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Edward NEISTER

Sterilray

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(May 4, 2008)

Shining Light on Dirty Subject

Invention could solve resistant disease dilemma; MRSA to dust mites tremble

Ed Neister's been working to clean up people and the environment for over 30 years.

Five startup companies and numerous inventions later, the New Durham resident's newest venture arguably has the most potential yet for business success. More importantly, it could help health care professionals tackle the increasing scourge of drug-resistant infections, saving billions of dollars and countless lives.

Tucked away for the last few years in his backyard workshop off Brackett Road, Neister has developed the technology to kill Noroviruses, C. diff, MRSA and other problem viruses and bacteria using a section of the ultraviolet light, or UV, spectrum to bombard them with killing high-energy photons.

With the help of his brother John, he is ready to begin producing mobile disinfection units that will be marketed under the Sterilray name.

Several of the units have been sold and are being tested in this country and abroad.

The Neisters say their own research shows Sterilray is astoundingly effective, up to 10,000 times more deadly than chemical cleaners. But they are waiting for results from government and private industry now trying out the new units, and for word to spread that Sterilray performs as advertised.

Then the market for their hand-held disinfection wands could be worldwide — and huge.

"In the medical area, everybody wants to see results first," said Ed Neister, who formed Healthy Environment Innovations LLC four years ago to produce Sterilray. He first called it GermBuster but since has changed the name.

The physicist left his fifth startup, Powerspan, to devote himself to finding a solution to so-called "superbugs" using light waves.

Powerspan develops environmental control technology for electric power plants and is headquartered just down the road from Neister's home and workshop. Before that, his other ventures have included a laser device that removes tattoos.

Light has been a specialty of his since his doctoral studies at Brandeis University, and he did research with lasers at AVCO and later Honeywell.

The problem

The problem Sterilray targets has been quietly growing in hospitals worldwide as overuse of antibiotics has created strains of resistant microorganisms that cause everything from annoying intestinal distress in the case of the Norwalk virus to staph infections that can kill weakened patients.

Several years ago, health officials began to see infections occurring outside hospitals. There is new awareness that adequate cleaning is needed not just in hospitals but also hotels, workplaces and public gathering places such as cruise ships.

In recent testimony before the congressional House Committee on Government Oversight and Reform, Dr. Betsy McCaughey, chairman of the Committee to Reduce Infection Deaths, urged the government to do more to halt the spread of hospital infections.

She said in 1993, there were fewer than 2,000 reported MRSA infections in U.S. hospitals. By 2007, 880,000 cases or 2.4 percent of all patients, were infected. MRSA stands for methicillin-resistant staphylococcus aureus, a staph superbug.

McCaughey said MRSA and other resistant bacteria increasingly are present in hospitals and the government is not adequately monitoring infection rates.

"As long as hospitals are inadequately cleaned, doctors' and nurses' hands will become recontaminated seconds after they wash and glove, as soon as they touch a keyboard, or a privacy curtain or a bedrail. How dirty are hospitals? A recent survey of 49 operating rooms in four New England hospitals found that over half the surfaces in the operating room that were supposed to be disinfected by hospital cleaners were left uncleaned," said McCaughey.
Even with awareness, thoroughly cleaning an infected surface is difficult.

The most common method has been to use a solution of various disinfecting chemicals and water, often a 10 percent bleach solution.

In other applications, such as sewer plants, ultraviolet light has been used for years to incapacitate germs by exposing water to UV rays in what is known as the "germicidal" spectrum. This works by interfering with the germ's DNA so it cannot reproduce. This can come undone, however.

Neister became interested in light as a disinfectant after news of a persistent problem with the Norwalk virus on cruise ships. After research in conjunction the University of New Hampshire, he found that by directing photons from the "far" UV spectrum he not only inactivated the germs' DNA but actually broke it up, killing them.

Excited by his findings, Neister began working on manufacturing a small device that could generate far UV in a mobile disinfecting unit. He has applied for and has had 22 patents accepted related to the Sterilray light wand.

Once he had a viable device, Neister sought out a laboratory to do further testing on a range of problem germs.

Jim Barbato, president, of Microbiology Research Associates, in Acton, Mass., said his lab put various problem microorganisms in petri dishes and briefly exposed them to Neister's device. The results were very promising.

"As microbiologists we don't get too excited about things, and it was rather astounding to see how it killed microorganisms so quickly. We got excited about this," said Barbato. "They were able to kill almost 100 percent."

Infectious microorganisms now are dealt with using chemicals, heat or radiation. These have to be handled properly and can be toxic, said Barbato. He said Neister's device has an advantage in that it's dry and fast. It also avoids the resistance cycle that has created superbugs.

"It's almost equivalent to hitting them with a bomb. They're not going to develop a resistance," said Barbato.

Small and light

Once Neister knew he'd found the right UV frequency, he focused on designing a functional device that could be carried from room to room and easily used by a cleaning worker.

The first prototype of his light wand weighed 11 pounds. Neister since has reduced it to 4 pounds.

It looks like a clothes iron with a thin light bulb tucked into its hot iron end.

The wand emits a purplish light that is shined 2 to 6 inches above a surface to disinfect it. Results take less than a second. Its power comes from the larger power pack the wand is stored in.

So far, Neister plans to produce two styles of the Sterilray.

One power pack is the size of a heart monitor machine and can be wheeled around a facility. Another is the size of a vacuum and can be strapped on like a backpack.
Each style has its accompanying hand-held wand.

They will not be cheap, costing roughly $26,000 each. But the cost should come down as more units are produced.

Younger brother John, 58, is retired from publishing sales, and has joined Ed in the venture as executive vice president. He comes up from his home in Lincoln, Mass., several days a week to help market Sterilray.

One unit is being tried by a Veterans Affairs hospital in California, and several more have been sold to a sales representative in England.

John leaves soon for Mexico to deliver another Sterilray to a potential distributor. Once results start coming in from these first units, he believes sales will follow. Here in the U.S., there has been more interest among food establishments than from hospitals, which frustrates John.

"They seem to feel that infection in hospitals is inevitable, and we think it is preventable," he said. "The surfaces are dirty and people are getting sick."

Wound cleaning is another potential application for the device. The Neisters have other plans to market Sterilray for cleaning homes and offices and are working on a version that will treat air ducts. They are looking for distributors and may consider franchising.

Ed believes his far UV frequency also will kill dust mites and allergens. Soon he plans to begin offering a home disinfection service for $100. Information about this will be available at www.sterilray.com.

After years out of the limelight in his workshop, Ed is ready to launch his latest business. With enormous potential rewards.

"We've been flying under the radar on this," said Ed. "It's got a great potential. If it gets huge it can keep me busy for a while."

For more information about the company, Healthy Environment Innovations, go to www.he-innovations.com or call 879-0503.

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http://www.wpi.edu/News/Transformations/2007Summer/eureka.html

WPI Transformations (Summer 2007) -- Worchester Polytechnic Institute

Beyond 'Eureka!'

By

Kate Evans-Correia

Photo by Dan Vaillancourt

Brandishing WPI's legacy of innovation and entrepreneurial spirit, Edward Neister '65 and Timothy McGreal '04 (MS) have proven that with determination, passion, and hard work you can see a great idea to fruition. Both have formed their own companies and invented products that could ultimately save lives. On the other end of the invention spectrum is Michael Feely '93, who is responsible for reviewing many of the 400,000 patent applications filed each year in the United States.

Ed Neister's invention looks like a prop from the 1984 movie Ghost Busters. But instead of trapping pesky ghosts, Neister's gadget zaps something real and much more threatening— germs.

His GermBuster Sanitation Wand, which uses Sterilray, a new type of ultraviolet lamp developed by Neister, could revolutionize the way people disinfect surfaces. By killing stubborn bacteria and viruses instantly, it could prove invaluable to health care facilities, food processing centers, germ testing laboratories, and hospitality centers, including cruise ships.

Consider this: A typical surface can have a million CFUs (coliform units) of bacteria per square centimeter, but a typical surface cleaner kills only a small percentage of those bacteria. It can take as little as 10 viral units of a norovirus to make a person sick. "What we're saying is, there's no better way to disinfect a surface than to use this far UV light," Neister explains.

After graduating from WPI in 1965 with a BS in physics, Neister went on to become one of the earliest developers of products using laser technology. He has started six companies, including his current enterprise, Healthy Environment Innovations, in New Durham, N.H., and has invented several products, including a tattoo removal laser. His latest idea has turned into the GermBuster.

Neister chose to attend WPI because he "wanted a school where a student was not just a theorist but an experimentalist." It was important for him to be able to grasp "the physics of nature, not just the calculations."

When he began his doctoral studies at Brandeis, the potential of laser technology (still in its infancy) was too tempting for Neister's entrepreneurial side. "It wasn't long before I realized I didn't want to be a nuclear physicist," he admits. "I said, 'It's new technology and I'm there.' I took a leave of absence [from Brandeis] and never went back."

He eventually earned his MS in physics from Northeastern University, while continuing to work at AVCO and later at Honeywell in laser research. Yet, as exciting as the research was, Neister became disillusioned with the field's lack of job security. "In 1970 I said, 'Enough!' and started my own company."

Several years (and companies) later, Neister began exploring wastewater treatment using UV rays and looking for ways to apply the same process to kill surface bacteria.

Used commonly in the treatment of wastewater, rays in the UVC, or "germicidal" band, cause base pairs in the DNA molecule to bond tightly, rendering the molecule unable to replicate and microorganisms unable to reproduce. But under certain circumstances, light with longer wavelengths can weaken the base pair bonds, enabling the organisms to start reproducing again. Neister discovered that light in the far UV spectrum, with a much stronger photon energy than light from standard UV lamps, killed significantly more pathogens and actually damaged other parts of the DNA molecule. It virtually destroys all types of pathogens in less than one second. Hence, the birth of Sterilray.

"We made a simple lamp at different wavelengths, tested it at the University of New Hampshire, and saw improvement [in the destruction of a phage virus]," says Neister. At that point, he knew he had a "significant method for killing viruses on a surface."

Though it has taken almost five years to develop fully, there's still more testing to be done. Neister is looking at the possibility of doing bacterial and virus testing at WPI's new Life Sciences and Bioengineering Center at Gateway Park, part of an 11-acre life sciences and bioengineering district the university is developing with the city of Worcester. He says that a partnership with WPI is likely sometime within the next year.

Neister is excited at the prospect of working with WPI again. After all, he notes, it was a great foundation for his career as scientist, inventor, and entrepreneur. "The most important thing is WPI's ability to teach students to think for themselves," he says. "Doing all those experiments gave you a sense that you have a bunch of doors that you must figure out how to open. You won't get that out of books. You have to think your way through problems."

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http://www.he-innovations.com/

Sterilray Disinfection Wand

Healthy Environment Innovations has filed patents for an exciting, innovative approach to destroying life-threatening organisms on all types of surfaces and in the air. Sterilray™ Technology is 10,000 times more effective in killing pathogens like MRSA, Acinetobacter, C-diff, and the norovirus than any other disinfecting or sterilizing method. It is capable of destroying many of the pathogenic bacteria and viruses in less than one second. Other methods and chemical cleaners require contact times of 30 seconds to 5 minutes to be effective.

The Sterilray™ Disinfection Wand (formally known as the GermBuster Sanitation Wand) does this by targeting two critical bonds that make up the proteins in the DNA structure. Recent electron micrographs show for the first time rupture of the cell wall and segmentation of a Bacillus Atrophaeus spore (first on the list of hardest to kill) after irradiation. Thus Sterilray™ is much more effective than any other method for destroying bacteria, viruses, spores, and cists, as well as toxic substances that have similar bond energies. This new technology will radically change the manner in which the spread of contagious agents are contained, controlled, and eliminated in confined populations. It reduces treatment time, as well as cost, and improves the quality of the disinfection and sterilization process. For the first time, the ability to isolate the source of contamination and prevent its spread will be available 24/7.

The Sterilray™ Disinfection Wand will revolutionize the way people disinfect surfaces. This site will be continually updated as our product line, applications and test results of Sterilray™ Technology expand, so please visit us often. Please send us an email or call if you would like more information. We, at HEI, welcome your interest and would be pleased to help you control pathogens in your workplace where people gather and are vulnerable to the spread of disease. Our goal is to improve the health, the well-being, and productivity of people around the world by creating safe, germ-free environments.

S. Edward Neister
President
HEI

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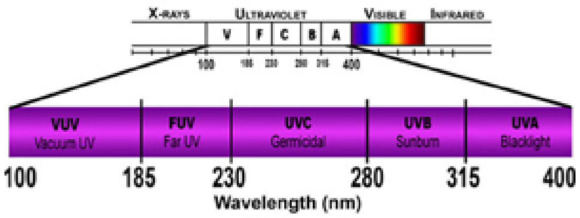
http://www.sterilray.com

How Does Sterilray Work?



Inactivation vs Kill

Before the development of Sterilray™, all UVC lamps produce a specific wavelength of 253.7 nanometers (commonly called 254nm). The UVC band contains wavelengths called “Germicidal” because they alter or flip a microorganism’s DNA so that it can no longer reproduce. The photon energy penetrates the outer structure of the cell and alters the DNA molecule to form dimers. This process of DNA modification is called deactivation. However, under certain conditions, dimers produced by 254 wavelengths can flip back and the pathogens can start to replicate.

Sterilray produces a wavelength in the FUV band with much more photon energy. This additional energy breaks either the protein peptide bonds or the disulfide bonds of the DNA totally killing the microorganism.

Action Time

254nm output of photon energy is measured in microwatt seconds. New 254nm lamps will produce UV energy in the range of 500 microwatts per square centimeter. A 254nm lamp close to a surface would need more than 100 seconds to “deactivate” pathogens. This output will slowly deteriorate over a one year period and is affected by the number of start cycles.

Sterilray’s photon effectiveness is nearly 10,000 times greater. This increase in effectiveness translates to faster action times making it possible to kill pathogens in less than one second! The Sterilray™ lamp remains efficient for more than one year.

Performance

Moving air, especially below 77°F (25°C) has an adverse effect on the 254nm light tubes performance. To compensate, additional lamps are installed and change out cycles are accelerated. The output and stability of standard UVC lamps are drastically reduced in the presence of cold and/or moving air.

Sterilray's does not use cathodes and is therefore not affected by temperature or humidity. Sterilray™ is RF excited so it can be turned instantly on and off hundreds of times without affecting the lamp life.

Power

Even the so called high-output ultraviolet germicidal devices produce relatively low amounts of photon energy. Standard 254nm lamps only have one power setting and can not be changed.

Sterilray's ability to change power is a major benefit. The Sterilray™ Disinfection Wand has three power settings:

Smooth — for sanitizing smooth hard surfaces or low level disinfection.

Textured — for sanitizing textured surfaces such as bedspreads or where a higher level of disinfection is required.

Deodorize — will produce a low level of activated oxygen directly to the surface to deodorize that specific area and produce the highest level of disinfection when required.

Sterilray's high power is primarily used for oxidation of surfaces. This is the power setting of the lamp that will destroy chemicals and odors such as cigarette smoke, VOC's, diesel fumes and formaldehyde. activated oxygen (O3) is a colorless gas with a distinct, pungent odor. It is a molecule made up of 3 atoms of oxygen. It is three thousand times more potent than chlorine in destroying bacteria and viruses.

Benefits of Activated Oxygen

Once generated, activated oxygen is quite unstable, one of the three oxygen atoms eagerly splits off the molecule and attaches itself to any particle or pollutant with which it comes in contact. That single oxygen atom from the activated oxygen air purifier proceeds to "oxidize" that particle. As a result, the particle will no longer be toxic, and will no longer be able to reproduce, if it is biological. When the single oxygen (O1) molecule oxidizes the particle, it too is destroyed. The Food and Drug Administration (FDA) requires activated oxygen output of indoor medical devices to be no more than 0.05 ppm (parts per million). Sterilray™ applies activated oxygen directly to the surface—only the area directly below the Disinfection Wand has any measurable activated oxygen. This dissipates within seconds so no residual activated oxygen remains present in the room or treated area and is always well below the .05 ppm requirement.

Patents

USP # 6,132,692
Barrier discharge conversion of SO.sub.2 and NOx to acids
A process for reducing particulate, Hg, NOx, and SO.sub.2 emissions from the combustion of fossil fuel while providing the capability of producing an end product that is commercially useful comprising the steps of oxidizing Hg, NOx and SO.sub.2 using a barrier discharge reactor to produce the HgO and acids HNO.sub.3 and H.sub.2 SO.sub.4, collecting the HgO, acids and particulates in a wet ESP, and then draining them from the wet ESP to remove them from the flue gas stream.

USP # 6,117,403
Barrier discharge conversion of Hg, SO.sub.2 and NOx
A process and apparatus for reducing particulate, nitrogen oxides ("NOx"), sulfur dioxide ("SO.sub.2 "), and mercury ("Hg") emissions from the combustion exhaust of fossil fuel fired plants while producing an end product that is commercially useful, comprising the steps of oxidizing Hg, NOx and SO.sub.2 using a barrier, pulse, corona, or electron beam electrical discharge apparatus (100) to produce HgO and the acids HNO.sub.3 and H.sub.2 SO.sub.4 collecting the HgO, acids and particulates in a wet ESP (120), and separating the particulates from the collected acid mixture, then separating and concentrating the acids for industrial use.

USP # 5,920,474
Power supply for electrostatic devices

A power supply method particularly adapted for use with an electrostatic particulate collection device to provide substantially ripple-free DC power for improved operation. The power supply is adapted to receive three-phase AC power and to transform the AC power into high voltage DC power having a minimum of voltage ripple in the output. The power supply includes a multi-phase transformer having three primary windings, each of the primary windings having associated with it a pair of secondary windings. The primary windings can be either delta connected or wye connected. One of each of the secondary windings associated with one of the respective primary windings are connected together in a delta connection arrangement, and the remaining secondary windings are connected in a wye connection arrangement. Because the respective AC voltage outputs of each of the secondary windings is out of phase with the AC voltage outputs of the other secondary windings, the resultant combined DC output voltage, after the DC voltages have been rectified in a three-phase full-wave bridge rectifier stack, produces minimum ripple voltage and current, without requiring additional, more expensive, and less reliable components.

USP # 5,903,450
Electrostatic precipitator power supply circuit having a T-filter and pi-filter
An electrical filter apparatus for an electrostatic precipitator, wherein the filter apparatus is a T-type or pi-type filter electrically connected to a high voltage output of an electrostatic precipitator power supply and an electrostatic precipitator electrode. The T-type filter comprises a first inductor electrically connected to the high voltage output and a capacitor that is also electrically connected to ground. A second inductor is connected to the first inductor and the electrostatic precipitator electrode. In another embodiment, a two-stage inductor assembly is provided having a third inductor member defined by a plurality of turns of a continuous length of wire, and a fourth inductor member defined by a plurality of ferrite beads in end-to-end relationship.

USP # 5,871,703
Barrier discharge conversion of SO.sub.2 and NOx to acids
A process and apparatus for reducing particulate, nitrogen oxides ("NOx"), sulfur dioxide ("SO.sub.2 "), and mercury ("Hg") emissions from the combustion exhaust of fossil fuel fired plants while producing an end product that is commercially useful, comprising the steps of oxidizing Hg, NOx and SO.sub.2 using a barrier, pulse, corona, or electron beam electrical discharge apparatus to produce HgO and the acids HNO.sub.3 and H.sub.2 SO.sub.4, collecting the HgO, acids and particulates in a wet ESP, and separating the particulates from the collected acid mixture, then separating and concentrated the acids for industrial use.

USP # 5,777,437
Annular chamber flashlamp including a surrounding, packed powder reflective material
A coaxial flashlamp for optical pumping of a tunable dye laser. The flashlamp includes electrodes preferably made from a tungsten-based alloy for reduced metallic vapor deposition within the flashlamp. Positioned around the outer tube is a packed powder material having a diffuse reflectivity of the order of at least about 98%. The outer surface of the outer tube is placed under an inwardly-directed pressure provided by a pressurized cooling liquid that serves both to cool the flashlamp and simultaneously to offset internally generated pressure within the flashlamp caused by the pressure wave resulting from the movement of the ionization front through the gas within the annular gas chamber defined between the inner and outer tubes.

USP # 5,740,024
Two-stage, high voltage inductor
An improved two-stage, high voltage inductor assembly. The inductor assembly is particularly adapted for use in a power supply circuit for an electrostatic precipitator. The inductor assembly includes a first inductor member defined by a plurality of turns of a continuous length of wire, and a second inductor member defined by a plurality of ferrite beads in end-to-end relationship. The assembly changes the electrical characteristics of power generated by a power supply to increase the output voltage, decrease ripple, and decrease the amount of power required. The assembly also reduces the arcing and sparking which normally occurs, improving the collection time and efficiency of the precipitator.

USP # 5,631,818
Full-Text Power supply for electrostatic preciptator electrodes
A power supply system particularly adapted for use with an electrostatic precipitator to provide substantially ripple-free DC power for improved precipitator operation. The power supply is adapted to

receive three-phase AC power and to transform the AC power into high voltage DC power having a minimum of voltage ripple in the output. The power supply includes a multi-phase transformer having three primary windings, each of the primary windings having associated with it a pair of secondary windings. The primary windings can be either delta connected or wye connected. One of each of the secondary windings associated with one of the respective primary windings are connected together in a delta connection arrangement, and the remaining secondary windings are connected in a wye connection arrangement. Because the respective AC voltage outputs of each of the secondary windings is out of phase with the AC voltage outputs of the other secondary windings, the resultant combined DC output voltage, after the DC voltages have been rectified in a three phase, full-wave bridge rectifier stack, which produces minimal ripple voltage and current, without requiring additional, more expensive, and less reliable components.

USP # 5,629,842
Two-stage, high voltage inductor
A two-stage, high-voltage inductor assembly. The inductor assembly is particularly adapted for use in a power supply circuit for an electrostatic precipitator. The inductor assembly includes a first stage inductor member defined by a toroidal inductor member formed from a plurality of turns of wire to define an inductor member having a first inductance, and a second stage inductor member defined by a plurality of end-to-end ferrite elements carried on a copper conductor to define an inductor member having a second inductance. The first inductor member blocks the low to moderate frequency currents and voltages in the power output portion of an electrostatic precipitator power supply circuit, and the second inductor member blocks the intermediate and high frequency currents and voltages in such a circuit. The first and second inductor members can be carried on a single body member which can be of tubular construction and in which the first inductor member is exteriorly carried on the body member while the second inductor member, which is electrically connected with the first inductor member, is interiorly carried within the tubular body member.

USP # 4,250,427
Dye laser flashlamp and method of making same
A coaxial dye laser flashlamp, each electrode of which is made of spaced rings joined by several molybdenum strips evenly spaced about and between the coaxial quartz tubes of the flashlamp. The coaxial quartz tubes are then fused together in the regions of the molybdenum strips.

METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES...
CA2600923 (2007-07-26)

BARRIER DISCHARGE CONVERSION OF SO2 AND NOX TO ACIDS
CA2355396 (2003-02-16)
US6132692 (2000-10-17)

Barrier discharge conversion of Hg, SO2 and NOx
US6117403
2000-09-12

Electrostatic precipitator power supply circuit having a T-filter and pi-filter
US5903450
1999-05-11

BARRIER DISCHARGE SO2 TO SO3 CONVERTER
WO9803429
1998-01-29

Power supply for electrostatic devices
US5920474
1999-07-06

Two-stage, high voltage inductor
US5740024
1998-04-14

Annular chamber flashlamp including a surrounding, packed powder reflective material
US5777437
1998-07-07

POWER SUPPLY FOR ELECTROSTATIC PRECIPITATOR ELECTRODES
WO9735378
1997-09-25

POWER SUPPLY FOR ELECTROSTATIC PRECIPITATOR ELECTRODES
CA2257342
1997-09-25

Dye laser flashlamp and method of making same
US4250427
1981-02-10
