SATORI
CLEAN AIR SYSTEMS™

Advanced Pathogen Control for Buildings

Maximizing technological application of the Brownian theory of random particle movement.

About the Author
Dr Arthur Martin, PhD

Dr. Arthur V. Martin, a Nobel Prize Nominated Scientist for his work with COVID-19, is considered one of the world's foremost experts on the various technologies available to control the spread of disease. He is highly sought after for his expertise in selection of the most efficient and efficacious technology as required for a specific structure or application. He has worked in and consulted to more than 20 countries and governments as well as private entities.

A former ASHRAE member, his past projects have been recognized with 1st place Awards for Existing Health Care as well as Existing Institutional Buildings. One of his projects was voted the Most Efficient Building in The Nation. He is the Environmental Consultant to The Faisal Group of Companies in Riyadh, Kingdom of Saudi Arabia, a member of the W.H.O. Stop TB board, and a Member/Researcher of the Infectious Diseases International Research Initiative, Ankara, Turkey as well as a Collaborative Researcher with Camarines Norte State University, Daet, Philippines. Dr. Martin is also the Chief Scientist of a Tianjin, China Biotechnology Company as well as STIMANOVA INTERNATIONAL-FZCO of Dubai, UAE.

He is a past nominee for the W.H.O. Kochon Prize for innovative work with TB in buildings thereby reducing treatment times and allowing more infected people to be treated quicker, more efficiently and in a less costly manner. In 2021 he was nominated for a Nobel Prize, specifically for innovative work with COVID-19 including development of an organic based, non-toxic anti-pathogenic product that can be mass produced and globally distributed. The product is tested and proven to kill COVID-19 in two (2) minutes or less. Along with the product, Dr. Martin conceptualized, designed, prototyped, patented and made available a delivery system that will automatically infuse the product into enclosed buildings and vessels.

Dr. Martin has innovated agricultural crop production through use of his Nobel nominated product. It has been successfully utilized in the Philippines on fungal issues with coconut, pineapple, strawberries, tomatoes, and numerous other crops. In Nigeria Dr. Martin's technology has produced a 25% to 30% increase in organic forage crop growth organically. Ground nut production has substantially increased as well as has rice and maize production. The product acts as a chemical free pesticide, fungicide, bactericide and as a growth enhancer. Crop use is one of the fastest expanding market segments for the product.

Dr Martin and the Satori company continues to apply his extensive success with his product to the built environment within the USA focusing on private commercial, medical and government projects as well as aeronautics, hospitality and rail.

Forward
Thomas Marcello, PhD

The world is currently confronted with so many critical issues that it is easy to get lost in the wave of overwhelming pressure to address all of them, but can we afford not to? Dr. Martin has in his latest treatise addressed one issue that, after the Covid pandemic, we all can relate to personally; the ever-present pathogen dilemma.

In Advanced Pathogen Control for Buildings, he presents a detailed, cogent, science supported argument for his S4 System®. The data is clear and concise and presented in a way that first educates you then supports his hypotheses. The S4 A.P.A.S.® system can improve, protect and eliminate deadly pathogens in indoor environments. Can you imagine the impact it would have on your employees if you could say that your work environment is 99.9% pathogen free. How about if you were a building manager and renting space and you could make that claim. Eliminate the competition!

Covid is just the latest pathogen attack on society. What's next... and I know and you know there will be a next.

Your time reading Advanced Pathogen Control for Buildings will be a great investment and hopefully an inducement for you to act.

Defining the Real Issue

Assume that you are out to dinner with family and friends or even colleagues. Your server greets you with a friendly smile as menus are passed around for everyone. It is an upscale restaurant. The tables are neatly covered and there are approximately 25-30 other guests also scanning the table fare.

As in any typical restaurant you see appetizers, soups and salads, sandwiches, a couple pages of main course dishes and a spectacular variety of deserts. The drink menu is separate because that too has a range stretching from premium bottled water to alcoholic beverages. Your server carefully catalogs everyone's choices, agrees to bring out your drinks and hurries off to the kitchen to pass your choices to the chef. Your group begins a mix of personal and business banter and you watch the other patrons do the same.

Give some quick thought to the following scenerio: Your group just placed a diverse order of appetizers, main courses, deserts and an incredible array of drinks. Look at everyone and quickly assess their choices and yours also. Now ask yourself a simple question:
"We are different people with different physical makeup and assorted health issues and we each had the opportunity to choose what we drink and choose what we eat. However, none of us, nor any other diner here this evening, has the opportunity to choose the air we breathe, do we?"

Did you know that pathogens, including fungi, bacteria, yeasts and viruses as well as non-volatile and non-viable particulates have limited access to the human body? Those choices are limited to ingestion, direct contact and, most critically, respiration which averages 11,000 liters per day. Think of this while eating your scrumptious meal.

Accordingly, the air we breathe contains a fairly consistent group of things. Nitrogen composes approximately 78% of standard air. Then we have 21% Oxygen, >1% other potential gases, >1% of Argon and approximately 0.04% Carbon Dioxide. If in fact, if this was the only combination of air that we breathe throughout our life contained; we would all be pretty healthy individuals. Unfortunately, both harmful and benign pathogens are structurally small enough and gravimetrically light enough that they can remain suspended in air for as long as 3-4 hours with very little air movement. They will eventually settle out and fall onto porous and non-porous surfaces. This means they will also end up directly on exposed skin surfaces of humans, allowing them internal access through a cut or minor scratch, a nasal passage or ingestion or simply contact with eye moisture. If we know this and we understand this concept then why has a positive solution been so difficult to define and execute?

How COVID reinforced the issue

We, scientists and engineers, have always been a bigger part of the problem than the solution.
Let me give you an analogy. Let's say you want to take a drive across country from Miami to Los Angeles. You're a special person! You decide to engage the top 4 or 5 automotive engineers in the world to design a specialized vehicle for your trip. Based on my 40+ years of affiliations with scientists and engineers, I would guarantee you that you will end up with a multi-million-dollar, futuristic, artificial intelligence-controlled vehicle that is one of a kind. The truth is , a currently available foreign or domestic sedan will get you there just as well.
My point is: the inability to recognize simple facts that produce repeatable outcomes and understand that complexity is not the answer is one of the leading factors which has hindered advanced pathogen control in buildings until now.

A study supported by the Medical Health Technology Project for Guangzhou, the Science and Technology Project of Guangzhou, and the Project for Key Medicine Discipline Construction of Guangzhou Municipality determined the following. Indications would substantiate claims that the virus initiated in China. The actual START location within China was not established and confirmed however.

From January 26 through February 10, 2020, an outbreak of 2019 novel corona-virus disease (COVID-19) affected 10 persons from 3 families (families A-C) who had eaten at the same conditioned restaurant in Guangzhou, China. One of the families had just traveled from Wuhan, Hubei Province, China. On January 23, 2020, family A traveled from Wuhan and arrived in Guangzhou. On January 24, the index case-patient (patient Al) ate lunch with 3 other family members (A2-A4) at restaurant X.

Two other families, Band C, sat at neighboring tables at the same restaurant. Later that day, patient Al experienced onset of fever and cough and went to the hospital. By February 5, a total of 9 others (4 members of family A, 3 members of family B, and 2 members of family C) had become ill with COVID-19. The only known source of exposure for the affected persons in families Band C was patient Al at the restaurant.

Restaurant X is an air-conditioned, 5-floor building without windows. The third-floor dining area occupies 145 sq m. each floor has its own air conditioner. The distance between each table is about 1 m. Families A and B were each seated for an overlapping period of 53 minutes and families A and C for an overlapping period of 73 minutes. The air outlet and the return air inlet for the central air conditioner were located above table C.

How COVID reinforced the issue

On January 24, a total of 91 persons (83 customers, 8 staff members) were in the restaurant. A total of 83 had eaten lunch at 15 tables on the third floor. Among the 83 customers, 10 became ill with COVID-19; the other 73 were identified as close contacts and quarantined for 14 days. During that period, no symptoms developed, and throat swab samples from the contacts and 6 smear samples from the air conditioner (3 from the air outlet and 3 from the air inlet) were negative for severe acute respiratory syndrome corona-virus 2 by reverse transcription PCR.

Virus-laden small (<5 μm) aerosolized droplets can remain in the air and travel long distances, and with COVID-19 particle sizes as small as 1 um, standard technology simply does not work. Potential aerosol transmission of severe acute respiratory syndrome and Middle East respiratory syndrome viruses had previously been reported. However, none of the staff or other diners in restaurant X were infected.

Moreover, the smear samples from the air conditioner were all nucleotide negative. This finding is less consistent with aerosol transmission. However, aerosols would tend to follow the airflow, and the lower concentrations of aerosols at greater distances might have been insufficient to cause infection in other parts of the restaurant.

A more in-depth analysis using simple physics equations of fluid mechanics coupled with the theories of Brownian Motion and statistical analysis seems to suggest the complete picture has not been sufficiently addressed. Based on the kinetic theory of aerosols, particles as large as 8 microns will stay in the air for 300 seconds traveling a distance of 1 meter. With as little air flow in an HVAC system of 1270 ft/minute those particle sizes can be airborne for as long as 5 minutes which is sufficient time to travel down extremely long lengths of air conditioning duct distribution systems.

Since the retention rate is actually logarithmic or exponential, the dwell time in moving air could be as long as 3 to 4 hours. Air change rates in buildings are dependent on numerous factors including type of construction, building conditioned space use, climatic conditions, ambient pathogen concentration levels and fan system efficiency. Needless to say, airborne particles as small as the COVID-19(SARS CoV2) virus have the ability to circulate and recirculate through a closed indoor environment repeatedly while still viable and maintaining a high rate of infective ability.

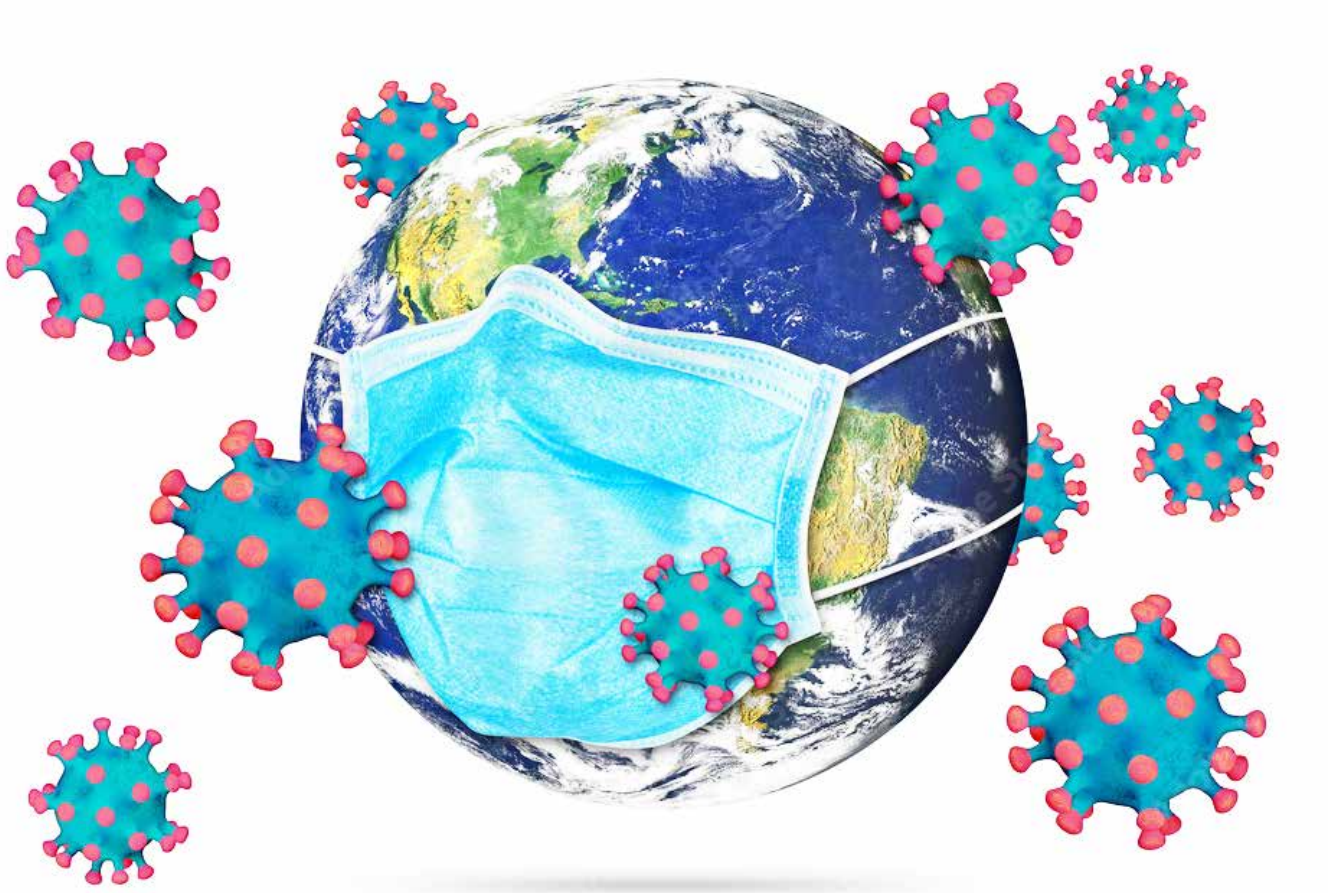
The Centers for Disease Control and Prevention now states explicitly that airborne virus can be inhaled even when one is more than six feet away from an infected individual. The new language, posted on the C.D.C's Website, is a change from the agency's previous position that most infections were acquired through "close

How COVID reinforced the issue

contact, not airborne transmission." As the pandemic unfolded, infectious disease experts warned for months that both the C.D.C. and the World Health Organization were overlooking research that strongly suggested the coronavirus traveled aloft in small, airborne particles.

Despite insistence that surface contamination was a prime source of COVI0-19 along with proximity to infected individuals almost no thought was given to transmission by aerosolization. We were repeatedly informed that there was no documentation to support this and only a vaccination was the answer.

NOTE: Several scientists on Friday, May 7, 2021, welcomed the agency's scrapping of the term "close contact," which they criticized as vague and said did not necessarily capture the nuances of aerosol transmission.



COVID Timeline

A brief timeline is detailed here to inform how it took seventeen (17) months for a government agency to make an announcement of a change in policy as to causation:

MARCH 2003. SARS Coronavirus virus breaks out in Hong Kong and spreads to Singapore. 8,098 confirmed cases.

APRIL 2009. HlNl Virus emerges in Mexico. 60.8 million cases globally.

SEPTEMBER 2012. MERS Virus emerges in Saudi Arabia. 2,602 confirmed cases.

DECEMBER 12, 2019. A cluster of 41 patients in Wuhan, Hubei Providence, China begins to experience shortness of breath and fever (reported but NOT documented).

JANUARY 5, 2020. CDC's National Center for Immunization and Respiratory Diseases (NCIRD) activates a Center Level Response for novel pneumonia of unknown etiology.

...over the next 17 months...
JANUARY 17, 2020. CDC begins screening passengers on direct and connecting flights from Wuhan, China at San Francisco, California, New York City, New York, and Los Angeles, California and plans to expand screening to other major airports.

JANUARY 20, 2020. CDC reports the first U.S. laboratory-confirmed case of COVID-19 in the U.S. from samples taken on January 18 in Washington state.

MARCH 11, 2020. The World Health Organization declares COVID-19 a pandemic.

APRIL10, 2020. The U.S. surpasses Italy as the global leader for reported deaths due to COVID-19 with 23,036 deaths.

MAY 28, 2020. United States coronavirus (COVID-19) death toll surpasses 100,000.

SEPTEMBER 22, 2020. United States coronavirus (COVID-19) death toll surpasses 200,000.

DECEMBER 14, 2020. United States coronavirus (COVID-19) death toll surpasses 300,000.

JANUARY 18, 2021. United States COVID-19 death toll surpasses 400,000.

FEBRUARY 21, 2021. United States COVID-19 death toll surpasses 500,000.

MAY 7, 2021. Several scientists on Friday, May 7, 2021, welcomed the agency's scrapping of the term "close contact", 11 which they criticized as vague and said did not necessarily capture the nuances of aerosol transmission.

MAY 2022. United States COVID-19 death toll reaches 1,000,000 (One Million).

Current Technologies
HEPA FILTRATION

By definition, a HEPA is a type of pleated mechanical air filter. It is an acronym for "high efficiency particulate air [filter]" (as officially defined by the U.S. Dept. of Energy). This type of air filter can theoretically remove at least 99.97% of dust, pollen, mold, bacteria, and any airborne particles with a size of 0.3 microns (µm). The diameter specification of 0.3 microns responds to the worst case; the most penetrating particle size (MPPS). Particles that are larger are typically trapped with higher efficiency. Using the worst-case particle size results in the worst-case efficiency rating (i.e., 99.97% or better for all particle sizes). All air cleaners require periodic cleaning and filter replacement to function properly. Follow manufacturer's recommendations on maintenance and replacement.

Minimum Efficiency Reporting Values, or MERVs, report a filter's ability to capture larger particles between 0.3 and 10 microns (µm). This value is helpful in comparing the performance of different filters
The rating is derived from a test method developed by the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) [see www.ashrae.org).

The higher the MERV rating the better the filter is at trapping specific types of particles.

MERV RATING	Average Particle Size Efficiency in Microns
1-4	3.0 – 10.0 less than 20%
6	3.0 -10.0 approximately 49.9%
8	3.0 – 10.0 approximately 84.9%
10	1.0 – 3.0 approximately 64.9%, 3.0 – 10.0 approximately 85% or greater
12	1.0 – 3.0 approximately 89.9%, 3.0 – 10.0 approximately 90% or greater
14	0.3 – 1.0 approximately 75%, 3.0 approximately 90% or greater
16	0.3 – 1.0 approximately 75% or greater

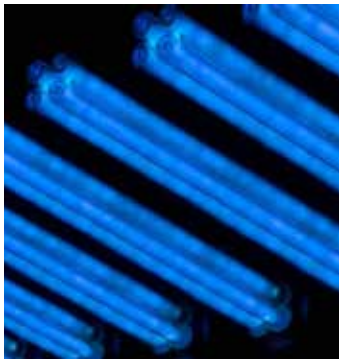
Current Technologies
HEPA FILTRATION

HEPA filtration is a common, inexpensive methodology utilized for air sanitization. There are obvious and glaring deficiencies related to viruses such as COVID, Influenza, Pneumonia and others. HEPA filters are designed to “trap” particulates. They are not designed to “kill” particulates which would include fungi, bacteria, yeasts and viruses. Multiple iterations have been created including coatings with TI02 (Titanium dioxide) and charcoal. Viruses such as the recent SARS-CoV-2 (COVID-19) Virus are approximately 1 micron in physical size. Even a HEPA filter rated at a MERV 16 rating has an approximation capture rate of only 75% leaving 25% exposure.

A typical MERV 16 or HEPA FILTER will require system alterations which is not always practical. Resistance to airflow is higher than the standard system configuration allows, can cause operational issues. During the cooling season the reduced air flow can cause insufficient system refrigerant evaporation resulting in a frozen coil. Once that happens the air flow is reduced to zero.

Regardless of system alterations or adaptations of air flow dynamics, you are still left with an expense for a system that does not prevent virus sized pathogens from transiting the filter. The ultimate outcome is an unprotected indoor environment.

Current Technologies
UV LIGHT IRRIDATION



Ultraviolet germicidal irradiation (UVGI) is a disinfection method that uses short-wavelength ultraviolet (ultraviolet C or UV-C) light to kill or inactivate microorganisms by destroying nucleic acids and disrupting their DNA, leaving them unable to perform vital cellular functions. UVGI is used in a variety of applications, such as food, surface, air, and water purification.

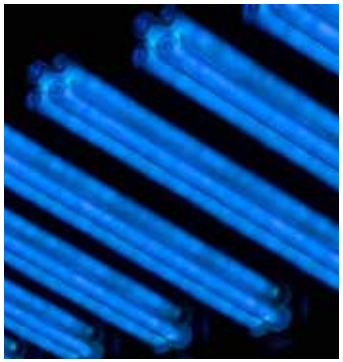
The application of UVGI for disinfection has been an accepted practice since the mid-20th century. It has been used primarily in medical sanitation and sterile work facilities. Wavelengths between about 200 nm and 300 nm are strongly absorbed by nucleic acids.. The absorbed energy can result in defects including pyrimidine dimers. These dimers can prevent replication or can prevent the expression of necessary proteins, resulting in the death or inactivation of the organism.

The effectiveness of germicidal UV depends on the duration a microorganism is exposed to UV, the intensity and wavelength of the UV radiation, the presence of particles that can protect the microorganisms from UV, and a microorganism's ability to withstand UV during its exposure. That is a huge downside to effectiveness right from the start.

In many HVAC systems, redundancy in exposing microorganisms to UV is achieved by circulating the air repeatedly. This ensures multiple passes so that the UV is effective against the highest number of microorganisms and will irradiate resistant microorganisms more than once to break them down. This necessity of redundant exposure is negated by constant reintroduction of mandated fresh air makeup already containing additional pathogens. The effectiveness of this form of disinfection depends on line-of-sight exposure of the microorganisms to the UV light. Environments where design creates obstacles that block the UV light are not as effective. In such an environment, the effectiveness is then reliant on the placement of the UVGI system so that line of sight is optimum for disinfection.

Use of the word, "sterilization" is often misquoted as being achievable. While it is theoretically possible in a controlled environment, it is very difficult to prove and the term "disinfection" is generally used by companies offering this service as to avoid legal reprimand. Specialist companies will often advertise a certain log reduction instead of sterilization. This takes into consideration a phenomenon known as light and dark repair (photoreactivation and base excision repair, respectively), in which a cell can repair DNA that has been damaged by UV light.

Current Technologies
UV LIGHT IRRIDATION



While there is partial application of this process, limitations include the following:

- A distance of approximately 1 meter away from a UV light, drops the efficacy exponentially.
- In a ducted HVAC system, UV light does not radiate down a long duct, around a corner, up a riser and down into multiple diffuser outlets.
- Buildup of “bio-burden” (particulates) on the bulb will decrease efficacy.
- Bulbs need to be changed regularly to make up for loss of efficacy and efficiency.
- The function in an HVAC unit known as “bypass air” is essentially air that did not come in contact with the bulb output.
- ALL commercial applications are mandated to include fresh air makeup. Since UV light does not kill everything on the first pass, the system will always have pathogens that do not come in UV contact and thereby remain viable.

Current Technologies
BIPOLAR IONIZATION

Bipolar ionization (also called needlepoint bipolar ionization) is a technology that can be used in HVAC systems or portable air cleaners to generate positively and negatively charged particles. This is an emerging technology, and little research is available that evaluates it outside of lab conditions. As typical of newer technologies, the evidence for safety and effectiveness is less documented than for more established ones. Unfortunately, Bipolar ionization has the potential to generate ozone and other potentially harmful byproducts indoors, unless specific precautions are taken in the product design and maintenance. If you decide to use a device that incorporates bipolar ionization technology, the EPA recommends using a device that meets UL 2998 standard certification (Environmental Claim Validation Procedure (ECVP) for Zero Ozone Emissions from Air Cleaners).

With limited documentation as well as emerging field reports of ineffectiveness it is not the safest, most effective methodology available for building protection:

- Bipolar Ions are essentially plasmas. Plasmas are created by the ionization of atoms and molecules. The mechanism and devices used to create plasmas are either through the use of electric arcs or plasma torches, which require a very high current source.
- All arc discharges will have to be created in every HVAC duct where the Bipolar Ion needle point discharges are installed.
- Ions or plasma particles are not usually stable and often recombine to become neutral atoms and molecules in very short durations.
- In Bipolar Ion devices used to decontaminate a building, an appreciable fraction of these Ions will recombine, Those recombined Oxygen and Nitrogen atoms and molecules lose their effectiveness in combating the Covid 19 Viruses.
- Using the air in a ductwork which has a significant amount of Oxygen, Nitrogen, and Carbon Dioxide could generate a significant amount of Oxygen plasmas which has a good potential of formation of Ozone (03) over an extended period of time. Ozone can be toxic to humans, especially in the amounts required to kill airborne pathogens.
- Plasma generation devices are expensive to manufacture and market and as such Bipolar Ions machines are costly.
- Bipolar Ionization can take as long as 472 minutes to “possibly” do the same thing as recently introduced, Nobel Prize nominated technology and therefore Bipolar Ionization is not a workable device to eliminate Covid19 viruses in a room.

Current Technologies
ROOM AIR FLUSHING

An air flush or building flush is a technique whereby air is forced through a building after construction and prior to occupancy in order to remove or reduce pollutants such as VOCs and particulate matter, inadvertently introduced indoors during construction. The onset of the COVID pandemic resulted in some engineers and engineering associations to modify and adapt the technique as a means of purging pathogens from the indoor environment. Original requirements are:
A building air flush is performed while maintaining an indoor temperature of at least 15 °C [59 °F] and relative humidity below 60%, at one of the following volumes:
1. An air volume of 4,266 m3 of outdoor air per m2 of floor area [14,000 ft3 per ft2] prior to occupancy.
2. An air volume of 1,066 m3 of outdoor air per m2 of floor area [3,500 ft3 per ft2] prior to occupancy, followed by a second flush of 3,200 m3 of outdoor air per m2 of floor area [10,500 ft3 per ft2 of floor area] post-occupancy. While the post occupancy flush is taking place, the ventilation system must provide at least 0.1 m3 per minute of outdoor air per m2 of floor area [0.3 CFM outdoor air per ft2 of floor area] at all times.

The concept has been modified with the idea that pathogens during occupied hours can and will increase in relation to occupant number and individual's health. The premise is correct but many variables are not taken into consideration. It was originally designed for new or renovated construction prior to daily occupancy. Occupancy in different regional and climatic conditions will require different energy consumption to provide a workable indoor environment at different times of the year. Energy consumption in Minnesota in January to maintain a heated space conducive to occupancy will be dramatically different than a similar building located in Florida. Regional costs of electricity, oil or gas will vary with location and demand - heating or cooling. Key factors for eliminating this technique include:

- The cooling load of any air-conditioned building has two components - cooling and dehumidifying. The Physics of Psychometrics ensues that any additional flushing of a building and replacing that volume of air with the introduction of outside air will greatly increase the latent cooling load requirements in any air-conditioned building.
- Replacement air intake will increase the amount of humidity and raise temperatures inside during summer.
- The higher frequency of operation will require additional amount of electricity.
- It will also provide a situation where any fungi achieve maximum ability to replicate
- Large costs to heat buildings due to the replacing flushed air with 'new'.

Building Air Flushing will never sufficiently address mitigation of pathogen matrices that vary by building size, configuration, occupancy and/or use.

A new approach
NOBEL PRIZE NOMINATED ANALYSIS AND TECHNOLOGY

The realization that antiquated scientific thought hindered progress was an impetus to step back and do some, what may be referred to within engineering as "oddball thinking." on the part of Dr Martin, Ph.D. All engineers agree that some things are definite and irrefutable, however one contrasting movement related to indoor pathogenic bio-aerosols is the application of The Brownian Theory of Motion and embraced by Dr Martin. The Brownian Theory of Motion describes how particulates move about within a medium in random fashion. That medium could be air or water but the theory has proven to be the same regardless of the medium applied.

Microscopic pathogenic bio-aerosols will move about randomly with no definitive pattern identified, planned on or depended upon. Compare The Daytona 500 Race where cars are moving around in a fixed pattern to the Bumper Cars at the amusement park where random interaction results in random direction.
No scientist or engineer, despite education or experience, will ever design a solution based on randomness and that originally included Dr. Martin until he sought to challenge current thought process. Instead of fighting randomness and wasting time and energy, why not use it to one's advantage. He had already developed, tested and received approval of a Certified Organic Input anti-pathogenic solution developed for disinfecting porous and non-porous surfaces, developed it as a unique tool in his consulting arsenal related to Infection Control.

Dr. Martin's Journey

The month of February 2003 brought an outbreak of severe acute respiratory syndrome (SARS) to the shores of Singapore. It had apparently started in Foshan in Guangdong, China with the first reported case being seen on 16 November 2002. It had spread quickly throughout China and worldwide as far as Canada. It was finally active in Singapore in May of 2003 with 33 reported deaths. I was working close by in Malaysia on issues related to Infection Control in hospitals and other building types at that time.

My work had already been recognized at that time with 1st Place Technology Awards issued by the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) for both Existing Institutional Buildings and Existing Health Care Facilities. Energy User News Magazine had also recognized my work with an award for The Most Efficient Building in The Nation.

After some consultation with my brother, a Naval Architect by training with an interest in Plant Pathology, I set a goal to develop an Organic Based Solution effective against a wide variety of Fungi, Bacteria, Yeasts and

A new approach
NOBEL PRIZE NOMINATED ANALYSIS AND TECHNOLOGY

Viruses in order to break the cycle of chemical/drug sanitization and disinfection of buildings and their HVAC (Heating, Ventilation, Air-Conditioning) systems. That was a four (4) year process.

I was still working in Malaysia and S.E. Asia in 2009, when the HlNl (Swine Flu) epidemic arrived there by transfer overseas students. The original source of the HlN1 epidemic was traced to swine located in a small region of Central Mexico. According to W.H.O, approximately 13,900 deaths in Malaysia were attributable to the HlNl virus. At that time, I was six (6) years into research and development of the A.P.A.S.® Solution® line of products and had it tested locally by a department of the Malaysian Government with stunning success against the HlNl virus.

Since those early research and development days, I have been joined by my son Kevin in this work. Kevin is a double Master's Degrees' graduate of Florida State University. As a team we have developed several derivatives of our original formulation. Laboratory tests conducted around the world as well as in the United States have yielded superior efficacy against numerous pathogens including the recent COVID-19 (SARS CoV2) variant. This has been done with an Organic Based, Non-GMO, Drug and Alcohol-Free solution that has no added chemicals during or after the compounding process.

Actual product content is listed on the FDA GRAS, Generally Regarded as Safe list or lists issued by the USA EPA with content approved for use in various pathogen fighting formulations. The extremely high efficacy is coupled with toxicity levels lower than anything else readily available. Exponential product content efficacy is the result of a proprietary process where sequencing of product compounding is regulated, and the times, temperatures and pressures of each stage are carefully and critically adjusted and monitored. Product use in now global in various market segments.

Today and Moving Forward

We have continued to innovate, adjust, modify and respond to ever changing attacks on multiple market segments by pathogenic Fungi, Bacteria, Yeasts and Viruses. Success with the current COVID-19 (SARS CoV2) virus is a prime example of how our persistence is bringing better health through food and bio-security to the global community has paid off. Laboratory documentation can be found on this web site, www.A.P.A.S.®.com. We continually seek out specialized expertise wherever and whenever possible that will help enhance what we have continued to do since the inception of the original project. Our global contacts and global work experiences have allowed us to introduce and incorporate both traditional as well as non-traditional healing techniques into our product development.

A new approach
NOBEL PRIZE NOMINATED ANALYSIS AND TECHNOLOGY

We have adapted how the product is applied based on the intended end use. The end use is determined by market segment. We have been successful in our primary goal which is the development of healthy indoor environments. We have also had tremendous success in the agricultural field, the textile industry, the poultry industry, helping to provide safe transportation on airlines and in the animal husbandry marketplace.
We are currently working with several medical institutions and scientists extending our reach beyond just safe facilities. We have made significant progress in the "human wellness" arena with a wide variety of product applications for personal sanitization, skin care and wound care.

Our philosophy of inclusiveness of global knowledge of both modern and ancient traditional healing, combined where appropriate, has brought breakthrough results to benefit all. An undeniable track record of efficacy and success related to people, plants and animals is testament to the truthfulness of the primary philosophy of "Utilizing Nature to Relieve Nature's Ills."

Recent successful tests at a USA CDC Approved Lab include:

- Severe Acute Respiratory Syndrome related Coronavirus 2 (SARS-CoV2) COVID-19 Strain NIBRG-14
  Success in Less than two (2) Minutes
- AOAC Germicidal Spray Test Healthcare
  Staphylococcus aureus ATCC 6538
  Pseudomonas aeruginosa ATCC 15442
  Salmonella enterica ATCC 10708
  Success in less than two (2) minutes
- Avian Influenza Virus (HSN!) Strain NIBRG-14
  Success in ten (10) minutes or less
- Influenza A Virus {HlNl) Strain A/PR/8/3
  Success in ten (10) minutes or less

Numerous other pathogen lab tests available on request.

A new approach
NOBEL PRIZE NOMINATED ANALYSIS AND TECHNOLOGY

Issues Related to Common Chemical Disinfectants

The American Chemical Society recently conducted a research project investigating Increased Indoor Exposure to Commonly Used Disinfectants During the COVID-19 Pandemic. This can be found at https://doi.org/10.1021/acs.estlett.0c00587

Disinfecting products containing quaternary ammonium compounds (QACs), also termed "quats", are recommended by the United States Centers for Disease Control and Prevention (CDC) and Environmental Protection Agency (EPA) for disinfecting procedures specifically targeting SARS-CoV-2. QACs make up the major class of disinfectants and antimicrobials used in cleaning products, biocides, personal care products, and biomedical materials. QACs are salts of quaternary ammonium cations with at least one long hydrophobic hydrocarbon-chain substituent and other short-chain substituents, such as methyl or benzyl groups.

Exposure to QACs has been associated with several adverse health effects. QACs are recognized as asthmagens, as previous animal and occupational studies have demonstrated that exposure to QACs may lead to a significant increase in asthma triggers and other breathing problems, such as pulmonary cell damage and inflammation. Skin irritation and decreased fertility were observed in rodents and guinea pigs exposed to some QACs through inhalation and diet. In addition, QACs increase the permeability of outer membranes of living organisms and their long-term use may disrupt the protective lipid membranes of the skin and potentially increase the absorption of toxic substances.

Hence, the increased use of household disinfectants and other cleaning agents containing QACs during the COVID-19 pandemic is of significant concern.

The S4 System A.P.A.S.® Combination Technology

Progress and innovation are the result of communication. What and how we describe our technology is important but more important is how we listen. Our ability to adapt and improve is directly proportional to our ability to receive suggestions, analyze them and evaluate their importance.

On a consulting trip to Riyadh, Kingdom of Saudi Arabia, at the invitation of His Royal Highness Dr. Prince Mohamed Faisal Bin Abdul Aziz Al Saud, to review some Infection Control issues at King Fahad Medical Center, our product delivery mechanism became more focused. Manual application of the any product to HVAC systems has always been subject to human error.

Our standard Project Protocol is to collect biological and chemical samples to identify and quantify the individual pathogens and chemicals and structure protocol prior to application of A.P.A.S.® Anti-Pathogenic Aerosol Solution®.

Guidelines exist that set maximum exposure to for those items by human occupation and those exposure limits vary by conditioned space usage. Once the offending items are cataloged, we determine how much product is necessary for pathogen neutralization. Product application by frequency and amount is then organized into a maintenance protocol. Long term success of the project is determined by strict adherence to the protocol.

With the goal of overcoming the shortfalls of human application error, we began designing a unit that would automatically infuse the proper amount of product at a frequency determined to mitigate the offending pathogen matrix present.

Historically, a Hospital Project under consideration consisted of seven (7) industrial sized air handlers in one mechanical room it was decided that I would design a unit to do all of them. Configuring a single unit with seven (7) separate requirements for product infusion due to separate portions of the hospital served to be become a challenge to overcome with new invention.

From an engineering standpoint is was a simple matter to determine product infusion rate and frequency for each section of the hospital after reviewing individual laboratory results. Incorporation of individual department components including individualized control and fluid dynamics resulted in a system design of unwieldy proportion, maintenance complexity and inflated costs. It was decided to conceptualize a smaller, single unit per air handler. The result of that thought process is the current day S4 System®.

The S4 System A.P.A.S.® Combination Technology

The Science

Utilizing the Brownian Theory of Motion, defined as, "The erratic random movement of microscopic particles in a fluid, as a result of continuous bombardment from molecules of the surrounding medium" our team has developed a way to use this principal to micro-infuse millions of molecules of our organic, extremely high efficacy, botanical based product into and onto the surfaces of the buildings HVAC system so that any pathogenic bio-aerosols such as viruses, fungi, bacteria, yeasts and non-viable particulates such as pollen will come into contact with each other through circulation and recirculation of the air within the occupied space.

When a molecule of high efficacy contacts a unit of viability such as a virus, fungal, bacteria or yeast the viable unit's ability to reproduce is disrupted and destroyed. Similarly, non-viable items such as pollen have their capability to be allergenic negated. Dry air is composed of approximately 78% nitrogen, 21% oxygen, 1% argon, carbon dioxide, water vapor and a minute amount of other gases. Non controllable factors contribute to that healthy air also containing a very large variable amounts of viruses, fungi, bacteria, yeasts, plant pollen and numerous other potentially harmful disease carrying particulates.

The key to keeping building occupants safe and healthy is the ability to provide Proactive Pandemic Protection automatically, constantly and safely with innovative technology that is "Organic based, Non-GMO, Tested, Proven and Approved." Combined with a specially developed, botanical/organic based solution there is no product or system available today to match the efficiency, efficacy, longevity or ease of installation of The S4 System®. USA-CDC Approved Laboratory results indicate a kill time against COVID-19(SARS) CoV-2 of "TWO MINUTES OR LESS." Numerous other pathogens have also been tested for with similar results.

Added capabilities include the following.

VOC Control

VOCs, Volatile Organic compounds are responsible for the odor of scents and perfumes as well as pollutants. VOCs play an important role in communication between animals and plants, e.g., attractants for pollinators, protection from predation, and even inter-plant interactions. Some voes are dangerous to human health or cause harm to the environment. Anthropogenic VOCs are regulated by law, especially indoors, where concentrations are the highest. Most VOCs are not acutely toxic, but may have long-term chronic health effects. Concentrations of voes in indoor air may be 2 to 5 times greater than in outdoor air, sometimes far greater. During certain activities, indoor levels of voes may reach 1,000 times that of the outside air.

The S4 System A.P.A.S.® Combination Technology

Studies have shown that emissions of individual VOC species are not that high in an indoor environment, but the total concentration of all voes (TVOC) indoors can be up to five times higher than that of outdoor levels.

Health Risks

Respiratory, allergic, or immune effects in infants or children are associated with man-made VOCs and other indoor or outdoor air pollutants. Some voes, such as styrene and limonene, can react with nitrogen oxides or with ozone to produce new oxidation products and secondary aerosols, which can cause sensory irritation symptoms.

Health effects include eye, nose, and throat irritation; headaches, loss of coordination, nausea; and damage to the liver, kidney, and central nervous system. Some organics can cause cancer in animals; some are suspected or known to cause cancer in humans. Key signs or symptoms associated with exposure to VOCs include conjunctiva! Irritation, nose and throat discomfort, headache, allergic skin reaction, dyspnea, declines in serum cholinesterase levels, nausea, vomiting, nose bleeding, fatigue, dizziness.

Accurate measurements conducted in a typical S4 System® building installation utilizing an Automated Logic Building Environmental Control System conclusively proved that while the system was in operation values under 200 ppb were seen all day long dropping as low as 50 ppb. When the system was off, levels climbed to 400-800 ppb. The trend showed the particle count has been below 30 micro/grams per cubic feet all the time. It has gone as low as 5-6 micro/grams per cubic feet. When the system was turned off for any period of time the particle count climbed above 50 micro/grams per cubic feet.

Non-Viable and Non-Volatile Particulates

Non-Viable and Non-Volatile particulates are outside the realm of Fungi, Bacteria, Viruses and Yeasts but can pose serious health hazards. The main entryway into the human body is through respiration. Commonly found items in enclosed spaces include skin cells, carbon particulates, pollen, starch particles, fiberglass particles and others. "Particulate matter," also known as particle pollution or PM, is a complex mixture of extremely small particles and liquid droplets. Particle pollution is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles.

The size of particles is directly linked to their potential for causing health problems. EPA is concerned about particles that are 10 micrometers in diameter or smaller because those are the particles that generally pass through the throat and nose and enter the lungs. Once inhaled, these particles can affect the heart and lungs

The S4 System A.P.A.S.® Combination Technology

and cause serious health effects if they are toxic.

The size of the particle is the main determinant of where in the respiratory tract the particle will come to rest when inhaled. Larger particles are generally filtered in the nose and throat via cilia and mucus, but particulate matter smaller than about 10 micrometers, can settle in the bronchi and lungs and cause health problems. The 10-micrometer size does not represent a strict boundary between respirable and non-respirable particles but has been agreed upon for monitoring of airborne particulate matter by most regulatory agencies. Because of their small size, particles on the order of 10 micrometers or less (coarse particulate matter, PMl0) can penetrate the deepest part of the lungs such as the bronchioles or alveoli. When asthmatics are exposed to these conditions it can trigger bronchoconstriction.

Similarly, so called fine particulate matter (PM2.5), tends to penetrate into the gas exchange regions of the lung (alveolus), and very small particles (ultrafine particulate matter, PM0.l) may pass through the lungs to affect other organs. The smallest particles, less than 100 nanometers (nanoparticles), may be even more damaging to the cardiovascular system. Nanoparticles can pass through cell membranes and migrate into other organs, including the brain.

Recent S4 System installations have been accurately measured to reduce items such as skin cells, carbon particulates and starch particles in excess of 99.99%. Fiberglass particulates have been measured at zero in post installation S4 System projects. The S4 System® continues to exceed all design and engineering parameters on a regular basis for both pathogen control and critical VOC, Non-Viable and Non-Volatile Particulate reduction and control, both which can be serious health hazards under the right conditions.

Equipment Investment

Control Module

The S4 System proprietary sequence of operation is built into a compact pumping and control module that can be installed inside your Central VAC Air Handler, on the exterior or on an adjacent wall. This module is designed to input only one authorized organic based product effective solution against harmful pathogens. Our proprietary sequencing of frequency and amount of product input has been scientifically tested in more than 4,000 buildings worldwide. This assures clients of maximum results with minimum costs.

Dispersion Nozzle

Based on the micron size output we require to maximize the Brownian Motion effect, the S4 System dispersion nozzle was designed and selected to work only with our component package. There are multiple

The S4 System A.P.A.S.® Combination Technology

options for mounting the dispersion nozzle based on a client's particular air handler configuration.

Foot Valve
To ensure a proper fluid pickup and delivery to the pumping and control module, S4 System engineers designed the Foot Valve with a weighted bottom so it will stay upright in the fluid reservoir. It has been designed with no moving parts for trouble free, dependable operation.

Industry Dominating Technology and Results - Research

All S4 System dominant industry technology has been centered around the concept of extraordinary results coming from restructuring of the process with emphasis on the organic input material content. What do we mean by that? Our A.P.A.S.® Anti-Pathogenic Aerosol Solution® is composed of readily available, pre-approved individual content. The exponential efficacy it produces is the result of our closely held IP, Intellectual Property, related to the development process.

During the four year development process combined with field testing globally under varied climatic conditions, the sequence of compounding underwent frequent positive as well as negative changes. Ingredient sequencing was easy to change but what was really challenging was changing the time, temperature and pressure of each stage to enhance the content interaction to produce

The following pathogens were selectively tested. The reasoning was that we have numerous laboratory tests from around the world on these items for results on surfaces. The emphasis on efficacy in air, before the pathogens could be respirated, has been a desire for quite some time. We have utilized a particular USA based lab to construct a special chamber for testing product specifically for airborne efficacy. The following bacteria were tested:

Escherichia Coli
This bacteria is a Gram-negative, rod shaped, facultative anaerobe commonly found in the gastrointestinal tract of mammals. Although most serotypes of this microorganism are harmless there are pathogenic groups of coli such as enterohemorrhagic (EHEC), verocytotoxin producing (VTEC) and Shiga-like toxin producing (STEC) that can cause a multitude of illnesses. E. coli is relatively susceptible to disinfection when dried on a surface, yet it can be a challenging microorganism to mitigate in solution.

The S4 System A.P.A.S.® Combination Technology

Staphylococcus Aureus 6538
This bacterium is a Gram-positive, spherical-shaped, facultative anaerobe. Staphylococcus species are known to demonstrate resistance to antibiotics such as methicillin.5. aureus pathogenicity can range from commensal skin colonization to more severe diseases such as pneumonia and toxic shock syndrome (TSS). 5. aureus is commonly used in several test methods as a model for gram positive bacteria. It can be difficult to disinfect but does demonstrate susceptibility to low level disinfectants.

MS2 Bacteriophage (MS2), ATCC 15597-8 1
This virus is a non-enveloped positive-stranded RNA virus of the bacteriophage family Leviviridae. Bacterial cells are the hosts for bacteriophages, and E.coli 15597 serves this purpose for MS2 bacteriophage.Its small size, icosahedral structure, and environmental resistance has made MS2 ideal for use as a surrogate virus (particularly in place of picornaviruses such as poliovirus and human norovirus} in water quality and disinfectant studies.

Permissive Host Cell System for MS2: Escherichia coli, 15597 - Summary of the Procedure
- Test microoganisms were grown on appropriate media.
- Cultures used for test inoculum were evaluated for sterility, washed, and concentrated in sterile phosphate buffered saline upon harvesting.
- All Cultures were pooled together into a single conical.
- The test inoculum was split into two equal parts of 20.0 ml and added to the appropriate number of nebulizers.
- The Test Substance was setup per Study Sponsor requirements and operated per Sponsor instructions.
- The chamber was setup and the safety checklist was completed prior to test initiation.
- Test was initiated by aerosolizing the microorganisms per the nebulizers and allowing the concentration to reach the required CFU/m3 or PFU/m3
- Once the concentration was reached, a time zero sample was taken then the device was run for the specified contact time and an additional sample was taken for each contact time.
- The decontamination process was run, 2-4 hours of UV exposure, prior to any scientists entering the testing chamber.
- Samples were enumerated using standard dilution and plating techniques.
- Microbial concentrations were determined after appropriate incubation times.
- Reductions of microorganisms were calculated relative to concentration of the time zero or corresponding control run sample as applicable.

The S4 System A.P.A.S.® Combination Technology

Because the droplet micro vaporization results in molecular size and weight droplets which can stay entrained for up to three (3) hours it was determined that test results would be calculated at 20-, 40- and 60-minute intervals. Results are shown below.

Test Microorganism	Time Point	Average CFU per Cubic Meter	Log 10 Reduction	% Reduction Compared To Time Zero
Escherichia coli ATCC 8739	Time Zero	8.49E+06	N/A	N/A
	20 mins	<8.85E+01	>4.35	>99.99896%
	40 mins	<8.96E+01	>4.98	>99.9989%
	60 mins	<8.96E+01	>4.98	>99.89%

Test Microorganism	Time Point	Average CFU per Cubic Meter	Log 10 Reduction	% Reduction Compared To Time Zero
Staphylococcus Aureus ATCC 6538	Time Zero	1.76E+08	N/A	N/A
	20 mins	<8.85E+01	>6.30	>99.999950%
	40 mins	<8.96E+01	>6.29	>99.99994%
	60 mins	<8.96E+01	>6.29	>99.999949%

Test Microorganism	Time Point	Average PFU per Cubic Meter	Log 10 Reduction	% Reduction Compared To Time Zero
MS2 *Bacteriophage* ATCC 15597-B1	Time Zero	1.31E+09	N/A	N/a
	20 mins	3.03E+05	>3.64	>99.98%
	40 mins	3.66E+03	>5.55	>99.9997%
	60 mins	4.25E+03	>5.49	>99.99968%

CONCLUSIONS

This Nobel Prize nominated work resulted in a Pathogen Control System composed of materials and methodology currently unrivaled anywhere for efficacy protection 24/7/365. Other products and systems available produce a wavering graph of efficacy. The S4 System® + A.P.A.S.®® is the only system available that will 'flat-line' a reduction and/or elimate dangerous, life-threatening pathogens within an enclosed space.

The S4 System A.P.A.S.® Deployments

Partial Country Client List

Australia
Bangladesh
Bermuda
Canada
China
Columbia
Costa Rica
Denmark
Guam
Hong Kong
Indonesia Kenya
Laos
Malaysia
New Zealand
Nigeria Panama
Philippines
Saudi Arabia
Singapore
South Africa
Thailand
United Arab Emirates
United States
Vietnam

Other Venues

Hotels and Schools
Retail and Malls
Religious Facilities
Restaurants
Apartment Complexes
Entertainment Venues
Sports Complexes / Fitness Centers
Commercial Gathering Halls

Partial Medical Facility List

King Fahad Medical City. Saudi Arabia
El Amin General Hospital. Saudi Arabia
Glen Eagles Hospital. Malaysia
Pantai General Hospital. Malaysia
Sultan Ismail Hospital. Malaysia
Center for Chronic Disease Control. China
Mission Health Care. USA
Houston Health Care. USA
Trident Medical (3 facilities). USA
Colleton Medical Center. USA
Summerville Medical Center. USA
Mission Memorial Would Care. USA
Bayfront Medical Center Hospital. USA
St. Anthony's Hospital. USA
Sheridan Dental Clinic. USA
Hospital Dialysis Center. USA
St. Petersburg General Hospital. USA
Asheville Neurology. USA

Textile Manufacturing & Distribution

Philips Van Heusen (500+ locations)
Wuxi Jinmao Limited Company. China
Beximco Fashions Limited. Bangladesh
Azim Group Garments Division. Bangladesh
East Dye Limited Company. China

Insurance Companies

The Hartford Insurance
Auto Owners Insurance
State Farm Insurance
Nationwide Insurance
Allstate Insurance
The Travelers Insurance
Liberty Mutual Insurance
Farmers Insurance
Prudential Insurance
Amica Mutual Insurance
Erie Insurance

Satori is the prime distributor
for the S4 System and
A.P.A.S.® Solution.

Satori offices and distribution
centers are located in
Florida and Texas.

Designed and manufactured
in the USA.

SATORI
CLEAN AIR SYSTEMS™

www.satoricleanairsystems.com
817-822-6387
14311 Biscayne Blvd #3370
North Miami, FL, 33181-3370