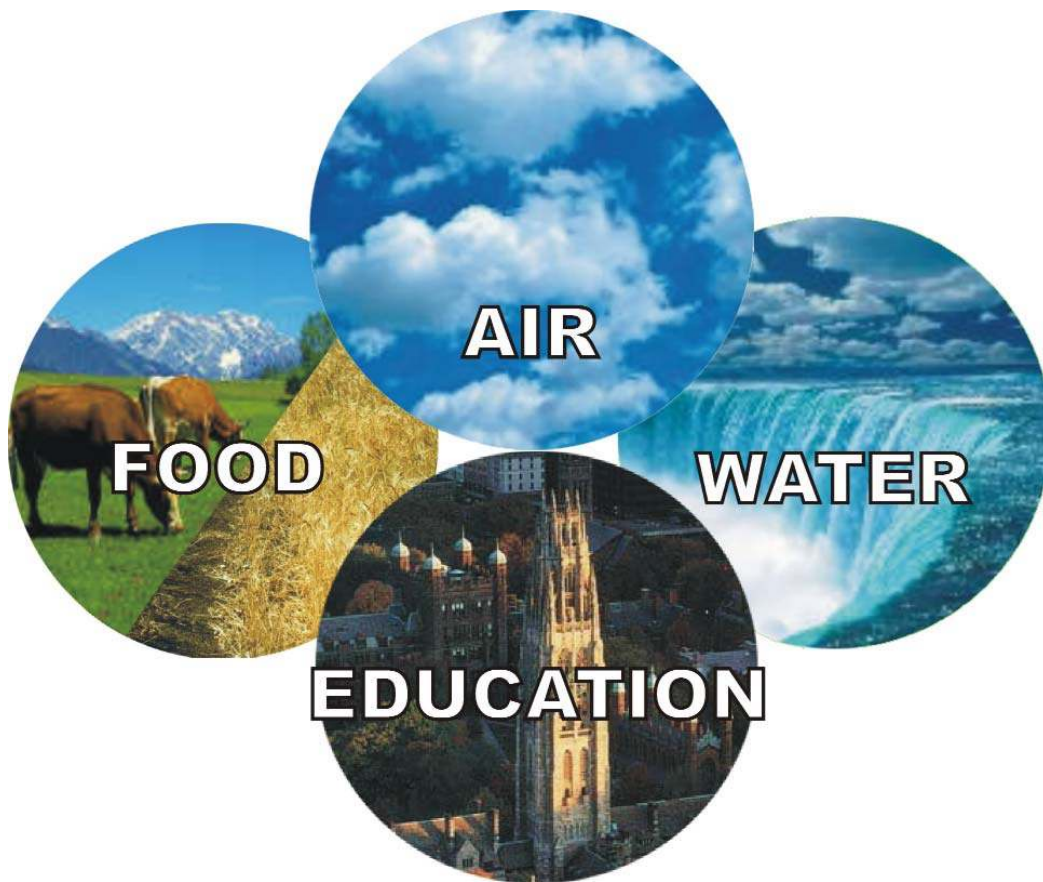
Photohydroionization™

PHI™

An Advanced Oxidation Technology



The history, evolution, validation, case studies, pilot plants and product lines utilizing Photohydroionization™ for water, food, air, laundry and grease treatment.



RGF Environmental Group's Mission

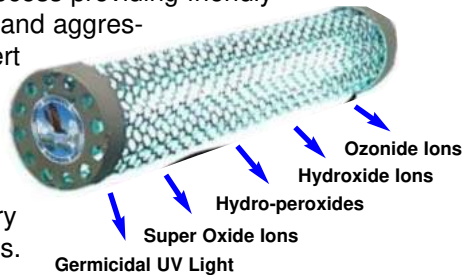
"To provide the world with the safest water, food and air without the use of chemicals."

Photohydroionization™ - An Advanced Oxidation Technology

By Ronald G. Fink

Summary

Photohydroionization™, or PHI™, is an Advanced Oxidation technology developed and owned by RGF Environmental Group. Basically, it is a broad spectrum high intensity UV light targeted on a quad metallic catalyst ultraviolet (UV) target in a low-level ozone and moist atmosphere. This creates an advanced oxidation process providing friendly oxidizers, or very safe and aggressive oxidizers that revert back to oxygen and hydrogen. PHI™ Technology has been successfully used in water, air, food, laundry and grease applications.



History

Experiments with food and water irradiation started in the 1960's (RGF employees participated in this work). Results were promising. However, food irradiation remains a problem to date. This is due to inconsistency in results, some taste concerns and mostly public fear of radiation. Irradiated food must be labeled as such, and the radiation symbol carries public concern.

In 1985 RGF formed with the corporate mission to provide the world with the safest water, food and air without the use of chemicals. Experiments with ozone (O_3) and UV light rays proved promising. UV light at 184 NM creates a low concentration of ozone. This low cost, low maintenance method of producing ozone was of commercial interest. However, the low concentration was an efficacy concern. Experiments were conducted by RGF's R&D in the late 1980's, and it was discovered that the use of UV ozone on industrial wastewater was feasible when the low-level UV ozone was activated with UV light, thereby producing a hydroxyl radical, the most powerful friendly oxidizer. This was an important find as the use of ozone was preferred. However, the traditional method of ozone production was the corona discharge or "CD" method, which produced a high concentration of ozone. The CD method was considered not practical due to high cost, high maintenance and high failure rate.

This find led to an 18 year string of discoveries involving: advanced oxidation, utilizing UV irradiation, ozone, fenton reagents, catalytic oxidation, hydro peroxides, titanium-silver-rhodium and copper catalysts, silver ions, oxide ions, super oxide ions, ozonide ions, broad spectrum UV radiation, soft surface irradiation, hydroxide ions, radiated catalytic ionization™, hydroxyl radicals, HE-UV, sintered metal targets, PPC-UV coating, photocatalytic oxidation, photohydrocatalytic™ oxidation and the PHI™ Cell, resulting in numerous patents and over 500 RGF products.

Development

UV light and ozone are not new discoveries. Ozone was first discovered in the late 1800's and used as a water purifier in Europe. UV light was discovered in the 1930's. Actually,

nature discovered it before; it was called the "sun". The disinfection qualities of UV light are also not new. Hospitals have used UV light for decades in operating rooms. Barbers were disinfecting combs in the 1950's with UV light. What is new is the enhancement of both these natural, friendly oxidizers and the validation for use on air, water, food and laundry.

History of Water Systems

The first patents awarded to RGF were for its industrial wastewater treatment systems. RGF pioneered and developed both the discharge and recycling systems for heavy industry. By the mid-1980's, environmental concerns were peaking and RGF's systems were the industry choice. RGF maintains strategic alliances, national accounts and distributorships with many Fortune 500 corporations, including Caterpillar, John Deere, GE, Halliburton, Hertz, NASA, US Department of Defense, US Army, Navy, Marines, Air Force, Baker Oil, Waste Management, Laidlaw, Case, US General Services Administration, Hilton Hotels, FPL, US Nuclear Regulatory Commission, Schlumberger, Steris Corp., Food Safety Systems, ADM, Conagra, Seaboard Farms, Kraft, Coca Cola, Insinkerator, McDonalds, Regal Foods, Shaklee Corp., Sandia National Labs and Nevada Nuclear Test Site.

All of the industrial water systems used RGF's advanced oxidation (ozone/UV) systems with great success. RGF water systems have been manufactured since 1985 with over 20,000 water systems installed in 33 countries.

About Ozone

Ozone or O_3 is the result of oxygen (O_2) reacting with an electrical discharge such as lightning, a spark, or an electrical current, or UV light radiation. Ozone is a colorless gas that has an odor similar to the smell of fresh air after a thunderstorm. Ozone is extremely unstable and cannot be stored. It must be generated at the site. Ozone is faster and more powerful than chlorine and is an oxygen-based friendly oxidizer. By friendly we mean oxidizers that revert back to oxygen and hydrogen after they react. High levels of ozone can be a health hazard or even lethal.

History of Air Systems

In the mid-1980's air purifiers started to make their way into the residential market. Ozone air systems were widely used in the commercial restoration business for fire and flood damage to buildings. These applications utilized corona discharge systems (CD) that use a spark or electrically charged plates to simulate lightning. This converted the oxygen (O_2) to ozone (O_3). The CD method creates very high concentrated ozone. Plus by using air as the oxygen source, you are receiving 20% oxygen and 80% nitrogen. The problem with CD systems is with oxygen conversion you also get a nitrogen conversion, which makes nitric acid and nitric oxide. Therefore, most professional CD manufacturers provide oxygen generators (as does RGF) with their systems to prevent the nitric problem.

The problem facing the residential air systems was that the cost of an oxygen generator was so high they went without one. This, of course, created a CD unit that produced high concentrated ozone plus low levels of nitric oxide and nitric

acid. Maintenance was a problem due to the corrosive nature of nitric acid and the high concentration of ozone exceeding the Federal safety limits of .04 ppm. Ozone readings at the exhaust have exceeded 10 ppm, which is potentially lethal. RGF decided to stay out of this dangerous market and stay with our ozone commercial market which only used our equipment in evacuated buildings controlled by professionals.

In the late 1980's we discovered that the lower concentration of ozone could have an effect on odors, mold and bacteria levels as low as .02 ppm (half the Federal safety maximum) were reported as having significant results. Testing this theory, we determined that safe, low levels of ozone could provide a significant reduction in airborne mold, odors and bacteria. The challenge was to create a safe residential air purifier that could produce safe, low concentrations of ozone that would not exceed the .04 ppm Federal limits. This was accomplished in the early 1990's, at about the same time the Federal Government was going after the CD ozone residential units. This battle of the Feds and CD manufacturers gave ozone a very bad name.

With the technology to build a device that produces safe, low concentrations of ozone and the ability to ensure a room would not exceed .04 ppm, RGF set out to validate the use of this device on mold, VOC's, odors and bacteria. Fox TV News was doing a three-part series on indoor air problems and asked us to test one of the CD ozone units. The unit they gave us was producing 18 ppm ozone, a lethal amount that drove the camera crew and news reporter right out of the office. The Fox people then asked if they could independently test our RGF Pure Air unit. They ran tests supervised by an independent air specialist and two medical doctors. The series turned out to be a fantastic infomercial for RGF. The results couldn't have been better. Fox ran this on their national news network and their national health news. Popular Science picked up the story for the magazine and ran it on the Popular Science TV Show. Sales of our Pure Air residential line picked up substantially.

In the mid-1990's, a high-end resort island approached us about water and air problems on the island. The resort was called Little Palm Island. It is a five-acre island located 30 miles from Key West. The island was formerly



President Harry Truman's fishing camp. It was also the site of the film "PT-109", the JFK World War II story. The island maintained the original Truman House for the restaurant and had 32 thatched huts for rooms. With the high humidity and the inherent problems associated with an island, environmental problems such as mold and mildew were everywhere.



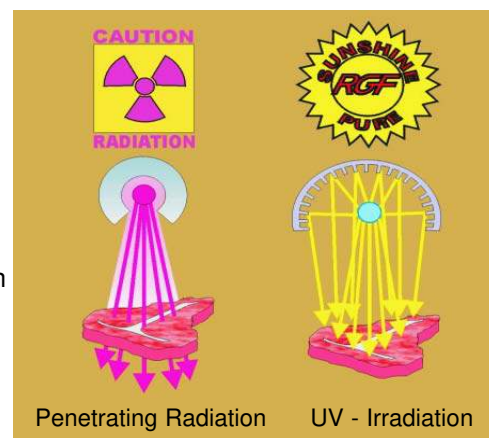
Little Palm receives EnviroVision Plaque

The rooms had sick building syndrome. The food storage rooms and kitchen were mold havens. Sewage was being injected into a sewage injection well. The sewage processing plant was over its capac-

ity. Drinking water was stored in underground tanks. Garbage odors were a problem, as it had to be stored on the island and shipped back by boat. With the use of our newly discovered Advanced Oxidation Technology, RGF was able to provide 19 systems to greatly improve the island environment. We called the project "Envirovision®". With the RGF Advanced Oxidation processes, we were able to provide the island with the purest possible water, air, food and laundry without the use of chemicals. This was the first time RGF was able to utilize numerous systems to cover all four areas: food, air, water and laundry.

The Little Palm Project gave us a few new problems - food, sewage and laundry. Little Palm, being an island, offered a mold, mildew, odor, sewage and bacteria problems like we had not seen before. Food shelf life was short, mold grew on the walls, and airborne mold spores and bacteria were heavy. In the food storage areas, the food needed a chemical-free method of sanitation. Reflecting on food irradiation experiments of 40 years ago and the associated problems with radiation, it was ruled out. The food problem was a surface contamination problem resulting from airborne mold and bacteria in a very growth-friendly atmosphere (warm and humid). Penetrating radiation was overkill. Why penetrate through a food item when the contamination is on the surface? Accordingly, we tried soft radiation, or non-penetrating radiation like sunlight or UV radiation.

Straight 254NM UV, sometimes referred to as germicidal UV, works well on surfaces. Subsequent experiments found that creating an advanced oxidation atmosphere between the UV lamps and the food surfaces or photoionization provided fairly broad kill rates of over 90%.



In addition, we provided ozone/water food wash down stations. Ozone gas dissolved in water is a very aggressive and friendly disinfectant that also removes chlorine and pesticides from fruits and vegetables.

The sewage plant was another unique problem that our PHI technology helped us with. The plant was overloaded and the injection well was under designed (installed by the Trumans in the 1940's). In order to increase the efficacy of the plant, we added fluidized bed technology to the existing plant. Also, we treated the restaurant grease separately. We discovered that the PHI Cell's advanced oxidation gas actually broke the grease down to a food source for the bio plant, which created an interesting scenario. Instead of grease adversely affecting the plant's operation, the PHI treated grease improved the plant's efficiency. To relieve the overflowing injection wells, we installed a sewage reclaim system using the PHI Cell to sanitize the water for irrigation. This system not only helps save the island's natural environment, it provides a highly nutrient rich water source to the island's plant life saving over \$100 per day in irrigation costs.

The laundry also presented a problem. Laundry detergents tend to be unfriendly to sewage plants. Ozone had been used on hospital and hotel laundry since the late 1980's. RGF worked with EPRI (Electric Power Research Institute) to do the first hospital laundries. Results were promising. However, the high concentrations of ozone tended to bleach out colors so it could only be used on whites. Little Palm Island had colored towels, sheets, basically everything. The ozone laundry system had many advantages. Unfortunately, the bleaching problem made it unacceptable. The use of our PHI™ Cell again came to the rescue. The cell produced ozonide ions, hydro peroxides, super oxide ions and hydroxide ions. In safe low levels with small amounts of enzymes, cleaning was as good, even better than harsh detergents. Plus, without all the chemical residue in the towels, they became one-third fuller. Colors were vibrant, allergic reactions stopped, and the island saved energy as the PHI Cell works best with cold water.

Food Systems

With the success of the Little Palm Island Program, the Envirovision Program was then installed in a chicken processing plant. The chicken was being cleaned and soaked with tap water and chlorine. The odor in the plant was high as was the airborne bacterial levels. The chlorine left a residual on the chicken surfaces. When chlorine reacts with an organic (chickens are organic), it forms trihalomethane, a highly suspected carcinogenic.

Chlorine

•Water Treatment	.5 ppm
•Swimming Pools	2-5 ppm
•Sewage Odor Control	5 ppm
•Food Grain Washing	400-600ppm
•Food Celery/Carrot Washing	50 ppm
•Food Poultry Carcass Washing	100 ppm

Chlorine has been used to kill germs in drinking water since 1916 in Canada, and since 1908 in the United States.

The potential danger isn't in the chlorine itself. When chlorine is added to water with organic material such as algae or bits of river weeds, it produces by-products known as tri-halomethanes and haloacetates.

In 1995, the Ontario Cancer Treatment and Research Institute and the University of Toronto found Ontario residents using chlorinated water had higher rates of bladder and colon cancer than people who drink well water. That study said the problems could come both from drinking treated water and from bathing or showering in it and inhaling the water vapor or spray. People who had used chlorinated water for 35 years raised their cancer risk by 1.5 to 1.6 times, the study said. It blamed 10% to 13% of the bladder cancer in Ontario on chlorinated water.

Grain

RGF has replaced traditional anti-microbial chemicals such as chlorine (450-600 ppm) with non-chemical processes and further reduced bacteria by 80% at a grain plant.



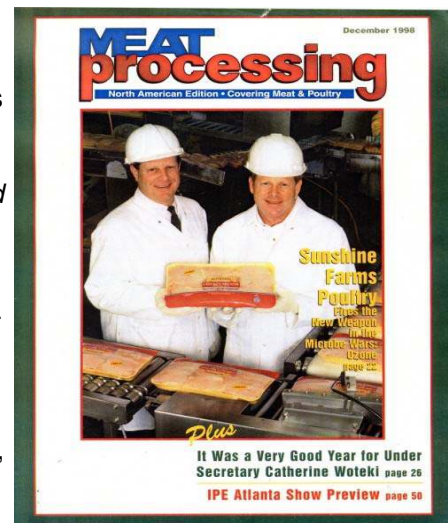
RGF's Photohydroionization™ of Grain

Under a USDA/FDA protocol, we installed EnviroVision Systems to provide the plant with air, water, food surface light and irradiation and sewage grease system. After two years of testing and more testing, the program was granted approval.

Results included:

Plant Air	Over 85% odor and bacteria reduction
Water	Over 80% bacteria reduction
Food Surface	99% bacteria reduction
Grease	80% bacteria reduction

The Sunshine / Envirovision project received excellent press with a cover story in *Meat Magazine* and a center spread with *Food Engineering Magazine*. Since the FDA/USDA approval, RGF's PHI technology for water, air and food surfaces has been successfully used on pork, poultry, beef, fish, ready-to-eat meats, grain, beverages and restaurants.



Food Engineering Magazine



Pork: RGF has reduced surface bacteria by 80% and increased shelf life up to 20% at one of the nation's largest pork producers.

Pork and Beef Brine Injection: RGF has reduced bacteria up to 99% at a beef and pork processing plant.



Vegetables: RGF has reduced surface bacteria on corn, peas, carrots and celery by more than 90% at a number of vegetable houses.



RGF's Advanced Oxidation of Celery

With these successful applications, RGF formed a strategic alliance with BOC, a \$7 billion NYSE food processor supplier. The vast food industry would require a world-class food sales and support team second to none. BOC had it. More recently, BOC has purchased five RGF PHI technologies for the food processing industry in the USA and Canada. RGF will continue to work with BOC with manufacturing and future food inventions under an engineering services contract.

In the late 1990's a group of Shaklee executives came to RGF. (Shaklee is a multi-level marketing company with a 40-year history. They enjoy a good reputation and are primarily concerned with health and nutrition). They were interested in getting Shaklee in the air purification business. Shaklee, owned by a Japanese pharmaceutical company, is extremely conservative and cautious with new technology. They had seen our old Fox TV News video after visiting our facility, and were convinced we were perfect for Shaklee. It took over one year of validation testing, lawyers and more testing. Shaklee finally launched their AirSource project. The unit contained an RGF Photoionization Module and another technology for par-

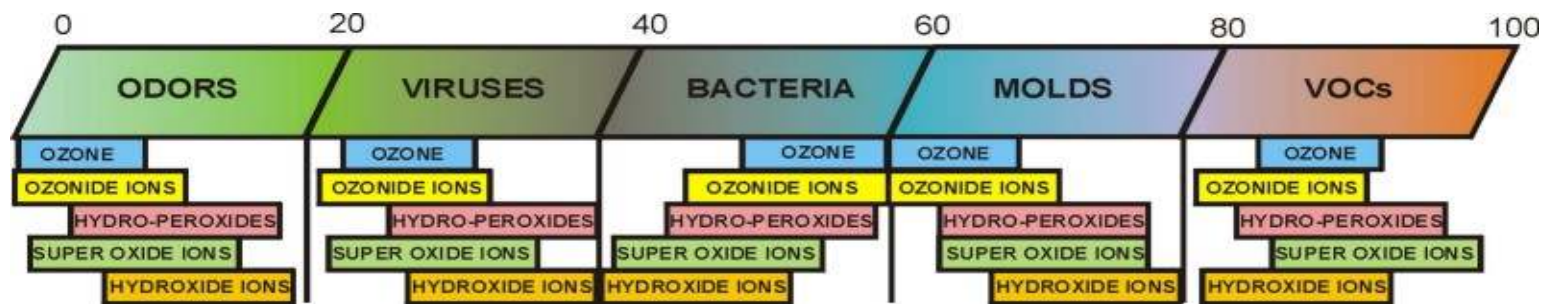
ticulate removal. The results were outstanding. Shaklee's sales were over \$50 million retail the first year. Customer satisfaction was very high. Basically, the entire project was a huge success.

R&D continued on our PHI Technology with the goal of reducing ozone levels and creating alternative advanced oxidizers. In 2003 the PHI Cell was developed. The original PHI Cell was designed for use in a central HVAC system. This provides the fastest and most effective oxidizer distribution. Rhodium as an additional catalyst as well as improved hydration compounds were also added. Plus, a totally new target



concept was used. A 360° cell of faceted expanded metal providing maximum exposure of the catalytic surface. Also "PPC", a poly protective cover, was added to protect from bulb breakage and resulting mercury spill, as all UV bulbs contain mercury. A broken bulb in a food establishment or in an HVAC system where the mercury could end up on the heating wires or burner where it could volatilize would be disastrous, to say the least. New laws in 2004 require manufacturer to label all packaging with "Contains Mercury". The bulb was reworked and an RGF HE/UV Broad Spectrum 100-300-NM bulb with a heavy duty filament was developed. This combined with a soft start ballast and the insulating qualities of our PPC gave the new PHI-Cell an unprecedented 3 year, 25,000 hour life. This was a major improvement over the current standard 8,000-10,000 hour UV bulb life. The most important improvement was the efficacy, the new cell design created more hydroperoxides, super oxide ions and ozone levels were .01-.015 ppm. Country or forest air is .01-.02 ppm of ozone. Most people can smell ozone at .01 ppm, and .05 ppm is the federal safe limit for medical devices. The new cell also produces hydroxide ions and ozonide ions which broadened our scope of capabilities. (See chart below)

By using a PHI Cell with redundant oxidizers our scope of



Organic Spectrum

Effectiveness is widely broadened with Multiple Oxidizers

Riviera company enlisted to fight off SARS in China

effectiveness is widely broadened.

The SARS virus was a major concern. Our Representative in China worked with the Chinese government and tested the cell. This testing proved positive that the PHI Cell could help contain the SARS virus by making a kill at the source. Most air purifiers require the contaminant to actually enter the purifier. With the PHI-Cell the oxidizers are distributed throughout the room. With this in mind and our success with mold, VOC's, bacteria and odors, we started looking for a way to test common "microbials" or "germs".

Four years ago, BOC brought in Dr. Marsden, a well known Food Scientist and Professor at Kansas State University. Dr. Marsden has been instrumental in validating our food sanitation systems. He has recently formed a new company "Food Safety Systems, L.L.C." Together with his team of experts, they provide consulting to the food industry with food safety science recommendations. They are also working with Sandia Laboratory in New Mexico, a National Laboratory responsible for Homeland Security. A meeting was held at RGF with Dr. Marsden's group. Virus and bacteria transmittals were discussed as well as the PHI Cell's ability to kill airborne viruses and bacteria at the source. A testing protocol concept was



discussed which included a "Sneeze Simulation Machine" and "Sneeze" chamber. A sneeze can travel at up to 100 mph, so we had to consider lung capacity, sneeze pressure, and liquid volume to properly simulate a human sneeze. This was accomplished and the test proceeded with outstanding results. An average of 78% reduction of microbials was achieved in a double blind test, at 3 feet from the sneeze source. This is clearly not a medically supervised test or protocol. However, from a practical point, it was definitely providing some kill at the source and will provide some level of protection.

The physics of PHI as an air purifier is unique. A PHI System is not a filter or an ozone generator. It is a cell that radiates

OXIDIZERS (In order of strength)

1. Fluorine
2. Hydroxyl Radical*
3. Ozone*
4. Hydrogen Peroxide*
5. Permanganate
6. Chlorine
7. Bromine
8. Iodine
9. Oxygen*

* Elements of the RGF Advanced Oxidation Process. Friendly oxidizers do not use chemicals and revert back to oxygen and hydrogen.

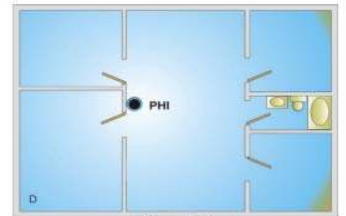
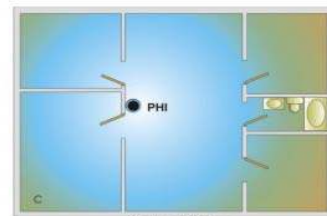
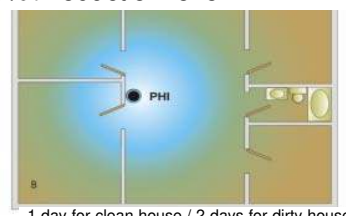
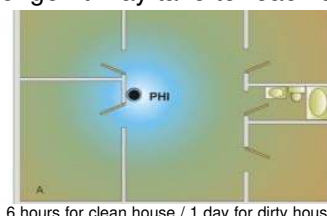
friendly oxidizers.

These oxidizers travel through a room or home by Brownian Motion (natural air movement). One of the five PHI oxidizers is hydro peroxides. In layman's terms, treating a room with hydro peroxides is like misting a room with a weak hydrogen



peroxide (H_2O_2) mist. Each time a hydrogen peroxide particle finds an airborne organic contaminant it will oxidize or neutralize the contaminant, and in the process kill itself. The hydrogen peroxide particle

(H_2O_2) will revert to water vapor (H_2O). This will permit the next H_2O_2 particle to move a little further into the room until the entire area is purified. This is the reason one small PHI unit can work on large areas up to a 5,000 sq. ft. house. The factor is time. The more pollutants or contaminants, the longer it may take to reach a 90%+ reduction level.



Restaurants

The PHI Cell and technology have been widely used in our Restaurant EnviroVision Program. This program provides a restaurant with the purest water, air and food possible without the use of chemicals. Typical PHI Systems used at restaurants include:

- Food Sanitizer
- Grease Sewer System
- Food washing
- Air Filter System (grease, VOCs and odors)
- Ice machine Sanitizer
- HVAC Systems
- Compactor Odor / Bacteria
- Restroom Bacteria / Odor
- Potable Water Systems

The benefits include:

- Longer food shelf life - up to 40%
- Safer food
- Airborne grease, odor and bacteria reduction

- Reduced legal liability
- Positive public image
- Improved worker safety



Restaurants participating in this program receive a commemorative plaque and a "We Care" Door Decal.



AIR PURIFICATION SYSTEMS

The goal of air purification is to remove contaminants from the air we breathe. Considering we breathe 23,000 times a day and move around 435 cubic feet of air, this is a major concern. Indoor air pollution is now considered by the EPA and Congress a major environmental health problem. Mold once considered just an unpleasant product of nature is now believed to be the cause of many respiratory diseases. Most colds and viruses are caught indoors by airborne germs. Indoor air pollution, left unchecked, can lead to sick buildings. With today's technology, indoor air pollution is no longer a necessary evil of today's tightly built, energy saving buildings. Indoor air pollution has a wide scope of symptoms, which generally include the following:

- Headaches
- Fatigue, Dizziness
- Eye Irritations
- Asthma Attacks
- Memory Loss
- Depression
- Skin Irritations
- Sinus Infections

2003 mold damage claims might hit \$1 billion

New York - Mold damage claims will hit \$1 billion again in this year, according to the McGraw-Hill Construction newsletter. One article quotes a national insurance expert as saying that mold will trigger about 300,000 damage claims nationwide this year. According to the expert, the average mold-damage claim is \$20,000 per homeowner and \$200,000 per commercial property owner.

- Breathing Problems
- Colds, Flu and Viruses

The traditional method of indoor air filtration is to force the room air through an HVAC duct filter, usually consisting of simple fiberglass or open-cell foam fibers, that are capable of removing only particulate matter over 10 microns in size. Microbes and polluting gases pass right through the filter, and in fact, the dust and dirt build-up on the filter can act as a breeding ground for bacteria, mold and fungus.

In order to properly decide on an air purification device, we must first identify the problem and then prescribe the technology for the solution. Indoor air pollution consists of three major categories:

Particulates - These consist of minute solids drifting in air currents. Particulates consist of dust, dander (skin flakes), soot, pollen, and smoke particles. Size range: .001 to 1,000 microns.



Microbes - These are bacteria, germs, viruses, fungi, spores and mold. Size range: .001 to 10 microns.

Gases/Odors - Indoor gases, such as benzene, formaldehyde, chloroform, hydrogen sulfide, ammonia, etc., are released from furniture, cabinets, carpets, cleaning chemicals, copy machines, insulation, insect sprays, hair sprays, etc. Size range: .0001 to .001 microns.



Air purification technologies consist of the following:

- Filters
- Ionizers

- Ozone Generators
- Ultraviolet Light Rays
- Photohydroionization (PHI)

FILTERS

In general, filters permit some pollutants to pass with the air flow. The higher the efficiency or density of the filter, the lower the air flow and higher restriction to the blower.

HEPA Filters:

HEPA stands for high efficiency particulate air filter. HEPA filters utilize a powerful blower to force the air through a very tight membrane to achieve high efficiency particulate filtration. They are very efficient in the filtering of air that passes through the filter. They filter to .3 micron. They require filter changes. The filter can act as a breeding ground for bacteria, mold and fungus. They do not remove odors, gases, pesticides, viruses, and many bacteria. They reduce air flow due to the tight pores of the filter. They are generally not used in central systems, and are sold as stand-alone units only.

Carbon Media Filters:

Carbon filters consist of carbon impregnated filter fabric or granulated carbon. These filters usually have a foam or fabric filter to hold the media. Carbon has the unique capability of acting as a physical filter trapping particulate, and on a chemical basis by reacting with some odors and some of the heavy gases.

Fiber/Foam Filters:

Fiber or open-cell foam filters rely on the air passing through a matrix of foam cells or fibers of fiberglass, wire, plastic or cloth. Typically, these filters only stop medium to large particulate.

IONIZERS

Electrostatic Precipitators:

Electrostatic Precipitators have been used by industry for many years to clean up smoke stack emission of particulate. They operated by electrically charging a field between metal plates. The air is charged with an electrical charge similar to static electricity. The charged particulates collect and coagulate on a second set of charged plates where they build up and fall to a collection tray. They require frequent cleaning and only filter the air that passes through the filter. The particle build-up can act as a breeding ground for bacteria. Some manufacturers install UV lights to kill these bacteria.

Negative Ion Generators:

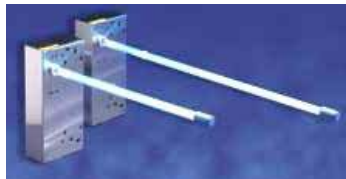
Negative ion generators have been used by industry for years to remove particulates from the air and to neutralize the effects of excess positive ions. Negative ions are produced electrically and travel through the air until they attract airborne particulate and coagulate the particulates until they are too heavy to drift and settle to the floor. They are very effective on removing smoke from the air. They travel throughout the entire room and purge all the air of particulate, not just the air that passes through a filter. They drop the particulates to the ground. They must be in each room as the ions cannot effectively travel through HVAC ducts. Some manufacturers claim negative ions can make you feel better. We find no credible studies to confirm this as it is a very subjective topic. The following is a comparison of indoor air quality systems for

HVAC contractors utilizing filterless system of Ozone and UV light:

- UV Germicidal Lamps
- UV Ozone Lamps
- Corona Discharge Ozone Systems
- UV Catalytic Oxidation Systems
- Photohydroionization™ System
- PHI Cell

Ultraviolet Light and Ozone

Ultraviolet Light and Ozone are receiving a lot of attention concerning indoor air quality. Both are nothing new. They have been used for decades in hospitals, medical applications and the food industry. We will outline each of the technologies used by the HVAC contractors and discuss the pros and cons of each.



UV-C - Germicidal Lamps

These are rapidly becoming very popular as an easy fix for the air conditioner coil mold problem. This is the most prevalent cause of the building

mildew smell you get when you enter an air-conditioned sick building. UV-C (254nm) lamps are basically similar to sun lamps and are typically only effective on microbials that pass by within a few inches of the lamp or areas where the light is shining directly on for extended periods of time, such as the air conditioner coil (see article in HVAC News - yellow highlighted).

Pros: Low cost, easy installation, and effective on suppressing mold growth on the coil.

Cons: Not effective at killing air-borne mold unless numerous lamps are used (see article) only effective on the surface of the coil that is in direct light. This leaves much of the coil with no treatment. Does not provide ongoing room protection. Most UV systems install a glass UV mercury bulb without protection from breakage. A broken bulb could release mercury, a potential environmental and health hazard.

Minimum of two lamps must be used to cover at least one-quarter of the coil surface (the upper half of the outer coil). For one-half coverage, three to six lamps must be used. 100% coverage is not practical.

According to "Proper Design of an HVAC Bacteria Control System" by James Hart P.E. In order to have a 90% kill rate on a very basic bacteria (*Bacillus Subtills*), you would need 47 30" UV lamps placed in 95' of duct 12" x 30". This is obviously beyond the ability of most homes.

UV-C - Ozone Lamps

UV lamps in the 185nm range produce low-level ozone, just as the sun does, which is very effective in odor, microbial and VOC's reduction.

Pros: Low cost, easy installation, and effective on mold, smoke, odors and bacterial. The ozone gas travels through the house to provide ongoing treatment, unlike the UV-germicidal lamps where only the air that passes within inches of the bulb is treated.

Cons: Ozone is a concern to some people. Improper systems

could produce ozone levels exceeding Federal guidelines. Ozone does not work on all odors and VOC's. Most UV systems install a glass UV mercury bulb without protection from breakage. A broken bulb could release mercury, a potential environmental and health hazard.



Corona Discharge Ozone Systems

These systems simulate lightning with a corona electric arc or spark. Strong ozone is produced by converting the oxygen (O₂) to ozone (O₃).

Pros: Low cost. Ozone effective on odors, bacteria, VOC's and mold.

Cons: Air is 80% Nitrogen and 20% Oxygen. These units convert Oxygen to Ozone. They also convert the Nitrogen to Nitric Acid and Nitric Oxides, which causes maintenance problems due to corrosion. They produce high concentrations of ozone, usually well over Federal safe limits as well as air-borne Nitric Oxides. These systems typically will require expensive monitors to control ozone levels. Also, arcing (sparking) can be a noise and safety concern.

Note: Corona Discharge Ozone Units should never be used for air purification in occupied areas, as they will usually exceed Federal safety limits of ozone.

UV Catalytic Oxidation Systems

This system utilizes a Titanium grid as a catalyst for UV-C (254nm) germicidal light. Air that passes through the grid and comes in contact with the catalyst is purified by Hydroxyl Radicals that are formed on the Titanium grid. Also, the UV-C light rays kill microbials that pass by them.

Pros: Effective on the air that passes through the system for mold, bacteria and VOC's.

Cons: Expensive, large, substantial installation, and not effective on odors. Only treats the air that contacts activated target surfaces as it passes through the unit. Most UV systems install a glass UV mercury bulb without protection from breakage. A broken bulb could release mercury, a potential environmental and health hazard.



Photohydroionization™ System



This is an advanced oxidation system that consists of a UV-Ozone producing bulb (185nm) targeted on a catalyst target, which produces low-level ozone. Hydro peroxides and super oxide ions

Pros: Low cost, low maintenance (yearly), and easy installation. Not only does this process treat the air that passes through the device, it sends low-level ozone (.04 ppm), hydro peroxides and super oxide ions into the room for complete coverage.

(Note: The Federal limit for ozone devices is .04 ppm.)

Cons: Ozone is a concern to some people even when it is within federal safety limits. Most UV systems install a glass UV mercury bulb without protection from breakage. A broken bulb could release mercury, a potential environmental and health hazard.

PHI Cell™ (Photohydroionization™ Cell)

This is the latest advanced oxidation technology that consists of a proprietary, high-



intensity broad spectrum UV tube (100 - 300nm) in a hydrated catalytic matrix cell (Quad-Metallic). Low-level ozone is produced in the cell, the majority of which is converted into airborne hydro peroxides, super oxide ions, ozonide ions and hydroxides. The UV bulb is encased in a protective poly tube to prevent any glass or mercury breakage/leakage. Also, the entire assembly is encased in a protective metal cell.

Pros: Low cost, no maintenance (25,000 hour life, 3 year

warranty), easy installation, airborne hydro peroxides, super oxide ions and very low-level ozone (.01 - .02 ppm*) travels through the house providing 24-hour protection against airborne mold, bacteria, viruses, odors and VOCs. The cell also acts as a germicidal lamp and treats the air that passes by it. The cell has a built in fiber optic which acts as a remote indicator. **Cons:** None

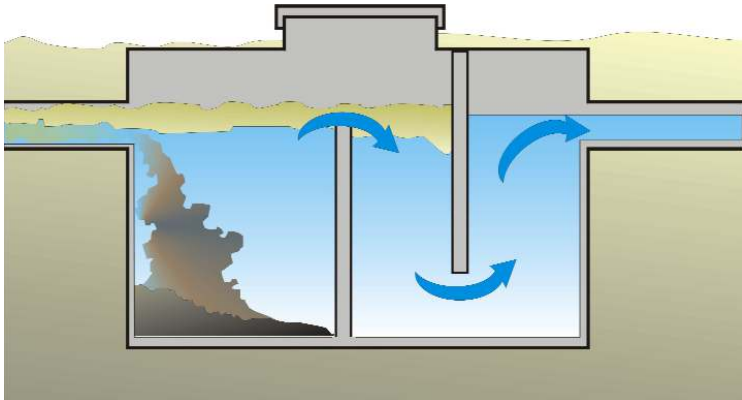
(*Note 1: Federal safety limits are .04 ppm. At .01 - .02 ppm this is not considered an ozone device.)

HVAC Comparison Summary

	UV-C Germicidal Lamp	UV-C Ozone Lamps	Corona Discharge Ozone Systems	UV-C Catalytic Oxidation Systems	Photohydroionization™ Systems	PHI Cell™
Designed for HVAC Systems	Yes	Yes	Yes	Yes	No	Yes
Provides whole house air purification	No	Yes	Yes	No	Yes	Yes
Keeps mold from growing on AC coil	Yes	?	?	No	Yes	Yes
Reduces odors, VOC's, bacteria, viruses and mold throughout the house	No	?	?	No	Yes	Yes
Low initial cost	Yes	Yes	No	No	Yes	Yes
Low installation cost	Yes	Yes	No	No	Yes	Yes
Reduces microbials by over 90% throughout the house	No	?	?	No	Yes	Yes
Provides a broad range of disinfection	No	No	No	Yes	Yes	Yes
Low maintenance	Yes	Yes	No	?	Yes	Yes
Low power consumption	Yes	Yes	No	?	Yes	Yes
Meets Federal ozone safety guidelines	Yes	?	No	Yes	Yes	Yes
Has the broadest range of effectiveness	No	No	No	No	No	Yes
One unit will service an HVAC System	No	Yes	Yes	Yes	?	Yes
UV bulb is protected from breakage & mercury contamination	No	No	N/A	No	No	Yes
Has 3 year warranty 25,000 hour life	No	No	No	No	No	Yes
Provide point of source microbial reduction sneeze test	No	No	No	No	?	Yes

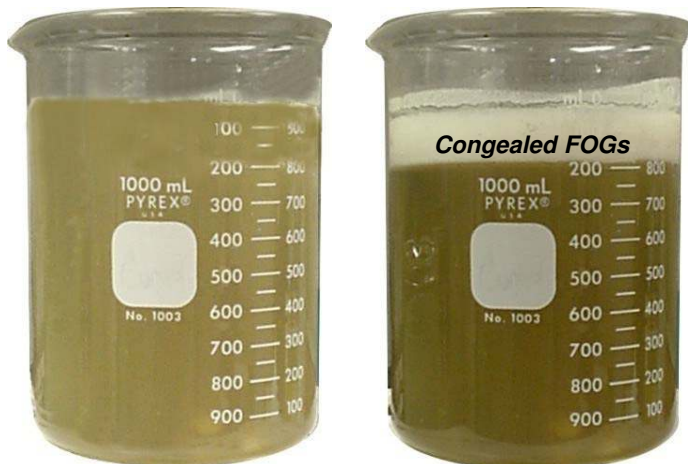
GREASE

Do a web search of "grease" and the first two pages are concerning a 1970's vintage movie starring John Travolta. Try "fog" and you will get pages of information on low clouds and water vapor, and a poem, "Fog" by Carl Sandburg. Now type in fats, oils and grease or "F.O.G.'s", and you will pick up a vast array of technical data on a major problem for sewer systems, actually a \$25 billion per year problem for U.S. taxpayers. The problem is so serious it has made the front page of the Wall Street Journal! They reported 75% of the nation's sewers work at half capacity because of grease clogs. The Journal and most other articles use the word "grease" as an all encompassing term for what is actually fats, oils and grease or F.O.G.



Grease trap, 3 part separator, oil water separator or interceptor

Oils and grease come in two forms: polar and non-polar. Polar is associated with food and non-polar is related to petrochemical hydrocarbons. For the sake of this article, we will be discussing polar F.O.G.'s as related to restaurants and food processors. Why is this problem gaining so much attention in recent years? A lot has to do with the growth of take-out restaurants and double-digit restaurant sales growth. Restaurants create F.O.G.'s, especially fast food and many ethnic restaurants. Globally, F.O.G. output has tripled since the 1960's to over 100 million tons per year. It is estimated that U.S. restaurants dump over three billion pounds of F.O.G.'s per year, which results in F.O.G.'s being the No. 1 cause of sewer overflow - an estimated 40,000 illegal overflows per year. Cities are implementing fines of up to \$1,000 per day and 60 days in jail for willful violations of F.O.G. discharges.



Emulsified FOGs

After 24 hours emulsified FOGs are release

Grease traps, three-part separators or oil water separators, also sometimes called interceptors, have been around since the 1940's. There are an estimated one million grease traps in the United States. Basically, a grease trap operates on the principal that F.O.G.'s have a lower specific gravity than water. As such, they rise and float on the surface of water. This is under ideal conditions.

What happens in a kitchen and drain is the F.O.G.'s are emulsified with detergents and hot water. Also, they mix with solids, such as dirt and food particles, etc. In addition, turbulence mixes them up. In time, the hot water will cool and the detergents will release the emulsified F.O.G.'s from suspension. The F.O.G.'s will rise and congeal on the surface, often as a solid mass, and then must be physically removed or they will block the grease trap or sewer lines and create an overflow. Overflows are a health hazard and a legal or sometimes criminal liability.

Many managers do not realize that you're supposed to pump them out. The grease trap faces an "out of sight, out of mind" situation. 21,000 restaurants have over 5,000 F.O.G. based back ups per year. New York City uncovered a 73% rate of grease trap abuse. The city now has a \$1,000 per day fine.

Grease traps must be sized properly to work right. A typical Chinese restaurant could need a 5,000-gallon grease trap. The size is important due to the required dwell time so the F.O.G.'s can be released from suspension. Temperature, detergents and the amount of solids, as well as turbulence all contribute to the release and coalescing (joining of F.O.G. particles together), and their subsequent rise to the surface.

The problem is further exasperated by the local sewer authorities who do not want to receive F.O.G.'s from the pump out trucks. These grease trap pump out services must have a place to discharge the F.O.G. waste. Increasingly, Landfills will not take it, and many sewer treatment works will not take it as the concentrated F.O.G. mixture upsets the balance of the plant and creates odors. F.O.G. wastewater must have a concentrated pre-treatment to break down the F.O.G.'s before they enter the plant. These pre-treatment systems are expensive and are not widely available.

How can we safely, effectively and economically solve the grease problem? A number of technologies have been proven to have varying degrees of success in breaking down F.O.G.'s. The breakdown methods are performed by three major categories: physically, chemically and biologically. First is physically or mechanically. These methods include:

Macerator Pumps - Similar to a kitchen garbage disposal, these grinding type pumps break F.O.G. down to a slurry.

Oil Wheels - These discs are slow moving wheels that dip into the top of a grease trap. As the F.O.G.'s stick to the wheel, they are scraped off by a scraper and flow into a waste reservoir.

Aeration - High volume of air is bubbled into the grease trap, which mechanically breaks the solidified grease down to slurry. Aeration can be applied by using a fluidized media bed to enhance the breakdown.

DAF or Dissolved Air Flotation - Large volume of compressed air is injected into water. This air saturated water is then released into an open top vessel, where the air then comes out of solution, thereby breaking emul-



RGF DAF System

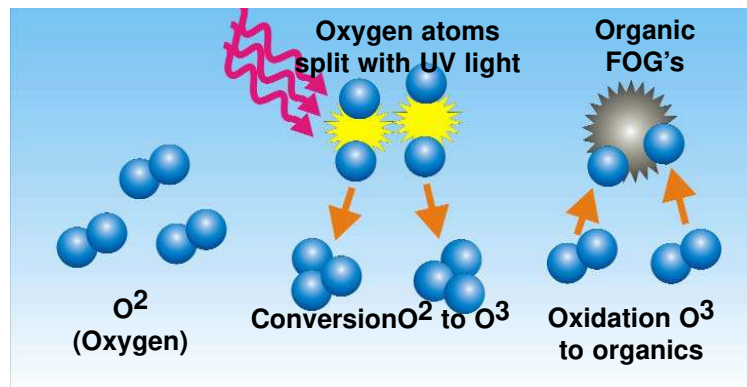
sions and aiding the F.O.G.'s to rise and congeal.

Biological

Bacteria - Aerobic Sewer Treatment System utilizing various medias and bacteria to literally digest the F.O.G.'s into water and carbon dioxide.

Chemically

Ozone - O₃ is an oxygen molecule with a loosely held extra atom that is very aggressive. Ozone will oxidize and break down grease. As it does so, the O₃ turns to O₂ or oxygen! Ozone and other advanced oxidation gas also eliminate sewer and F.O.G. odors and airborne bacteria.



Saponification/Base Hydrolysis Reactions - The use of caustics to alter the pH, thereby turning the F.O.G.'s into soap, similar to the cowboys who used lye and fat to make soap!

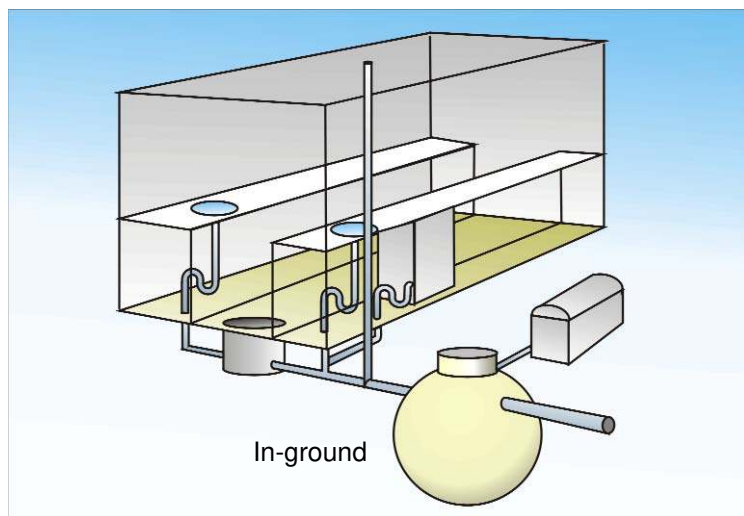
RGF Environmental has taken ten proven technologies and combined them into a compact unit. By combining technologies, you provide redundancy. The system utilizes aeration in a fluidized bed reactor to physically break down the F.O.G.'s.

In addition, rather than just using air, RGF uses advanced oxidation gases, including ozone, hydro peroxides, and super oxide ions. These advanced oxidation gases also reduce sewer odors and airborne bacteria. As the ozone breaks down F.O.G.'s, it then converts to oxygen, which in turn promotes aerobic bacteria growth.

F.O.G specific bacteria are then continuously dripped into the oxygen enriched chamber to automatically break down the remaining F.O.G.'s. This is all done in a five-chamber PHI / Bio Ox Reactor. A periodic oxidation purge provides a saponifica-



RGF PHI / Bio Ox Mod



tion flush of the system. A compact unit has been designed for hotels with indoor lift stations. The two-foot square footprint makes installation simple. A PHI / Bio Reactor can be used, or the existing sump can be used as the Reactor Vessel. This system will break the F.O.G.'s down to short chain molecules, which are readily digestible by a treatment plant.



Existing sump

Validation Summary

RGF Air, Water, Food and Laundry Systems have been tested and validated by hundreds of US and Fortune 500 companies. Over 100,000 systems are in use in 33 countries. The following is a summary of some typical lab tests and validations.

WATER

EPRI (Electric Power Research Institute) 2000. Case study RGF's advanced oxidation system "Hospital Laundry of the Future". Results/Finding: Decreased energy, reduced chemical costs, lower water consumption, reduced wastewater treatment, increased protection from pathogens, longer textile life, improved working conditions and improved patient care.

Rochester Institute of Technology and New York State Energy and R&D Authority. Testing and Endorsement of RGF's industrial water recycling equipment - 2003.

GE performed it's famous 6 Sigma testing program on RGF's water systems which passed on the first try.

U.S.Army Corps of Engineers, 9/96 evaluation of RGF water recycling and treatment system found to be superior to competition.

Seaboard FoodLab, 99.9% bacteria reduction with RGF's low volume fluid UV sanitizer.

Hilton Hotel PHI - Grease System 2001 test acceptable for grease, odor and bacteria reduction.

Licensed Professional Chemical Engineer and IAQ

PHI Ice System 95% bacteria reduction in ice.

Kansas State University - UV / Ozone System inactivity of Hepatitis A

FOOD

Swift and Co. - Food Lab reported up to a 3 log (99.9%) reduction with RGF-PHI Fluid Sterilizer system. Testing was on brine solution.

EPRI (Electric Power Research Inst.) study on RGF Advanced Oxidation Technology for sanitizing meat processing equipment published in EPRI-Tech Application Bulletin. More.....

"Meat Processing" Magazine December 1998 RGF's Envirovision program was a cover story entitled "Sunshine Farms - Microbe War Uses RGF's Air Water and Food Advanced Oxidation Technology"

Frozen Food Digest December 1997.

"RGF Advanced Oxidation As A Preservative for the Frozen Food Industry". Food shelf life extended up to 40%.

Food Engineering Magazine May 1999 features RGF's Advanced Oxidation Food Sanitation Processes receiving USDA Approval. Air, water and food contact. Conclusion of the article was reduced food bacteria by almost 3 fold and considerably increased shelf life of chicken.

Kansas State University, 4.42 Log (99.99%) reduction of Listeria bacteria with RGF PHI Food Hood.

Sunshine Farms Poultry Lab test of chicken breast treated with PHI Hood 94% reduction of bacteria.

Electric Power Research Institute - Grain Milling 75-80% reduction of TPC over traditional chlorine treatment.

UK Bakery - Pre-packaging PHI treatment - Doubles shelf life from 3 - 6 days.

AIR

California Microbiology Center for RGF's Shaklee PHI unit. Home reductions after 4 days

Test 1 - Mold 97.7%

Test 2 - Yeast & mold 90.9%

Test 3 - Mold 77.0%

Test 4 - Bacteria 34.5% (Bacteria test in a home with low ambient bacteria will show low percentage drops.)

Licensed Professional Chemical Engineer and IAQ Spec

Ozone levels for RGF's Shaklee PHI unit.

Test 1: Residence 2200 Cubic Feet Max .02 ppm

Test 2: Office 832 Cubic Feet Max .03 ppm

Test 3: Sealed test chamber 1000 Cubic Feet Max .04 ppm

FDA safety limits are .05 ppm.

GC/MS Nelap Accredited Lab for RGF's Shaklee PHI unit.

Compound	Odor	% improved in 4 hrs
Hydrogen Sulfide	Rotten eggs	80%
Methyl mereapthn	Rotten cabbage	100%
Carbon Disulfide	Vegetable sulfide	30%
Butyl Acetate	Sweet banana	100%
Methyl Metharcyline	Plastic	100%

Licensed Professional Chemical Engineering and IAQ Spec for RGF's Shaklee PHI unit.

Test 1 - Bacteria reduction in 3 days 88%

Yeast & Mold reduction in 3 days 71%

Test 2 - Bacteria reduction in 3 days 78%

Yeast & Mold reduction in 3 days 90%

NELAP accredited lab (Volatile organic compounds) levels tested on a GC / MS by for RGF's Shaklee PHI unit.

· Methyl Ethyl Ketone 13%

· D-limonene 98%

· Toluene 29%

Medical Clinic Bacteria Test for RGF's Pure Air

Advanced Oxidation unit.

By Dr. Victor Marcia - Vega MD. 2500 Sq ft. medical clinic

Sample #	% Reduction	Odor Reduction
1	72%	Yes
2	71%	Yes
3	80%	Yes
4	74%	Yes
5	72%	Yes

Independent Lab Test - IBR (48 Hrs) for RGF's Pure Air

Advanced Oxidation unit.

Test for Airborne Mold

Average of 50 tests = 97.6 reduction of mold spores in a lab test chamber.

Field test of home 80% reduction of airborne bacteria and fungi.

Popular Science Magazine

RGF Pure Air Unit (advanced oxidation)

RGF Pure Air 2500 is the first home Ozone Air Purifier to meet federal ozone safety limit of .04ppm for occupied room even after running 24 hours for a full week. The purifier reduced airborne microbial levels by 97.1%.

Kane Regional Hospital Center Pittsburgh PA.

RGF: Photoionization Microbial reduction 60 - 90%

Odor neutralized

Ozone less than .04 ppm

Pittsburgh, PA Allegheny County, Letter from Dr. Wecht M.D. J.D.

"It is the first Air purifier that removes odors as well as airborne bacteria in our autopsy suite. It kills airborne mold, fungus, bacteria and some viruses. We have installed a unit

in our courtroom because of body odors, perfumes and people with cold flues and other communicable diseases that become airborne."

Independent Licensed professional Engineering Firm IAQ

Certification- Efficiency test of a RGF PHI module with a 3" - 1100-rpm fan in a 3000 sq. foot Poly Air tight simulated house. Testing was conducted over 12 days average microbial reduction 90% ozone level below .02ppm.

Licensed Professional Engineer and IAQ Spec. -

Efficiency test of RGF's Radiant Catalytic Ionizer, Air Purifier, (a PHI Technology) in a 275 Sq. Ft. Simulated residence room - Poly air tight tested for 6 days average microbial reduction 83.1% ozone levels were less then .04ppm

Khalidi Medical Center Amman Jordan - Hospital tested RGF's PHI Air system for infective control use unit met there requirements. Certification issued.

IAQ Specialist and Licensed Professional Engineer

Private resident bathroom 1 hour 97.2% reduction mold and bacteria.

Licensed Professional Chemical Engineer and IAQ Spec.

Auto interior 1 hour PHI test 94% reduction of mold and bacteria.

Licensed Professional Chemical Engineer and IAQ Spec.

Commercial airliner 1 hour PHI test 94% bacteria reduction.

Other PHI Applications

R&D work with the PHI has proven successful in many applications. In 2002, we installed five PHI Grease Systems in a Hilton Hotel. The problem was from five sewer lift stations in the basement that had grease, odor, bacteria and monthly pipe clogging problems. The installation of the PHI Grease System eliminated the bacteria and odor problem in one hour and digested the grease in 48 hours. No clogging has occurred. Larger PHI Grease Systems have worked well for grease haulers to digest concentrated grease before sewer treatment.

Cutting Oils

Over 200 GPM PHI Fluid Sanitizer successfully kills bacteria in machine cutting oils.

Compactor Odor/Bacteria Control

In 2001, a major manufacturer of trash compactors approached us with an odor and bacteria problem that drug stores have. The compactors are connected to the building by a trash chute. As heat builds up in the compactor, the air expands into the chute and subsequently into the building, bringing odors and airborne bacteria into the building. We designed a custom PHI Compactor Unit for the compactor manufacturer. Over 1,000 units are in operation without a single complaint or problem. Trash compactor and sewer lift

station odor control have been successfully handled with ozone for many years. The advantage PHI has over the ozone is you get a broader scope of odor and bacterial control, and PHI oxidizers are not corrosive or offensive to humans. See **Odor Spectrum** page 14.

Cooling Tower Systems

For prevention of Legionaire Disease we have successfully developed a skid mounted system with Marley Cooling Towers for prevention of slime and bacteria in cooling towers.

Sewer Lift Station Odor Control



Marley Coling Towers/RGF Advanced Oxidation System

Our PHI Cells have successfully controlled sewer lift station odors.

Fire and Flood Restoration

Smoke and mold are easily controlled with a high volume unit.



Auto Detailer System

Smoke, car odors and bacteria are controlled in a car.

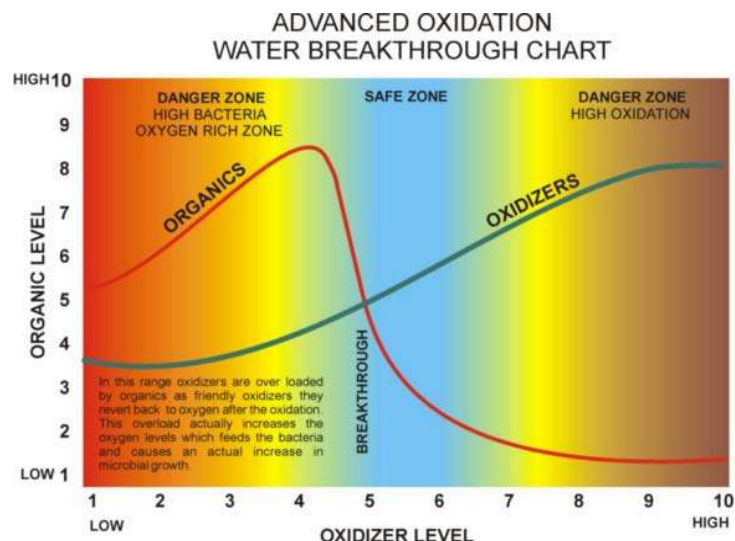
Marine Sewage Holding Tank System

Sewage odor control for ships and boats.

Competition

Water

Ozone in water has been around for over 100 years. It is very prominent in Europe and Japan and used in preference over chlorine. Most municipal water systems now use ozone. It is the preferred method of swimming pool sanitation in Europe. Ozone laundry systems came out in the early 1990's. It all seemed so simple. Buy a corona discharge ozone generator, use a venturi to inject the gas in the water, and shazam - you have a water treatment system or whatever! Put a neat name on it, make a brochure and you're in business! For a while, maybe. Numerous ozone companies have gone under. The fall out rate is probably higher than restaurants. What most companies fail to see is the engineering or application, laboratory and service end of the business. No two applications are the same. There are many variables. For one, incoming water chemistry is very important. If the water contains organics, a good portion of the ozone will be consumed and converted to oxygen, which can work in your favor, or can work against you. In the case of grease or sewage digested, high oxygen is favorable. In food sanitation, it is definitely not favorable and can easily increase food bacteria exponentially, which could be a very serious problem! We developed the following water breakthrough chart:



In addition, often multiple oxidizers are required, such as hydrogen peroxide, ozone or PHI activated by UV light. We have even used chlorine combined with ozone in a unique application. The point is, companies involved with just one technology that fits all are generally not a good choice. A qualified ozone or advanced oxidation supplier must have a well-rounded engineering staff, a fully equipped laboratory, and a R&D staff. One size and one technology do not fit all applications.

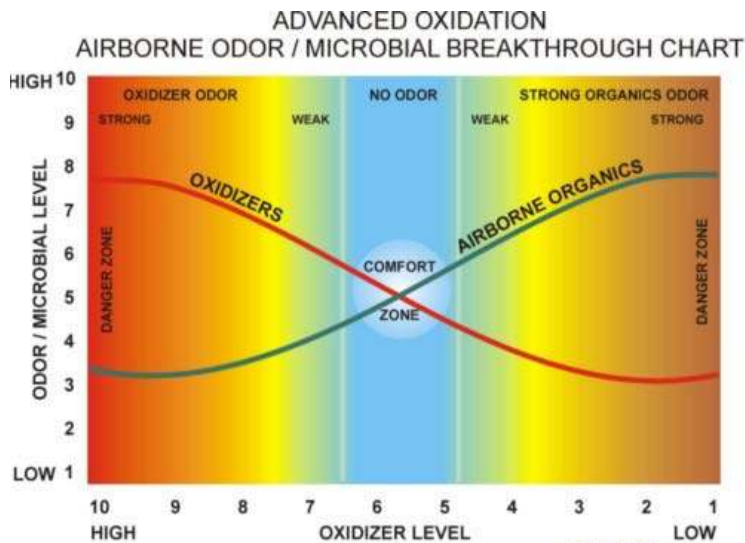
Air

With any new and promising technology comes competitors and knock-offs. Unfortunately, most of the time they lack any real science, so you end up with a good sales story, but nothing to back it up. One such company had us make 20 units for their sales team's evaluation. The sales team turned out to be a guy who owned a deli (ham and cheese) in Vero Beach, Florida. The next thing we knew, he had a knock off unit that he claims was a catalytic oxidizer that made "purifying plasma" with below .04 ppm of ozone, which of course, is pure

nonsense. Our R&D engineers tested the unit and found it was nothing other than a standard UV ozone producing bulb and a standard off the shelf ballast, and the unit created ozone levels that far exceed the Federal safety limits. The R&D engineers thought the catalytic and purifying plasma claims were hilarious.

Another company claims to make O₃, O₄, O₅, O₆ and O₇. Sure, this guy invented new molecules! Again, our R&D engineers can find no merit to these claims. There are a few light in a box snake oil types on the web with unbelievable claims. Our advice is to do a third party check of the company before you get involved.

We find most air competitors have the same mentality as the water competitors. Make a lightning in a box-type corona discharge ozone generator and blast a room with high ozone levels, giving no regard to Federal safety limits. Some popular corona discharge "lightning systems" emit ozone levels over the human tolerance levels, which is completely irresponsible. For a broader scope of oxidation with very low ozone levels, we use our PHI technology for commercial projects. We have a staff of engineers and scientists and a fully equipped lab. The following breakthrough chart was developed by RGF to guide our engineers to carefully balance a system.



Food

In general, we do not see many unqualified competitors in the food industry. A few have popped up, but they never last long. This is probably due to the sophisticated knowledge of the food industry and strict testing and validation requirements. Any food company should be very careful to check references and visit the facility to make sure they have engineers on staff and a qualified laboratory and service department. There is currently one competitor that has the most creative literature we have ever seen. His literature, compared to reality, is quite a stretch. Hopefully, the FTC will take care of this snake oil merchant before he damages the entire industry.

In general, before you partner with an ozone or advanced oxidation company, visit their facility. It's the single most important thing you can do. Notice I used the word partner. This is a whole new industry. It is unlikely you will buy equipment without coming back to the manufacturer for service or more information.

ODOR SPECTRUM

PROBLEMS			SOLUTIONS
COMPOUNDS	ODOR	MOLECULAR STRUCTURE	ADVANCED OXIDIZERS
Amino Acids	Ammonia Urea Fertilizers		<div>OZONE</div> <div>OZONIDE IONS</div> <div>HYDRO PEROXIDES</div> <div>SUPER OXIDE IONS</div> <div>HYDROXIDE IONS</div>
Aldehydes Carboxylic Acids	Vinegar, Alcohols		<div>OZONE</div> <div>OZONIDE IONS</div> <div>HYDRO PEROXIDES</div> <div>SUPER OXIDE IONS</div> <div>HYDROXIDE IONS</div>
Lactic Acid	Rotting Meat		<div>OZONE</div> <div>OZONIDE IONS</div> <div>HYDRO PEROXIDES</div> <div>SUPER OXIDE IONS</div> <div>HYDROXIDE IONS</div>
Hydrogen Sulfide	Rotten Eggs		<div>OZONE</div> <div>OZONIDE IONS</div> <div>HYDRO PEROXIDES</div> <div>SUPER OXIDE IONS</div> <div>HYDROXIDE IONS</div>
Sucrose Carbohydrates	Rotting Plant Matter		<div>OZONE</div> <div>OZONIDE IONS</div> <div>HYDRO PEROXIDES</div> <div>SUPER OXIDE IONS</div> <div>HYDROXIDE IONS</div>
Volatile Organic Compounds	Household Chemicals/ Cleaning Solvents		<div>OZONE</div> <div>OZONIDE IONS</div> <div>HYDRO PEROXIDES</div> <div>SUPER OXIDE IONS</div> <div>HYDROXIDE IONS</div>
Methane/ Ethane Propane	Gas / Sewer Gas		<div>OZONE</div> <div>OZONIDE IONS</div> <div>HYDRO PEROXIDES</div> <div>SUPER OXIDE IONS</div> <div>HYDROXIDE IONS</div>

Redundant oxidizers provide a broader scope of odor control

New Technologies

RCI

Work continues on a new technology called "Radiant Catalytic Ionization" or "RCI". This uses reflective UV energy to produce air cleaning "ions".



Ship Ballast Water Purifier

200 gpm modules kills 99.9% ballast water pathogens



PHI™ Hand Sanitizer / Dryer

An automatic and touchless PHI™ hand sanitizer kills salmonella, E coli, listeria and hepatitis A.



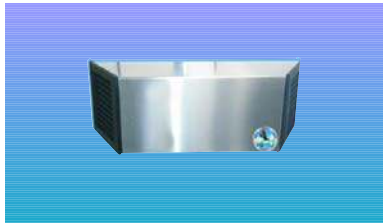
What's Next - Silver Nanotechnology
 PHI - Electro Static Air System
 Nano - PHI Targets,
 Terrorism-Total Air Protection

RGF's PHI Products

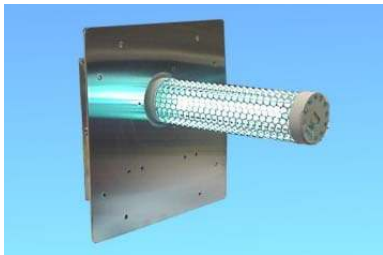


RGF Commercial APS - The ultimate commercial air purification system consisting of 8 optional technologies. A dual Photohydroionization cell for mold, odors, virus, VOCs and bacteria. six optional absorbers: Grease, HEPA, Ultra filter, VOCs, mercury and radon. Over 95% reductions. Housed in a polished heavy-duty stainless steel cabinet. 3 year PHI cell life.

Applications: Offices, food processors, restaurants, medical facilities, factories, nail salons



RGF APS Mini for rooms under 1000 square feet. This low-maintenance system will reduce bacteria, mold and odors using RGF's Photohydroionization Cell. Ideal for small restaurants, restrooms, locker rooms, etc. The small size (6" x 6" x 12") makes this unit very versatile. 3 year PHI cell life.



HVAC PHI Cell a Photohydroionization Cell that is easily mounted into air conditioning and heating systems air ducts. This air purification system is designed to reduce sick building syndrome risks by reducing odors, air pollutants, mold and bacteria. The HVAC Cell provides any commercial, residential or industrial air handling system with over 90% reduction of mold, bacteria and odors. 3 year PHI cell life

Applications: Homes, offices, factories, medical facilities, etc.



Commercial Food Sanitizer A PHI Cell plus high intensity UV light provides a very aggressive atmosphere that obtains a 99% kill rate on foodborne bacteria. The food grade stainless steel cabinet fits a standard 18" x 24" tray. Increase shelf life up to 40%, decreases food poisoning liability. 3 Years 1 year on lamps

Applications: Restaurants, ships, institutions, food service.



Turbozone 1000 is designed to provide ozone and advanced oxidation gases for commercial air purification and odor destruction. This unit is fully automatic, easy to use. The Turbozone destroys odor molecules and leaves no residue. This product has been engineered, designed, built, tested and thousands retailed. The Turbozone will destroy, not just cover up, the following airborne substances: smoke, mold, mildew, bacteria, viruses, VOCs, pollen and many more. Housed in a light weight heavy duty stainless steel case the 1000 is designed for small to medium commercial jobs. 3 year PHI cell life.

Applications: Hotels, professional cleaning companies, auto / boat detailers, rental companies.



Turbozone 7000 The same basic unit as the 1000 only seven times more powerful. This unit is designed for medium to large commercial jobs. 3 year PHI cell life.

Applications: Professional fire, flood, detailing, cleaning companies, rental companies.



RGF Mobile Pro for auto detailers, car washes and auto dealers is a light weight, high powered unit producing ozone and advanced oxidation gases which eliminate smoke and all other car odors and bacteria. AC or 12VDC with a cigarette plug housed in a heavy duty polished stainless steel housing. 3 year PHI cell life.

Applications: Auto, boat detailers.



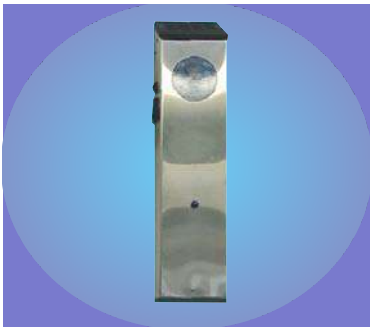
BOS Bacteria / Odor Abatement System is specifically designed for outdoor use. It is intended to reduce and eliminate odors associated with sewer lift stations, sumps, pits, trenches, garbage compactors and dumpsters. These models are fully automatic and require very little yearly maintenance. The units come complete with power switch, hour meter and intake air filters. 3 year PHI cell life.

Applications: Waste haulers, compactor / dumpster manufactures, lift station companies, municipal sewer companies, waste recycling companies, hotels, restaurants, institutions, ship holding tanks, refrigerators up to 3000 cubic feet.



Compactor BOS II Bacteria / Odor Abatement System is specifically designed for outdoor use. It is designed and engineered to reduce or eliminate odors, bacteria, viruses and VOCs associated with compactors smaller than 20 cu yds. 3 year PHI cell life.

Applications: Same as above.



Indoor Compactor /Refrigerator BOSIII Bacteria / Odor Abatement System specifically designed for indoor compactors. It is designed and engineered to reduce or eliminate odors, bacteria, viruses and VOCs associated with indoor compactors up to 5 cu yds and refrigerators up to 1000 cubic feet. Also small lift stations, boat waste holding tanks, etc. 3 year PHI cell life.

Applications: Restaurants, institutions, boats.



RGF's Plug In commercial air purification system for hotels, institutions, boats etc. This photohydroionization air purifier is a no maintenance system (annually) a switch provides a high / low / off settings. Low is for silent sleeping mode. This unit plugs into an electrical outlet, anti-theft device secures the unit to the wall and two built in outlets provide additional electrical service. This unit provides rooms up to 1500 sq ft with mold, odor and bacterial reductions of over 90%. An attractive molded ABS plastic housing with a lighted logo provides for a low level night light. 3 year PHI cell life.

Applications: Hotels, hospitals, institutions, schools, boats, offices, restaurants, residential.



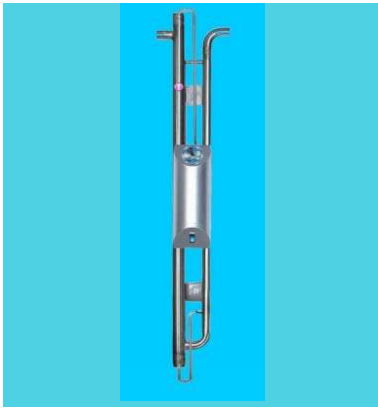
Ice Machine Sanitizer A PHI Cell provides a safe steady stream of 5 Advanced Oxidizers to the ice storage bin. PHI Cells provide over 90% kill of Listeria bacteria. A deadly persistent bacteria that lives in ice bins. 3 year PHI cell life.

Applications: Ice machines



PHI Indoor Air Systems RGF private labels and OEM manufactures numerous air purification systems.

Applications: Hotels, residences, hospitals, cruise ships, institutions, offices



Advanced Oxidation Water Purification System

The RGF Photohydroionization Water System is a purification process designed to treat water and liquids with Photohydroionization, UV light, ozone, hydroperoxides and super oxide ions. This is not a filter. It will not remove particulate, heavy metals or hardness from the water. Other RGF filters should be used in conjunction with this system for these purposes. This system will kill 99% of bacteria and viruses and reduce or remove chlorine and odors.

Applications: Restaurants, hotels, institutions, residential, hotels, food & drink processors, hospitals, medical offices, schools, cooling towers, pools, fountains, ice machines and any liquid purification.



PHI Grease System is designed to break down fats, oils and grease to carbon dioxide, water and small chain food sources for traditional sewage treatment. This unit easily fits into the smallest of lift stations. Lift station grease is physically, chemically and biologically broken down and freely washes away as liquid and gas. Lift station room odors and airborne bacteria are reduced by over 90%.

Applications: Restaurants, food processors, institutions, ships, sewer plants.



Advanced Oxidation Fluid Purification System

RGF has developed a specialized Advanced Oxidation treatment system for water and most other fluids. The unique design of this system incorporates precision machining to optimize fluid flow characteristics as well as high intensity ultraviolet light transmittance into the fluid space. The vertical reactor design allows for continuous operation at pressures as high as 50 PSI while providing the smallest possible footprint. A high volume gas injection system can provide advanced oxidation gases PHI or simply air to aid in clean in place. Units available from 10 gpm to 200 gpm.

Applications: Food processors, oil disinfection, brine disinfection, ships, potable water disinfection, waste water disinfection, juice disinfection.



Commercial Laundry AOS Advanced Oxidation Laundry System that fits any washing machine with no modification. A dual PHI Cell provides 5 Advanced Oxidizers to clean and sanitize fabrics. A silver ionizer adds silver ions for ongoing bacteria and odor protection. Brushed stainless steel. Three year cell life.

Applications: Hotel / institutional / ship laundries.



WashMaster Universal

RGF's Advanced Water Recycling System. The patented system collects contaminated water, which typically contains...petroleum hydrocarbons (oil, grease, and fuels), heavy metals, solids, cleaning fluids, and detergents. The collected water is processed through the system and PHI cell for purification and reuse.
Applications: Industrial waste water recycling, equipment wash water recycling.



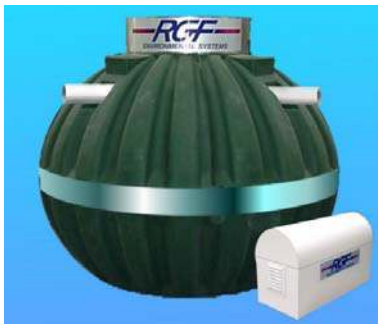
Sewer Discharge Systems

Three models from 20 to 50 gpm multi technology systems for pre-treatment to discharge applications. Disinfection is by RGF Advanced Oxidation.
Applications: Industrial waste water treatment.



Industrial Advanced Oxidation Water Systems

For large applications such as fish farming, RGF's PHI provides protection against bacteria, viruses and algae.
Applications: Fish farming, potable water treatment, waste water treatment, food sanitation.



Sewage Reclaim Systems

Bio System with PHI sanitation for water reuse.
Applications: Hotel / residential / industrial waste water reclaim.



Food PHI Tunnel

Provides 99.9% surface pathogen reduction with PHI Technology 360° coverage.
Applications: Food processors, industrial disinfection.



PHI Belt Sanitizer

Provides 99.9% conveyor belt surface sanitation.

Applications: Food processors conveyor belts.



Low Volume Fluid Sanitizer

Up to 99.9% reduction of bacteria in brine or turbid fluids.

Applications: Food processors, industrial application.



Water Ozone Washing System

Successfully replaces chlorine systems with superior results.

Applications: Food processors, water treatment, waste water treatment, industrial / commercial laundries.



Advanced Oxidation Systems

Provides PHI oxidizers for a broad application of water purification.

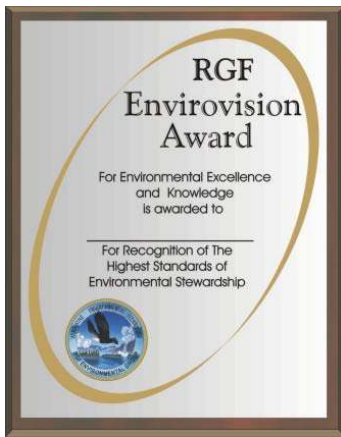
Applications: Waste water treatment, ground water remediation.



Thermo Oxidizer

A Flash Evaporator that eliminates highly contaminated water. PHI Cells provide Advanced Oxidation for a clean exhaust.

Applications: Heavy equipment manufacturing, casting companies, dye / ink manufacturers, paint manufacturers, manufacturers



Envirovision Program

A total facility program that provides over 50 RGF environmental products and certification as an Envirovision Facility. Providing the safest food, water and air without the use of chemicals. Also provides environmental legal compliance.

Systems include:

- Water Treatment
- Cooling tower water treatment
- Marina systems
- Kitchen and food preparation systems
- Pond and lake treatment
- Golf course maintenance environmental compliance
- Medical office systems
- Laundry systems
- Vehicle wash systems
- Fueling / maintenance environmental compliance
- Sewer treatment / recycling systems
- Sewage odor control
- Room mold control
- Fountains

Applications: Resorts, hotels, institutions, nursing homes, cruise lines



Other RGF products

- Chemical floccing systems
- Oil water separators
- Air purification systems
- Ozone generators
- Chemical storage centers
- Fluidized bed bio reactors
- Military equipment cleaning systems
- Golf course environmental programs
- Marine bilge filters
- Marine waste water discharge
- Resort programs
- Supermarket audit programs

The Company



Customer Service Award.

Innovation

Since 1985 RGF has maintained a steady flow of award winning innovative pollution solutions. RGF has been awarded national recognition as a recipient of the Inc./MCI

Benefits

By utilizing the latest state of the art sanitation technology, RGF provides a media recognition event for positive press. By taking a proactive approach you may be eligible for insurance rate reductions and you will be adding value by providing a safer product.



and environmental law. fast, accurate designs.

Design

Our technical staff consists of the following specialists: biological, mechanical, chemical, waste treatment, construction engineering, nuclear, fabrication, design, Our AutoCAD service provides

R & D

RGF maintains a Research and Development staff that is involved in EPA / USDA / FDA / EPRI and University Environmental Studies. Our staff continuously develops system improvements and new products. RGF personnel have been published in over 70 national journals and textbooks.



Patented Technology

RGF has been a leader in patented Environmental Technology.

Custom Applications & Components

RGF's award winning engineering team custom designs systems for wastewater recycling, ozone, pesticides, marine, and laundry treatment.



Advanced Oxidation

RGF has been a leader in Advanced Oxidation technology since 1985. We developed an advanced catalytic oxidation system for total organic oxidation. Our Photohydroionization process has been approved by

the USDA / FDA / FSIS for food processing.

Lab

RGF maintains a state-of-the-art analytical lab, which will provide free water testing for as long as you own your RGF system to assure continued performance. This assures our customers that, should your waste stream change, you will be able to make the appropriate modifications to meet your needs.



Validation Studies

RGF has a scientific staff capable of validating PHI claims. RGF designed and built a sneeze simulator. All testing is independently validated by licensed professional

engineer / university scientists. RGF has built 5000 sq. ft. / 50,000 cu. ft. test chambers for validation of air treatment systems

Publications

RGF personnel have had articles published in over 100 periodicals and text books.



RGF designs, engineers and manufactures over 500 environmental products to provide the world with the safest water, food and air without the use of chemicals.

About the author

Ronald G. Fink, President/CEO of RGF Environmental Group. BSME, holds numerous patents and has authored over 70 published technical papers. Mr. Fink has a 30-year background in nuclear energy, air, water and food purification systems.



RGF[®] **ENVIRONMENTAL GROUP, INC.**

*3875 Fiscal Court, West Palm Beach, FL 33404 U.S.A.
(800) 842-7771 (561) 848-1826 fax: (888) 848-0047*

www.rgf.com

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