Radiant Catalytic Ionization
for Healthier Indoor Environments

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Introduction

The direct relationship between indoor air pollution and health is quite obvious these days. Though the measures currently being taken are still not adequate, at least there is awareness that indoor environmental conditions require special attention. Caring for air quality or indoor environment takes care of the health of people who live, work, or otherwise spend considerable time inside a building.

Most people spend up to 90% of their time indoors, which prevents them from breathing good quality air. In fact, the European Commission (EC) has recently warned that the threat posed by indoor air pollution has been underestimated. According to EC, respiratory and infectious diseases and allergies have continued to grow in Europe, and by 2015 it is expected that half the Europeans will suffer some form of these, including eczema, hay fever and asthma. In fact, the number of cases of the latter has doubled in the last decade in EU and causes loss of productivity of € 9.8 million per annum (Rs.82 Cr).

Just as the concern over the quality of water in homes and workplaces has driven tremendous growth in bottled water and water filtration systems, there is also increasing awareness and interest in Indoor Air Quality (IAQ), which is leading it to become one of the top issues on everyone's minds. Poor air quality in commercial buildings often contributes to high absenteeism of employees and occupants of the facility. Because of high traffic in many commercial establishments, there is a constant influx of germs and bacteria brought in by building occupants. Radiant Catalytic Technology (RCI) offers a solution for air quality issues, ensuring an environment safe from air pollutants for occupants.

It should also be noted that the lack of hazard analysis associated with exposure to indoor air pollution has major economic consequences, both in public health spending as well as man-days of production lost and personal cost to individuals. Implementation of air purification technologies such

About the Author

Born in Spain, Oscar Romero is an alumnus of the University of Toledo, USA. After working with Steelcase in the office furnishing industry, he joined ActivTek, a global player in the air and surface purification industry. Oscar has been involved in projects aiming to provide healthier indoor environments as well as developing new markets and awareness of Indoor Air Quality - its impact on health and living conditions, and how the risks can be reduced.

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as RCI considerably reduces the high cost to the society associated with diseases related to indoor environments. Therefore, any development investment aimed at improving human health through healthy indoor environments should be weighed against the benefits it provides.

How Does RCI Technology Work?

This technology was developed at the Wisconsin Center for Space Automation and Robotics (WCSAR) that specializes in systems for biotechnology research, which achieved a major breakthrough by developing a technology that allowed the growth of plants and organisms in space without sunlight. They obtained an effective plant growth and found that using a UV light exposure on a noble metal alloy eliminates the ethylene gas that is responsible for the premature ageing of plants and other organisms. This development was used to validate RCI technology for application in industrial environments, leading to new products with advanced features.

Prestigious universities and laboratories such as Sandia National Laboratory (U.S. Biodefense) and the University of Cincinnati support the ability of RCI technology to remove pathogens by a factor of 99% on contact surfaces as well as at the aerobic level. It is currently the only known photocatalytic system that eliminates MRSA (Methicillin Resistant Staphylococcus Aureus), an antibiotic-resistant bacteria, and Influenza A virus (swine flu, avian and human), reducing and deactivating allergens, particles and spores and destroying most of the volatile organic compounds (VOCs).

RCI technology is based on the principle of photocatalysis (see *Figure 1*). It works by converting water vapor (H_2O) and oxygen (O_2) from untreated air into hydro-peroxides and hydroxyls, eliminating microbes (odors, mold, bacteria, viruses, VOCs, etc.) from the air, and creating a healthier indoor environment. Gaseous heterogeneous photocatalysis occurs through the absorption of light (UV) by a solid semiconductor (catalyst) that photo-activates, and can generate, at its surface in the presence of ambient humidity, redox active species whose reactions lead to the degradation of chemical, microbiological and gaseous (odors, VOCs, etc.) contaminants, finally eliminating them from air and surfaces.

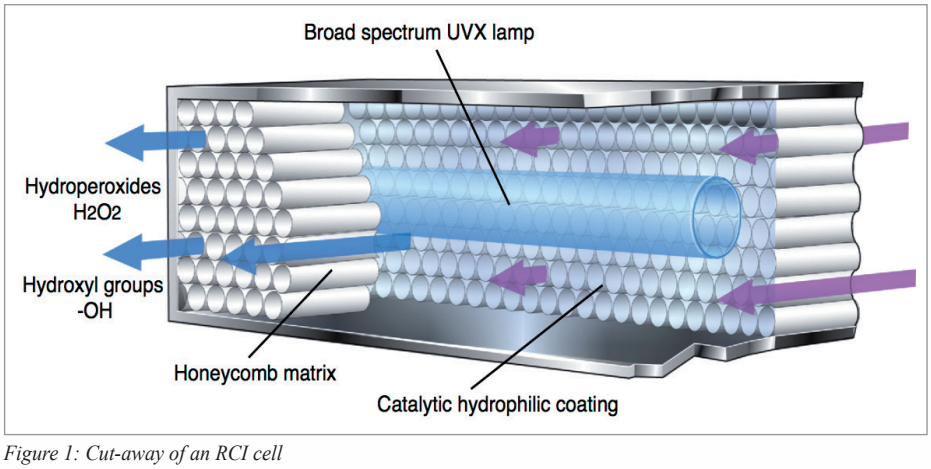

Figure 1: Cut-away of an RCI cell

Activation of a semiconductor material – by making a light source hit on it and projecting photons – is necessary to carry out the photocatalytic process. The light source is generated by means of ultraviolet radiation with a specific wavelength. Thus, for each photon with a given energy that hits on the semiconductor material, an electron from the valence band is promoted to the conduction band. During this process, reactions take place – both oxidation and reduction.

RCI technology generates purifying plasma that is dispersed in the environment and attacks pollution wherever it is, reducing bacterial levels on surfaces and in the air, as well as odors, 24 hours a day in a process that is harmless to health. It works to sanitize indoor air, as nature does with outdoor air.

RCI technology is designed and crafted to:

- Kill mold, bacteria and viruses on air and surfaces.
- Reduce VOCs, allergens and particulates.
- Cut down harmful chemical residues from paint fumes, insecticides, and cleaning products.
- Eliminate all kind of odors.

Active vs. Passive Technology

Unlike technologies that eliminate pollution through passive methods, RCI air purification is an active technology and works continuously to solve the problem, rather than wait for micro-organisms and particles (or microbe pathogens) to enter the device and then filter them (passive technology). Moreover, passive filters and passive technologies usually become a breading ground for contamination and create conditions that boost exponential growth of microorganisms.

Passive technologies include filters, UV lights and electronic air cleaners that require the air and the pathogen to go through the device. They always employ some form of filtration and require the contaminants to find their way to the filtering or passive device. Their effectiveness would be limited only to those contaminants that physically pass through the filtering mechanism, leaving all the unfiltered air contaminated.

The effectiveness of passive technologies depends upon meeting certain conditions. UV lights affect only the specific areas on which they directly shine. They are effective only if the contaminant is exposed at a close range and for sufficient time. If the pollutant passes through too fast or too far, it will fly freely about the air space. Passive air purification technologies leave any items or issues, not passing through its system, unresolved.

On the other hand, RCI is an active technology. Its purifying plasma can reach all corners of a room including remote areas. It is not a conventional filtration system because it acts both in the air and on surfaces, keeping them clean of microbes without using harsh chemicals.

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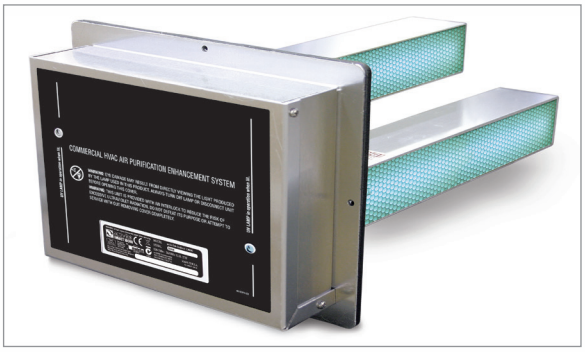

Figure 2: An in-duct RCI unit

Figure 3: Hospital beds

Buildings today are built tighter than in the past and, as a result, indoor air quality has become an increasingly important factor for builders and facilities managers. Many commercial and office buildings keep their users and employees in sealed indoor environments, where the air is being continually recycled by air conditioning systems. The introduction of RCI technology allows companies to improve environmental conditions in their work areas, resulting in health benefits for the occupants and productivity improvement.

It is worth noting that, in big cities and busy industrial areas, the so-called 'fresh air' brought into the facilities is hardly 'fresh'. Thus, an additional input is needed to get the desired IAQ. RCI can keep indoor air in better condition and significantly reduce the need for fresh air intake into a facility, leading to energy savings and lower building operation costs.

Applications of RCI

RCI technology is used in both stand-alone units and in-duct units (see *Figure 2*). In-duct units require installation into new or existing HVAC systems and/or AHUs. RCI treatment effectively handles odor and bacteria in hospitals, offices, industrial facilities, food industry, food storage facilities and chillers, restaurants, bars, dumpsters, transport industry (public and food), homes, and all indoor areas.

Some of the application areas of RCI are given below.

Hospitals and Health Sector

It is well known that many of the problems in hospitals and medical facilities stem from germs and bacteria within the environment, rather than as a direct result of medical treatment. Often these germs and bacteria are brought into the hospital by patients and visitors. So, no matter how careful a facility is about its disinfecting procedures, new germs and bacteria are introduced on a daily basis, often evolving beyond the effectiveness of antibiotics. Hospital Acquired Infection is the second largest issue facing hospitals today. In addition to the challenges of providing a safe environment for its patients, hospitals are also faced with the financial burden of spending significant money on cleaning products to decontaminate. RCI provides a solution to air quality problems within a medical facility, so the patients are protected from indoor pollutants. RCI also provides a safe environment for medical professionals to treat their patients in.

Offices and Buildings

Figure 4: A glass façade building

Hospitality Industry

Figure 5: A fine dine restaurant

The crowded, high transit public places such as hotels, restaurants, bars and clubs have a high level of environmental pollutants. Bacteria, dust, dirt, smoke, soot, and aerosolized droplets are present in the air in these environments. The smaller the microbes and particles, the more dangerous and the deeper they get into the lungs, where they may cause problems. Likewise, construction and decoration materials such as carpets, furniture and paintings can emit harmful VOCs, which can seriously affect people with asthma and allergies.

However, most of the pollution in hospitality venues comes from undesirable odors. Heaters, boilers, kitchens, street traffic, and even people´s bodies are sources of contamination. RCI units can be installed in these environments to get rid of odors, bacteria, smoke and molds and extend the shelf life of fresh products at big chillers where food is stored, at restaurants, hotel rooms, toilets, etc. ❖