The history, evolution, validation, case studies, pilot plants and product lines utilizing RGF’s Advanced Oxidation technology for water, food, air, laundry, fuel, waste, grease and marine systems.
1960's  RGF employees participate in early experiments with hard irradiation. Also, UV light on food and water.

1970's  RGF employees work in nuclear and environmental industries.

1985  RGF was founded to provide the world with the purest food, water and air with soft irradiation without the use of chemicals.

1986  RGF develops Advanced Oxidation Technologies by combining ozone gas with ultraviolet light and hydrogen peroxides.

1988  RGF converts their Advanced Oxidation Technology to Air Treatment System for treatment of mold, bacteria and odors.

1990  RGF's R&D applies Advanced Oxidation to food sanitation projects.

1995  Little Palm Island, a five-star, high-end resort is the first "EnviroVision" project with 19 RGF Advanced Oxidation products purifying the Island's air, water, food and laundry.

1996  RGF applies air, water and food with direct irradiation with RGF's Advanced Oxidation technology to Sunshine Farm, a poultry processor. All major food industry magazines carry the story, many as a cover story.

1997  Fox, ABC and CBS News and Popular Science Magazine give RGF's Advanced Oxidation technology great press with our food and air products.

2000  RGF forms a strategic alliance with BOC, a $5 billion NYSE company for USA food product distribution of RGF's Advanced Oxidation products.

2000  RGF signs a contract with Shaklee Corporation to develop a small, in-room air purification device and long-term engineering services. After one year of testing and validation, over $50 million retail were sold the first year.

2003  RGF Advanced Oxidation technology was tested and chosen by the Chinese Government to help contain the SARS virus. Excellent television and press coverage.

2003  RGF developed a "sneeze" machine in conjunction with Sandia Labs for homeland security. RGF demonstrated a 78% reduction at 3' of sneeze microbials with RGF's AOT.

2003  RGF develops a small room AOT for Nesstech International, a Japanese infomercial marketer. After one year of testing, the Japanese government approves mold, odor and microbial reduction claims. Steady TV exposure for over one year with excellent sales.

2004  RGF signs a contract to develop 14 products for EcoQuest, who has sold over 1,000,000 air purifiers since 1986. EcoQuest changed their entire product line over to RGF's RCI, an advanced oxidation technology designed for small residential applications.

2005  MRI Testing Labs tests RGF's AOT for the cruise ship industry for the Norwalk Virus. Results were a 99% reduction on surfaces. Numerous cruise ships are now using RGF's AOT for Norwalk Virus protection as well as mold, odors and other microbials.

2006  Kansas State University tests RGF's AOT for the following:
       Streptococcus - 96.5% reduction on surface in 24 hours
       E.Coli - 98% reduction on surface in 24 hours
       Listeria- 99.7% reduction on surface in 24 hours
       Norwalk Virus - 99.9% reduction on surface in 24 hours

2006  RGF AOT Cell. Worldwide sales have exceeded 1,000,000 units with less than half of one percent warranty claims.

2006  RGF's Research & Development Department sets out to develop an improved AOT. RGF's development of PHI and other advanced oxidation technologies which works well on gases, odors and microbials, but have little or no effect on particulates. Testing and validation starts on RGF's REME technology or Reflective Electro Magnetic Energy, which will cover the full gambit of indoor air problems, gases, odors, microbials and particulates.

2007  RGF's engineers design REME Technology into most RGF products as REME seriously out performs PHI.

2008  REME is introduced at the ASHRAE Show in New York with broad acceptance.
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REME™ produces “Ionized Hydro Peroxides™ (IHP)”, which are oxidation gas exceeds that of all previous RGF AOTs. In addition, advanced oxidation gas. REME™ has been going successfully tested on engine exhaust for particulates. A reflective electro magnetic energy producing advanced oxidation gases to create an aggressive atmosphere that reduced or eliminated airborne microbials and gases/odors. The work done with Sandia National Labs with the sneeze test demonstrated RGF AOT gases destroy airborne microbials on contact. Numerous validation tests show effectiveness of up to 99+% on bacteria, viruses, odors, mold and VOC’s.

What makes REME™ so attractive?
REME™ is a new, highly efficient method of producing advanced oxidation gas. REME’S™ production of advanced oxidation gas exceeds that of all previous RGF AOTs. In addition, REME™ produces "Ionized Hydro Peroxides™ (IHP)", which are charged hydro peroxide molecules. The IHPs have the ability to neutralize the charged airborne particulates, deactivate them and drop them out of the air, or if collection and removal is preferred, a RGF charged filter can be used to collect and hold the particulate matter for disposal.

What is REME™
A reflective electro magnetic energy producing advanced oxidation gas and ionized hydro peroxides. REME™ works on a pulsed electro magnetic energy reflected in an oxygen and hydrogens spherical shroud. REME™ is a state-of-the-art, cutting edge technology that will be incorporated into most RGF products. REME™ is an electro magnetic ionization chamber that is not an ozone device unlike PHI. REME™ is out of the UV/ozone commodity marketing quagmire of endless phoney knock-offs giving the technology a marketing nightmare. REME™ is in its own league One of REME’s™ advantages is speed. It has been successfully tested on engine exhaust for particulates. A REME™ exhaust system is in use on the RGF Envision yacht.

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 (O3) 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 a 20+ year string of discoveries involving: advanced oxidation, utilizing UV irradiation, ozone, fenton reagents, catalytic oxidation, hydro peroxides, titanium-silver-hromium 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, RCI, the PHI™ Cell finally REME 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.

**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 (O2) to ozone (O3). 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. 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 capacity. 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 cre-
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 trihalomethanes and halocetates.

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.

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

**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 trihalomethanethane, a highly suspected carcinogenic.

**Chlorine**

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

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 ozone 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.
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 360º 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 volatize 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 effectiveness is widely broadened.

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**RGF's Advanced Oxidation of Celery**

**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.

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 Air-Source project. The unit contained an RGF Photoionization Module and another technology for particulate 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 2000, 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.

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**Organic Spectrum**

Effectiveness is widely broadened with Multiple Oxidizers.

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**Tables and Diagrams**

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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 microbes 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 friendly oxidizers.

**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.

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 (H₂O₂) 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 (H₂O₂) will revert to water vapor (H₂O). This will permit the next H₂O₂ 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
- 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)
- Reflective Electro Magnetic Energy (REME)

**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

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2003 mold damage claims might hit $1 billion

New York - Mold damage claims will hit $1 billion again 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.

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6
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 airborne 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 Subtilis), you would need 47 30” 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 providing 24-hour protection against airborne mold, bacteria, viruses, odors and VOCs. The cell also acts as a germicidal treatment. Does not 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 over Federal safe limits as well as airborne 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.

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, ozoneide 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...
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: Works on gases, mold, odors, bacteria and virus but not particulates.

**REME Reflective Electro Magnetic Energy**
An Advanced Oxidation System that consists of an electro magnetic energy cell directed over to a reflective shroud which creates

REME or Reflective Electro Magnetic Energy utilizes an electro magnetic energy cell to create ionized hydro peroxides™, a friendly oxidizer plasma made from oxygen and humidity. This air purifying plasma is propelled into the HVAC duct or plenum by a silent plasma propulsion module that has no moving parts, yet propels the plasma at 2 cfm. This provides for fan or blower less operation on a 24-hour basis. The purifying plasma will be propelled through the ducts whether the fan or blower is on or not. This permits a hardwire 110 volt plug-in installation that lets the REME run 24/7 without wiring to the fan/blower circuit.

The REME+ cell incorporates a device that uses high voltage to ionize, or electrically charge, molecules of friendly oxidizers. REME can generate specifically charged ions (all positive or all negative) in the air, or it can create both polarities indiscriminately. During operation the REME HVAC Cell is designated to generate primarily negative ions (particles that temporarily contain an extra electron, causing the entire molecule to possess a negative electrical charge) as well as a mix of positive ions that other particulate matter are attracted to (similar to static electricity). It cleans the air by charging airborne oxidized particles. These charged airborne oxidized particles have an affinity to combine together due to this charging effect, which in turn creates larger, heavier combined particles, which are more easily collected and have been inactivated by the friendly oxidizers on both the REME charged collector media and to a lesser effect, on more conventional types of filtration media.

REME Silent Plasma Propulsion Module (SPPM) is an electro-hydrodynamic device that produces thrust in the air using electrical energy without moving parts. When the emitter is charged with high voltage, it causes nearby AOP molecules to become ionized. There are hundreds of thousands of friendly oxidized molecules per second ejected from the device, so the force or thrust exerted is comparable to a 2 cfm fan.

The REME+ Grounded Collector is a reusable/washable low-pressure drop (0.125" WC) intake collector intended to capture charged airborne particulates. It is constructed as a laminate consisting of an external support grid, which contains multi layer polymers and metal alloys. A charge dissipation layer is integrated into the collector core and it is mechanically connected to earth ground via a regulation circuit which continually dissipates the positive electrical charges accumulated on the collector surface.

The collector acts as a grounded electrostatic panel, using the accumulated electrostatic charges to attract oppositely
charged particles in the airstream. The static electricity is created by the air as it flows through the filter media core which is made of precharged electrets (materials carrying a permanent positive or negative electrical charge). The theory of operation has to do with the process of triboelectric charging, resulting in one object gaining electrons on its surface, and therefore becoming negatively charged, and another object losing electrons from its surface, and therefore becoming positively charged.

Air tends to charge positively. As air flows past the collector, it tends to become more positive, the filter materials more negative, leading to a regenerative charging effect. This, in turn, continuously renews the materials static charge allowing it to attract oppositely charged contaminants within the airstream. As the filtered or processed air flows past the grounded core, the excess positive charges are drawn out of the collector due to the natural differential created by the earth ground connection, thus leaving the airstream with a neutral charge. By enhancing the charge of the collector, via extracting the charged ions formed by the moving air passing through the multilayer core, and then controlling the discharge rate of these to ground, the collection material carriers a higher state of charge than would be normally possible, and results in an increase in their effectiveness of attracting and holding charged airborne particulates. As the air flows past the REME generator, we then introduce a large amount primarily negative charged ions with an associated lower amount of positively charge ions being formed via the AOP process, thereby also increasing the net charge of the particles in the air, causing them to not only increase their attraction to the REME collector (up to a 93% reduction), but also increasing their chance of being trapped by more conventional filters as well (up to 73% reduction).

The RGF Advanced Oxidation Technologies is a group of oxidants known as Hydroperoxides. Hydroperoxides have been a common part of our environments for over 3.5 billion years. Hydroperoxides are created in our atmosphere whenever three components are present: oxygen molecules, water vapor and energy (electro magnetic). REME+™ also has the ability to super charge these hydroperoxides or ionize them into Ionized-Hydro-Peroxides™. Ionized-Hydro-Peroxides™ are very effective at destroying harmful microbials in the air and on surfaces. As oxidants, they do this by either destroying the microbe through a process known as cell lysing or by changing its molecular structure and rendering it harmless (which is the case in VOC’s and odors). The amount of hydroperoxides required to accomplish this task in a conditioned space is well below
the level that is constantly in our outside air. The Advanced Oxidation Technology found in RGF’s Guardian Air product family has brought the oxidants found in the outside air into the conditioned space of your home. Hydroperoxides could be viewed as nature’s air purifiers. There is no known case of hydroperoxides ever creating a health risk. Considering we have been exposed to hydroper-

oxides in nature since the day man stepped on the planet, it is a reasonable assumption that hydroperoxides do not constitute a health risk. Over the past 20 plus years, RGF has more than one million Advanced Oxidation products successfully used worldwide without a safety problem.

Validation Summary

RGF first developed its Advanced Oxidation Technology over 20 years ago. Over 1 million RGF Cells are in use around the world. RGF has licensed its technology to many Fortune 500 companies for use in the medical, food, military, residential, commercial, marine, hospitality and government, etc. RGF cells in various products have been tested and approved by:

- UL, ETL, TUV, EU, EPA & CSA
- Japanese Government (TV commercials)
- U.S. Military
- Canadian Government
- Electric Power Research Institute
- U.S. Government – GSA
- Chinese Government
- European Union

In addition, RGF cells have been specified in the Norovirus & MRSA protection plan of America’s largest restaurant chains, hotel chains, theme parks, cruise lines, public schools and hospitals. The following is a summary of some of the testing and studies performed by third party independent labs and universities.

Sneeze Test - REME

A testing protocol concept was used 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 99% reduction of microbials was achieved with REME 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.

Tested by: Kansas State University, inactivation 99%
<table>
<thead>
<tr>
<th>Ozone</th>
<th>UV Light</th>
<th>Catalyst Based</th>
<th>Electro Magnetic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corona Discharge Ozone Systems</td>
<td>UV-C Germicidal Lamp</td>
<td>UV-C Ozone Lamps</td>
<td>REME™</td>
</tr>
<tr>
<td>Designed for HVAC Systems</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Provides whole house air purification</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Keeps mold from growing on AC coil</td>
<td>Yes</td>
<td>?</td>
<td>Yes</td>
</tr>
<tr>
<td>Reduces odors, VOC's, bacteria, viruses and mold throughout the house</td>
<td>?</td>
<td>?</td>
<td>Yes</td>
</tr>
<tr>
<td>Low initial cost</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Low installation cost</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Reduces microbials by over 90% throughout the house</td>
<td>?</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Provides a broad range of disinfection</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Low maintenance</td>
<td>No</td>
<td>Yes</td>
<td>?</td>
</tr>
<tr>
<td>Low power consumption</td>
<td>No</td>
<td>Yes</td>
<td>?</td>
</tr>
<tr>
<td>Meets Federal ozone safety guidelines</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Has the broadest range of effectiveness</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>One unit will service an HVAC System</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>UV bulb is protected from breakage &amp; mercury contamination</td>
<td>N/A</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Has 3 year warranty 25,000 hour life</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Provide point of source microbial reduction sneeze test</td>
<td>No</td>
<td>No</td>
<td>?</td>
</tr>
<tr>
<td>Particulate removal</td>
<td>No</td>
<td>No</td>
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</tbody>
</table>
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.

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.

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 principle 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 realeased into an open top vessel, where the air then comes out of solution, thereby breaking emulsions and aiding the F.O.G.’s to rise and congeal.

**Biological**

**Bacteria** - Aerobic Sewer Treatment System utilizing...
break the F.O.G.'s down to short chain molecules, which are readily digestible by a treatment plant.

**Validation Summary**

RGF Air, Water, Food and Laundry Systems have been tested and validated by hundreds of US and Fortune 500 companies. Over 1 million systems are in use in 33 countries. The following is a summary of some typical lab tests and validations.
Stale Air. Yachts are notorious for stale air. You can notice it as soon as you step onboard. There is a trademark odor. Some try to mask odors with another odor or scent. Companies actually specialize in "scent engineering", tying certain scents with feelings or moods. The problem with this concept of olfactory persuasion is that we all process odors differently. Roses may smell good to you and make you smile, but may remind the next person of a funeral home! The best scent engineering is a non-scent or the absence of all odors. Routinely, hotels change drapes and bedspreads not due to wear, but rather the absorption of odors. This problem is amplified on a yacht due to the wide variety of odors. Yachts are tightly built. Space and weight are design problems. Therefore heating, ventilation and air conditioning
les. Therefore heating, ventilation and air conditioning (HVAC) equipment is kept to a minimum. Make-up air or fresh outside air is limited or non-existent.

Make-up air should represent 25% of a yacht's airflow. Designers prefer to recycle air as it is usually warmer or cooler than outside air, so less energy is required to heat or cool the air. The problem is the same air is constantly being turned over. This is especially true in the lower staterooms. Assuming no one opens a port hole and each stateroom has its own air handler (heating/cooling unit) and two people are in a stateroom with the door closed, there is no fresh air circulating, just recycled air. This is true for the entire lower stateroom area. The only way to get fresh air down the stairway via Brownian motion or a very slow molecular air transfer. Trying to get fresh air down a stairway into closed staterooms is like trying to blow air into a bottle. The old air has no place to go so the area ends up with a static air situation. With all the airborne bacteria, molds, yeasts and VOC's, this build up can cause very serious problems. Most bacteria are harmless, but when there is a build up of billions, it drastically increase your chances of exposure to a bad one.

**Diesel Fuel.** A yacht can carry anywhere from a few hundred to tens of thousands of gallons of diesel fuel. The fuel, of course, is confined to the fuel tank. Most yachts have a diesel fuel odor. Some are subtle, some are stronger. Assuming there are no leaks or spills, you will still get diesel odors from the fuel tank vents that relieve air pressure caused by fuel displacement of air and temperature variations. Fuel vents vent outside the boat. However, some diesel odors always seem to find their way inside the yacht, plus the engine room usually has many small leaks and venting. Why is this important to the yacht owner's indoor air problems? Aside from diesel fuel odor being unpleasant, diesel fuel is a microbial breeding ground and food source. Diesel fuel has the ability to harbor and grow 30 types of bacteria, 12 yeasts and over 80 fungi species. When fuel odors are present, these odors actually represent minute aspirated fuel particles that can easily be carrying some of the bacteria, yeast or fungi known to grow in diesel fuel.

**Bilge odors.** All yachts have bilges, and with them come odors, oil, fresh water from air conditioner condensers, and soapy wash water. All are excellent breeding grounds for bacteria. Oil, like diesel fuel, contains bacteria, yeast and fungi. Soap and detergents contain phosphates, which can fertilize our lawns and gardens but can also fertilize microbial growth. As with diesel odors, bilge odors aspirate minute particles of bilge water loaded with microbial and food sources for the microbials.

**Holding tank odors.** Yes, sewage stored in a yacht holding tank can run from 50 gallons to over 5,000 gallons. Again, these tanks are vented outside of the hull, and are a huge source of bacteria, viruses, methane, and hydrogen sulfide gases, and of course, odors. These sewage gases, bacteria and odors always seem to find their way into the yacht, again providing microbials as well as food sources for the microbials themselves.

**Wastewater Related Diseases and Viruses from Inhalation**

- Tuberculosis
- Histoplasmosis
- Coxsackie A&B
- Adenovirus
- Bacteria Dysentery
- Common Cold
- Echovirus
- Rotavirus

*Water Pollution Control Federation

**Molds** are gaining worldwide attention. Multimillion dollar homes are being razed due to mold contamination. Insurance companies are excluding mold damage from their coverage. Mold spores are everywhere. They simply need still air, moisture and a food source. Yachts provide a perfect atmosphere for growing mold. Ideal food sources are leather, paper, fabric and wood. This combined with stagnant air and dampness produces a perfect mold farm.

**VOC's** or volatile organic compounds are a common indoor air problem as they are everywhere: cleaning compounds, plastics, furniture, etc. All are found on a yacht. However, a yacht will have much higher levels of VOC's then a home due to all the glues, sealants, oils and fuel. A fiberglass vessel will be continuously off gas VOC's.

**Lysteria Monocytogenes** is a unique strain of bacteria that can live in a very cold atmosphere and is often found in sink and shower drains and ice makers. When food poisoning breaks out in a restaurant and nearly everyone gets sick, it is usually from the ice machines lysteria bacteria. Most patrons are served ice and water or ice in a drink. Lysteria loves yachts - lots of ice machines, lots of drains and shower sumps to grow in. Drains, shower sumps and heads also add to the yacht odor and overall bacteria problems.

**Norwalk Virus** represents a very serious problem to the cruise and yacht industry. Thousands have been infected and many cruises cut short. Why is Norwalk so prevalent on a ship? Norwalk is most likely transferred by surface to hand contact in a confined environment. It is very difficult to contain. Disinfect surfaces or wash your hands frequently.

**Staph Bacteria.** There is a strain of staph that is frequently and accurately reported by the media as flesh-eating bacteria. The wounds are black, and it literally digs a hole into the flesh. The full name is streptococcal bacteria and it does eat flesh. There have been an unusual number of cases on yachts. Why yachts again? They are ideal breeding grounds for microbials and the higher number that you are exposed to means the harder time your immune system has to fight them off and the higher the odds are that you will be exposed to a dangerous microbial.
All of the above lead to Sick Yacht Syndrome. All can be controlled with the right program. Your yacht can be as fresh as the air at sea.

**Healthy Yacht Hints**

- **Good housekeeping.** Keep it clean and clutter-free to promote air circulation.
- **A filtered advanced oxidation fresh air makeup system.** This will help prevent stale air and provide a positive pressure atmosphere in the yacht.
- **A continuous duty advanced oxidation HVAC air purification system.** This will kill airborne and surface bacteria, viruses, mold, yeast and odors.

![HVAC Air Purification Unit](image)

- **A positive ventilation, oxidation and circulation system.** This will kill microbials as above, plus provide full vessel air circulation to prevent stale air pockets.

- **An advanced oxidation holding tank ventilation system.** Advanced oxidation gases are circulated through the holding tank to oxidize sewer gases, viruses, bacteria and odors.

- **An advanced oxidation fuel filtration system.** This will kill microbials in diesel fuel without the use of chemicals. Engines will run cleaner and fuel microbials will be limited.

![Advanced Oxidation Fuel Filtration System](image)

- **A continuous duty advanced oxidation ice machine and drain and head system.** This kills lysteria bacteria.

Advanced oxidation is a new technology that uses friendly oxidizers to oxidize (kill) mold, viruses, bacteria, yeast, VOC's and smoke into harmless CO2 and water. By friendly oxidizers, we mean oxidizers that turn into safe oxygen and hydrogen when the oxidation or kill occurs. Advanced oxidation or PHI cells create gases and ions such as hydro-peroxides, superoxide ions and ozonide ions. These aggressive gases are developed by targeting a high intensity UV light on a precious metal target. Unlike ozone generators, advanced oxidation systems use redundant safe oxidizers and are widely used by all major food processors, the military, major cruise ships, homeland security, hospitals, assisted living facilities, hotel chains, etc.
Envision, The World’s First Environmentally Friendly Mega Yacht

Where Technology Meets the High Seas!

From the moment you set your eyes on this yacht it is hard to believe. Step inside, take the tour, and you will really be in awe. Just what is "Envision"? She is an environmentally friendly mega yacht, perhaps the world’s first. Envision, a 110’ aluminum motor vessel, is the brainchild of the RGF Environmental Group in West Palm Beach, Florida. RGF was founded in 1985 by the owner and CEO Ron Fink. The company has invented over 500 environmental products. RGF's mission is to provide the world with the safest air, water and food without the use of chemicals. Envision is a floating showroom of RGF products, and over 50 are in use on this vessel.

How was the Envision concept conceived? The RGF team's mission was to build the world’s first environment friendly mega yacht. A keyword in any environmental program is sustainability. With that in mind, the team decided to renovate an older tired aluminum yacht and recycle her into a world-class enviro-friendly mega yacht.

Lady BeBe was a 100' Broward charter boat out of St. Croix, USVI, owned and operated by the owner of BeBe Clothing Stores. RGF purchased the boat in August 2004. She was hunkered down for a couple of Florida hurricanes and work began at the Riviera Yacht Center in Riviera Beach, Florida, just five mile from RGF's headquarters. RGF maintains a full staff of over 100 engineers, designers, electricians, welders, carpenters, pipefitters, instrumentation technicians, painters, etc. Work proceeded from bow to aft and mast to keel. The vessel was basically stripped to a bare aluminum hull. A 5' bow extension and a 5' aft stairway to the sea increased her length to 110'. The salon and galley windows were enlarged and softened with rounded ends. Hurricane and bullet-proof glass composite was used for safety, soundproofing and reduced solar load. High density foam core insulation was used to triple the original insulation and sound proofing.

The RGF team's mission was to build the world's first environment friendly mega yacht.

Envision staging being built

By Devon Julian
The original wiring was replaced, as was the entire main electrical panel. Mechanically she was rebuilt from rudders to stabilizers to engines to generators to transmissions. All new navigation was installed, as well as most controls.

The upper deck was extended 8' aft to accommodate an 8' diameter pool/hot tub with an innovative clear bottom providing water-diffused sunlight to the lower aft deck during the day, and a water-diffused light show at night.

A massive U-shaped teak bar dominates the upper deck. The addition of a radar arch and pipe mast opens the upper deck as a major entertainment area.

One of RGF's technologies is PHI® or Photohydroionization, a light-based electromagnetic energy that destroys odors, mold, bacteria, viruses and airborne organics. PHI® is used by most Fortune 500 food processors as a food, air and water sanitizer, and in many buildings for air purification. RGF's PHI® technology is used by the U.S. military and other federal agencies, as well as major cruise ship lines for control of mold, bacteria and Norwalk Virus.

Envision was equipped with PHI®-based systems for water, air, food, laundry, sewage, exhaust and bilge treatment resulting in a mega yacht with the purest air, water, food, sewage, laundry and bilge in the world. Just step aboard and

Envision’s upper deck extension and Stairway to the Sea

A massive U-shaped teak bar dominates the upper deck. The addition of a radar arch and pipe mast opens the upper deck as a major entertainment area.

Envision’s engine room water treatment system

your nose will tell the story, or better yet remove the cap on the holding tank - no odor, not a cover up, just zero odors. Try the bilge; again, no odor. The engine room is unbelievably pleasant to visit.

Envision was equipped with PHI®-based systems for water, air, food, laundry, sewage, exhaust and bilge treatment resulting in a mega yacht with the purest air, water, food, sewage, laundry and bilge in the world. Just step aboard and

Just what does PHI® do for a yacht? First is mold and odor control, it is gone. Just walk on board, your olfactory will never deceive you. Second is food safety and shelf life extension: up to 40% extended shelf life for food treated with PHI®.

Water from the pool/hot tub to the potable holding tank is crystal clear and pure. Nothing can ruin a soak in a hot tub like chemicals. The hot water opens your pores and the bromine or chlorine is readily absorbed into your skin as well as the hot vapors entering your lungs. This is precisely why Envision’s hot tub is equipped with PHI Technology using friendly oxygen based oxidizers to maintain crystal clear and pure water.

Upper deck hot tub with the “Thongbrella” shade and porthole bottom

Envision’s engine room water treatment system

your nose will tell the story, or better yet remove the cap on the holding tank - no odor, not a cover up, just zero odors. Try the bilge; again, no odor. The engine room is unbelievably pleasant to visit.
Next is safety. PHI® is not a passive system. It is an aggressive system that sends out hydro peroxides and hydro ions into the room, which aggressively kills bacteria, molds, odors and viruses. Tests show a room with PHI® will kill 78% of sneeze germs at three feet. This also includes the dreaded Norwalk Virus and SARS. Independent lab tests for the Cruise Industry provided a 99.99% kill of the Norwalk Virus.

The galley is equipped with a PHI water system that injects the activated friendly oxidizers into the water to wash fruits and vegetables which eliminates chlorine and pesticides. The refrigeration unit eliminates refrigerator odors and bacteria and increases food shelf life.

Food Pure, a PHI® system that has been approved by the USDA and FDA for commercial Fortune 500 food companies, provides safer food and increases shelf life.

PHI® Units are installed in the trash compactor for odor and bacteria control, and also the ice makers, where mold and the deadly Listeria bacteria are destroyed. Airborne cooking grease is broken down to an oxidized white powder for easy and odor-free disposal. Cooking and grease odors are eliminated.

On laundry day you can forget about those unsightly polluting detergent bubbles surrounding the yacht. PHI cleans the clothing as well and possibly better than your favorite detergent. PHI gases are injected into the wash and rinse water for an eco-friendly wash. Silver ions are added to the fabric for ongoing bacteria elimination.

Now, the real challenge: a 20-year old engine room. The door opens…shazam! Everything is white, clean labeled,
labeled, and there is no odor, no fuel, oil, exhaust, bilge or sewage odor; nothing! The white carpeting really set the stage, chrome and polished stainless steel is everywhere.

RGF’s APS (air purifier system) provides VOC (volatile organic compounds) Free air VOC’s are the usual engine room odor problem: fuel, oil, grease, mixed with holding tank and bilge odors are the culprits.

For Envision’s most impressive act, my RGF host opened the holding tank cap (which was 1/3 full) and invited me to “Take a whiff”. You guessed it, no odor. The PHI® holding tank system eliminated the odors. Envision even has clear hoses on the pump out system, and although I did not stick around for the show, the Captain assured me it will be a clear, odor-free liquid.

Fuel contamination is a constant battle for diesel powered vessels. Diesel fuel grows bacteria and algae that clogs filters, injectors and burns with dirty smoke; not something an enviro-friendly vessel should have. A PHI Fuel Pure System will continually pump fuel through a PHI cell where the high intensity light based technology kills 99.99% of the bacteria and algae. A filter then captures the dead organisms providing longer fuel life and a cleaner and more efficient engine. By using an electro/mechanical device you eliminate the traditional chemical fuel treatments that can effect the sulphur content of the fuel and possibly cause metallurgical problems.

An RGF US Coast Guard approved Bilge Filter assures no illegal overboard discharge of oily bilge water. The RGF BOS Bacteria Odor System removes the usual bilge odors. The BOS System, originally developed for commercial sewer plants, can be found in each head on the Envision. The unit is hidden in the cabinet and just a small 1/4” tube feeds the advanced oxidation gases into the head bowl destroying odors and bacteria instantly!

What about efficiency? To be enviro friendly, a product must be efficient. The re-design of Envision included a rounded transom to aid in handling following seas. Also 1,400 gallon, split ballast tank system provided 10,000 lbs of ballast, 5,000 lbs each side. This provides a method of providing perfect balancing for a more stable and efficient ride. Also, a trim fin was
fin was added to prevent back wash at low speeds. This trim fin turned out to be better than expected. Not only did she trim out at 1,600 rpm, the entire stairway to the sea was high and dry. The balancing is credited for her performance: 14 knots at 1,700 rpm and 55 gph. It will be hard to convince many that 55 gallons per hour is environmentally friendly, but for a 110’ vessel it is quite impressive.

Another impressive feature was the lack of exhaust smoke. Once again, a RGF technology called Hygenization™ Smoke Reduction, which is a combination of RGF’s hydrogen ion cannon and REMETM, which reduces the particulate in exhaust and destroys many of the gases.

Environmental concerns encompass many aspects. Most people think of chemical pollution of air and water contamination. There is also visual pollution.

Recognizing the value of a totally unique mega yacht, Sunbrella Corporation decided to use Envision as a showplace for their new line of fabric, which includes furniture, cushions, pillows, bedspreads, headlines, even a wedge-shaped upper deck shade, which the RGF team promptly nicknamed a “thongbrella”.

Step into the master stateroom and your are greeted with an open airy feeling provided by 4 oversized portholes. The master stateroom is decorated in marble, granite, coral, sea glass and 9 different woods and veneers. Over 20 species of woods and veneers were used onboard. All exotic wood were purchased through World Panel Products Inc. which assures that all the exotic species were farmed and processed to avoid deforestation of our environmentally sensitive rainforests. the master also has an environmental friendly fireplace for those “cold” south Florida nights. Needless to say the fireplace is all electric but you literally have to touch the flame to be sure its not real. The master head is equipped with a massive 6’ x 6’ twin shower head marble and sea glass shower. The sink is molded colored glass that perfectly matches the deep purple sea color of the Atlantic meeting the shallow turquoise water of the Bahama Bank just off West End, Bahamas.

Dust mites are a serious environmental problem. Apparently they live off our dead skin which is constantly flaking off,
off, a pleasant thought! The dust mites themselves aren’t the problem it’s their droppings that create a dust that can aggravate allergies. Traditional mattresses can have 2/3 of it’s weight being dustmite feces, another pleasant thought. Envision’s 10 mattresses and 42 cushions are made of a space age closed cell memory foam that literally seals out dust mites avoiding another serious environmental problem. Of course the master king size is also an oversized custom made 15” thick memory foam mattress for an environmentally friendly night’s sleep. Two spacious guest staterooms, one port and the other starboard, are equipped with all the amenities of a first class hotel, large closet, make-up table, LCD TV, DVD, CD, shower, jaccuzi, memory foam mattress and of course the purest air possible. A redesign of the lower deck included a library with an over sized porthole for extra lighting and more of an open feel. The library includes a wet bar, refrigerator, LCD TV, DVD, CD and video games and converts to a double bed.

The plans called for an underwater lighting and video system. The lighting presented the team with some challenges. First was the rounded stern swim platform and second was suitable commercially available aluminum housings. One of the advantages of having a first class factory of craftsman, is you simply design, engineer, fabricate and install your own. Four 10,000 hour LED super bright underwater lights were installed and work beautifully.

Details were not overlooked anywhere. Even the powder room features coral stone walls, marble floors, and woven wood door. In addition a PHI Odor / Bacteria Sys-
Virovision is a realistic, practical approach that helps preserve all our natural resources: water, air, food and energy. The concept, developed by RGF Environmental Group, provides a facility with safe, purified air, water and food. The process encompasses a broad spectrum of natural, non-chemical oxygen and light source based environmental technologies, combined with conservation for a total eco-friendly, yet sustainable environment. Resorts, hospitals, cruise ships, yachts, food processors, and restaurants are embracing this program. The benefits include a safer environment;

Bacteria System is built into the head eliminating the need for a noisy exhaust fan. Custom crown molding, designed and fabricated by RGF, is found throughout...even in the helm. The salon crown molding consists of 12 individual pieces and includes a low noise and draftless heating and air conditioning duct. The RGF team imported a container of farmed teak for many teak projects. Teak is laminated and clearcoated in the massive 8’ x 8’ upper bar, the aft deck table seats 8 and the bow cocktail area features a laminated teak surfboard table.

Every available space was used to improve the visual environment. Two art centers occupy unused space. The mermaid includes underwater illumination and recirculation pump which feeds water to her shell providing a pleasant water feature at the port entrance.

RGF awarded Envision its Envirovision Award. Envision’s upper deck teak bar

12 piece crown molding with built-in HVAC vent
EnviroVision is a realistic, practical approach that helps preserve all our natural resources: water, air, food and energy. The concept, developed by RGF Environmental Group, provides a facility with safe, purified air, water and food. The process encompasses a broad spectrum of natural, non-chemical oxygen and light source based environmental technologies, combined with conservation for a total eco friendly, yet sustainable environment. Resorts, hospitals, cruise ships, food processors, and restaurants are embracing this program. The benefits include a safer environment; lower utility costs, reduced liability and civil lawsuits, elimination of environmental compliance liability, reduction of employee sick time, all resulting in improved public image and enhanced quality of the overall facility.

"EnviroVision is a realistic, practical approach to provide a vessel with the purest possible water, air and food without the use of chemicals."

The formality of some mega-yachts can be intimidating. Aside from being environmentally friendly, a visit to this mega-yacht will leave you with a fresh and easy feeling, and a level of comfort that makes you want to return for another breath of fresh air.
WATER

EPRI (Electric Power Research Institute) 2000. Case study RGF’s advanced oxidation system “Hospital Laundry of the Future”. Results/Findings: 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.


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

<table>
<thead>
<tr>
<th>Test</th>
<th>Max ppm</th>
<th>Brackets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test 1 - Mold</td>
<td>97.7%</td>
<td>.02 ppm</td>
</tr>
<tr>
<td>Test 2 - Yeast &amp; mold</td>
<td>90.9%</td>
<td>.03 ppm</td>
</tr>
<tr>
<td>Test 3 - Mold</td>
<td>77.0%</td>
<td>.04 ppm</td>
</tr>
<tr>
<td>Test 4 - Bacteria</td>
<td>34.5%</td>
<td>.05 ppm</td>
</tr>
</tbody>
</table>

Licensed Professional Chemical Engineer and IAQ Spec Ozone levels for RGF's Shaklee PHI unit.

<table>
<thead>
<tr>
<th>Compound</th>
<th>Odor</th>
<th>% improved in 4 hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen Sulfide</td>
<td>Rotten eggs</td>
<td>80%</td>
</tr>
<tr>
<td>Methyl mercaptan</td>
<td>Rotten cabbage</td>
<td>100%</td>
</tr>
<tr>
<td>Carbon Disulfide</td>
<td>Vegetable sulfide</td>
<td>30%</td>
</tr>
<tr>
<td>Butyl Acetate</td>
<td>Sweet banana</td>
<td>100%</td>
</tr>
<tr>
<td>Methyl Methacryline</td>
<td>Plastic</td>
<td>100%</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Compound</th>
<th>Odor</th>
<th>% Reduction</th>
<th>Odor Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test 1 - Bacteria reduction in 3 days</td>
<td>88%</td>
<td>72%</td>
<td>Yes</td>
</tr>
<tr>
<td>Test 2 - Yeast &amp; Mold reduction in 3 days</td>
<td>71%</td>
<td>71%</td>
<td>Yes</td>
</tr>
<tr>
<td>Test 3 - Bacteria reduction in 3 days</td>
<td>78%</td>
<td>80%</td>
<td>Yes</td>
</tr>
<tr>
<td>Test 4 - Yeast &amp; Mold reduction in 3 days</td>
<td>90%</td>
<td>90%</td>
<td>Yes</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Compound</th>
<th>%</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Methyl Ethyl Ketone</td>
<td>13%</td>
<td></td>
</tr>
<tr>
<td>D-limonene</td>
<td>98%</td>
<td></td>
</tr>
<tr>
<td>Toluene</td>
<td>29%</td>
<td></td>
</tr>
</tbody>
</table>

Medical Clinic Bacteria Test for RGF's Pure Air Advanced Oxidation unit.

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

<table>
<thead>
<tr>
<th>Sample #</th>
<th>% Reduction</th>
<th>Odor Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>72%</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>71%</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>80%</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>74%</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>72%</td>
<td>Yes</td>
</tr>
</tbody>
</table>

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
bacteria into the building. We designed a custom PHI Com- pactor 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 18.

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

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.

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 Com- pactor 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 18.

Kane Regional Hospital Center Pittsburgh PA.

RGF: Photoionization Microbial reduction 60 - 90%
Odor neutralized
Ozone less then .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 court- room 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 reduc- tion 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 bacte- ria.

Licensed Professional Chemical Engineer and IAQ Spec.
Commercial airliner 1 hour PHI test 94% bacteria reduction.

Coling Towers/RGF Advanced Oxidation System

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Norwalk Virus

Noroviruses are a group of related, single-stranded RNA, nonenveloped viruses that cause acute gastroenteritis in humans. Noroviruses are named after the original strain “Norwalk virus,” which caused an outbreak of gastroenteritis in a school in Norwalk, Ohio, in 1968. No evidence suggests that infection occurs through the respiratory system. Noroviruses are highly contagious and as few as 10 viral particles may be sufficient to infect an individual. During outbreaks of norovirus, several modes of transmission have been documented; for example, initial food-borne transmission in a restaurant, followed by secondary person-to-person transmission to household contacts. 50% of all food-borne outbreaks of gastroenteritis can be attributed to noroviruses. Among the 232 outbreaks of norovirus illness reported to CDC from 1997 to 2000 36% were in restaurants, 23% were in nursing homes, 13% were in schools and 10% were vacation settings or cruise ships.

Source: CDC-Centers for Disease Control and Prevention

Tested by Midwest Research Institute Inactivation Rate 99+%
Methicillin Resistant *Staphylococcus aureus*
Methicillin-resistant *Staphylococcus aureus* (MRSA) is a type of bacteria that is resistant to certain antibiotics. These antibiotics include methicillin and other more common antibiotics such as oxacillin, penicillin and amoxicillin. Staph infections, including MRSA, occur most frequently among persons in hospitals and healthcare facilities (such as nursing homes and dialysis centers) who have weakened immune systems.
Source: CDC Centers for Disease Control and Prevention
Tested by Kansas State University Inactivation Rate 99+%

*Streptococcus Sp.*
Group A *Streptococcal* (strep) infections are caused by group A *streptococcus*, a bacterium responsible for a variety of health problems. These infections can range from mild skin infection or sore throat to severe, life-threatening conditions such as toxic shock syndrome and necrotizing fasciitis, commonly known as flesh eating disease. Health experts estimate that more than 10 million mild infections (throat and skin) like these occur every year. Secondary infections include: Rheumatic Fever, Impetigo, Cellulitis, Erysipelas and Scarlet Fever.
Source: U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Tested by Kansas State University Inactivation Rate 96+%

*SARS*
Severe acute respiratory syndrome (SARS) is a viral respiratory illness caused by a coronavirus, called SARS-associated coronavirus (SARS-CoV). SARS was first reported in Asia in February 2003. Over the next few months, the illness spread to more than two dozen countries in North America, South America, Europe, and Asia before the SARS global outbreak of 2003 was contained. The main way SARS seems to spread is by close person-to-person contact. The disease can spread when droplets from the cough or sneeze of an infected person are propelled a short distance (generally up to 3 feet) through the air. The virus also can spread when a person touches a surface or object contaminated with the infectious droplets and then touches his or her mouth, nose or eye(s).
Source: CDC-Centers for Disease Control and Prevention
Tested by NEI-Chinese Government Inactivation Rate 73+%

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Source: CDC Centers for Disease Control and Prevention
Tested by Kansas State University Inactivation Rate 99+%

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Source: U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Tested by Kansas State University Inactivation Rate 96+%

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Source: CDC-Centers for Disease Control and Prevention
Tested by NEI-Chinese Government Inactivation Rate 73+%
**Escherichia coli**

Escherichia coli, usually abbreviated to E. coli, discovered by Theodor Escherich, a German pediatrician and bacteriologist, is one of the main species of bacteria that live in the lower intestines of mammals, known as gut flora. The number of individual E. coli bacteria in the feces that a human excretes in one day averages between 500 billion and 10 trillion. All the different kinds of fecal coli bacteria, and all the very similar bacteria that live in the ground are grouped together under the name coliform bacteria. E. coli can be the causative agent of several intestinal and extra-intestinal infections such as urinary tract infections, meningitis, peritonitis, mastitis, septicemia and gram-negative pneumonia.

Source: CDC: Center for Disease Control and Prevention
Tested by Kansas State University
Inactivation Rate 99+%
**Odors**

The purpose of this test was to evaluate to what effect the RGF’s AOT unit has on cleaning chemicals, pet odors and perfume odors. This test was performed utilizing two 500 cubic foot test chambers and a ten-person odor panel. The qualitative assessments of the ten-person odor panel were then used as a means to determine the odor reduction.

Tested by C&W Engineering (Independent PE Firm)

Reduction %
- Cleaning chemicals 55+%
- Pet odors 72+%
- Perfume odors 63+% 

**Mold/Yeast**

The purpose of this test was to evaluate the effect the RGF AOT unit has on mold/yeast bacteria (TPC). This test was performed utilizing a standard 2000 sq. ft. home and 3000 sq. ft. simulated home.

Tested by California Microbiology Center
Independent Accredited Lab - IBR
Kansas State University
University of Florida
United States Air Force
R&D Labs
C&W Engineering
University of Cincinnati
Kane Regional Hospital

Reduction %
- Bacteria 99%
- Mold 97-98%
- Yeast 90+% 

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**Stachybotrys chartarum**

*Stachybotrys* is a greenish-black fungus found worldwide that colonizes particularly well in high-cellular material, such as straw, hay, paper, dust, lint, and cellulose-containing building materials such as fiber board and gypsum board that become chronically moist or water damage due to excessive humidity, water leaks, condensation or flooding. *Stachybotrys chartarum* grows and produces spores in the temperature range of 36-104°F. It is also capable of producing several toxins however, researchers still know little about the temperature and moisture conditions under which these toxins are produced.

Source: Health and Industry
Tested by Kansas State University Inactivation Rate 99+% 

**Candida albicans**

*Candida albicans* is a diploid sexual fungus (a form of yeast), and a causal agent of opportunistic oral and vaginal infections in humans. Systemic fungal infections have emerged as important causes of morbidity and mortality in immunocompromised patients (e.g., AIDS, cancer chemotherapy, organ or bone marrow transplantation). In addition, hospital-related infections in patients not previously considered at risk (e.g. patients on an intensive care unit) have become a cause of major health concern.

Source: CDC: Center for Disease Control and Prevention
Tested by Kansas State University Inactivation Rate 99+%
Smoke (Odors and Particulates)
The purpose of this test was to evaluate to what effect the RGF’s AOT unit has on cigarette smoke odors and particulate. This test was performed utilizing two 500 cubic foot test chambers and a ten-person odor panel. The qualitative assessments of the ten-person odor panel were then used as a means to determine the odor reduction. Particulate was tested with a laser particle counter.

Chemical Compounds
Gas Chromatograph/Mass Spectrometer test performed by Nelap Accredited Lab on airborne chemical compound reduction using RGF’s AOT.

Hydrogen Sulfide - Rotten eggs
Methyl mercaptan - Rotten cabbage
Carbon Disulfide - Vegetable sulfide
Butyl Acetate - Sweet banana
Methyl Methylacrylate - Plastic

Chemical odors (VOCs)
The purpose of this test was to evaluate the effect the RGF’s AOT unit has on chemical odors.
Tests were conducted by GC/MS
Tested by NELAP Accredited Independent Lab

Particulate (REME only)
The REME Cell is also effective in reducing particle counts in the controlled chamber. Particle counts are reduced to ISO Class 4 levels (10,000 - 0.1um) after 12 hours of exposure to the REME Cell. After 24 hours of treatment, ISO Class 3 levels (1,000 - 0.1um) were achieved. These are better than HEPA results.
Tested By Kansas State University
Performance Analytical Labs
Formaldehyde
The purpose of this test was to evaluate the effect the RGF AOT unit has on formaldehyde.
Tests were conducted in test chamber by Kansas State University.

Formaldehyde
The purpose of this test was to evaluate the effect the RGF AOT unit has on formaldehyde in a home.
Tests were conducted in actual mobile homes for FEMA.

Subway Corp. Ice Machine Test
The purpose of this test was to evaluate the effect the RGF AOT unit has on ice machines used in Subway Sandwich stores.
Tests were conducted in actual store.

Before testing and cleaning visible microbial growth.
Clean Ice Machine start of testing at Subway Corp.
3 months later using RGF Ice Units no visible microbial growth.
**Electrical**

All RGF AOP devices have been thoroughly tested for electrical safety in house, by consultants and certified independent agencies. Results were excellent.


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**Ozone / EMF**

RGF AOP devices have been thoroughly tested for ozone / emf - Electro Magnetic Frequency and have passed Federal Safety Standards.

Tested by: FSIS Federal Safety Inspection Services
UL, ETL, TUV, CSA
ISSES / Disney

Note: Many household appliances emit some ozone and emf in safe low levels such as and fluorescent lights, motors, computers, copy machines, refrigerators, blenders, electronic air filters, air conditioners, electric fans, microwave ovens etc.

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**Disclaimer:**

All the above tests were performed on RGF Advanced Oxidation products with Advanced Oxidation Plasma of less than .02 ppm. They were conducted by independent accredited labs and university studies. They were funded and conducted by RGF’s major clients to assure third party credibility. RGF products are not medical devices and no medical claims are made.

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**SAFETY**

It is a normal reaction to question the long term safety of any product that is effective and uses new or "breakthrough" technology. This type of question has become common as our litigious society has taught us to question things that significantly outperform existing methods or products.

The RGF advanced oxidation technologies that produced the results found on the pages of this report certainly fall into the category of breakthrough technology. This is evident by its outstanding test results across the entire range of microbes.

The breakthrough in the RGF advanced oxidation technologies is not found in the final product (hydroperoxides) but rather in the method by which they are produced. The active ingredient created by the RGF products is a group of oxidants known as Hydroperoxides. Hydroperoxides have been a common part of our environment for over 3.5 billion years. Hydroperoxides are created in our atmosphere whenever three components are present: unstable oxygen molecules, water vapor and energy (electro magnetic).

Hydroperoxides are very effective (as demonstrated by the test results in this book) at destroying harmful microbials. As oxidants, they do this by either destroying the microbe through a process known as cell lysing or by changing its molecular structure and rendering it harmless (which is the case in VOC’s and odors). The amount of hydroperoxides required to accomplish this task in a conditioned space is well below the level that is constantly in our outside air. The advanced oxidation technology found in RGF’s Guardian Air product family has brought the oxidants found in the outside air into the conditioned space.

There is no known case of hydroperoxides ever creating a health risk. Considering we have been exposed to hydroperoxides in nature since the day man stepped on the planet, it is a reasonable assumption that hydroperoxides do not constitute a health risk. Over the past 20 plus years RGF has more than 1 million Advanced Oxidation products successfully used worldwide.
**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. One laundry system 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.

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.
## ODOR SPECTRUM

<table>
<thead>
<tr>
<th>PROBLEMS</th>
<th>COMPOUNDS</th>
<th>ODOR</th>
<th>MOLECULAR STRUCTURE</th>
<th>SOLUTIONS</th>
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<td>Amino Acids</td>
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Speed of Reduction Comparison REME vs. PHI

Percentage of Reduction

Sampling Intervals in Minutes

REME
32.5% Faster than PHI

PHI
RGF’s AOT Products

**RGF Commercial APS** - The ultimate commercial air purification system consisting of 8 optional technologies. A dual REME cell for mold, odors, virus, VOCs, bacteria and particulate. 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 REME cell life. Applications: Offices, food processors, restaurants, medical facilities, factories, nail salons.

**REME Cell** - A Reflective Electro Magnetic Energy 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, bacteria and particulate. The REME Cell provides any commercial, residential or industrial air handling system with over 90% reduction of mold, bacteria, odors and particulate. 3 year REME cell life. Applications: Homes, offices, factories, medical facilities, etc.

**Commercial Food Sanitizer** - A broad band high intensity UV light provides an 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. 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 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 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 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 An Advanced Oxidation Cell provides a safe steady stream of 5 Advanced Oxidizers to the ice storage bin. Advanced Oxidation 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

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

Applications: Hotels, residences, hospitals, cruise ships, institutions, offices
Advanced Oxidation 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.

Advanced Oxidation Water Purification System
The RGF Advanced Oxidation 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.
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

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. Advanced Oxidation Cells provide Advanced Oxidation for a clean exhaust.  
Applications: Heavy equipment manufacturing, casting companies, dye / ink manufacturers, paint manufacturers, manufacturers
Marine AOT Products

Bathroom Odor Eliminator
Designed to reduce odors and bacteria present in shipboard heads. The unit mounts under a cabinet or out of the way and pumps Advanced Oxidation gases to the head via poly tubing.

RGF’s Plug In
This REMETM 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.

The RGFq Bilge FilterTM employs the same technology RGF Environmental has used on over 20,000 industrial oil removal systems worldwide. The system utilizes a proprietary matrix system of coalescing separation media to coagulate petroleum hydrocarbons, collect the free oils and absorb sub-micron hydrocarbons.
All this packaged in a non-clogging filter cartridge. U.S. Coast Guard approved.

RGF Delta Marine Type I Central System
The RGF Delta Marine Central Waste Treatment System is a batch type flow-through waste treatment system. The system works in conjunction with the vessel's toilet waste holding tank. The system is completely automatic and will treat a maximum of 332 gallons of toilet waste per day. The system meets or exceeds all requirements set by the U.S.C.G. and the EPA for Type I Marine Sanitation Devices for inspected or uninspected vessels. The unit may be used in conjunction with any number of marine heads and is highly recommended for use in vessels having three or more heads.

RGF Delta Type II Central System
The RGF Delta Marine Central Waste Treatment System Type II is a batch type flow-through waste treatment system. The system works in conjunction with the vessel's toilet waste holding tank. The system is completely automatic and will treat a maximum of 1,000 gallons per day. Due to the unique design of the RGF Marine Central Waste Treatment System Type II, the capacity of 1,000 gallons per day is both a maximum and average rating. The system meets or exceeds all requirements set by the U.S. Coast Guard and the EPA for Type II Marine Sanitation Devices.
Mini HVAC REME™ Cell
by RGF®
Same technology as our Standard HVAC REME™ Cell in a much more compact unit when space is at a premium. This unit can even be installed in smaller self contained AC units.

Intake Strainer Growth Elimination System
A high intensity UV system to eliminate growth in raw water strainers.

UV Fuel Growth Elimination System
A high intensity fuel filtration and algae/bacteria elimination system did away with the need for chemical fuel treatment.

Airborne Cooking Grease Eliminator
REME™ breaks down airborne grease to a white powder for easy and safe disposal. Cooking odors are eliminated.

REME™ Exhaust Hygenization™ Smoke Reduction System
RGF’s High REME Smoke Reduction System reduces exhaust particles up to 40% and reduces harmful exhaust gases.

Positive Ventilation System
A REME Cellplus filtration and a high efficiency super quiet fan to eliminate shipboard stale air problems.
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, bacteria and virus control
- Fountains

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

Other RGF products
- Air purification systems
- Chemical floccing systems
- Oil water separators
- 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
- Food Sanitation
- Odor Control
- Bacteria, Mold, Virus Control