Houston Methodist Hospital

Needle Point Bi-Polar Air Ionization for VOC Remediation

Field Study Results *October 2013*

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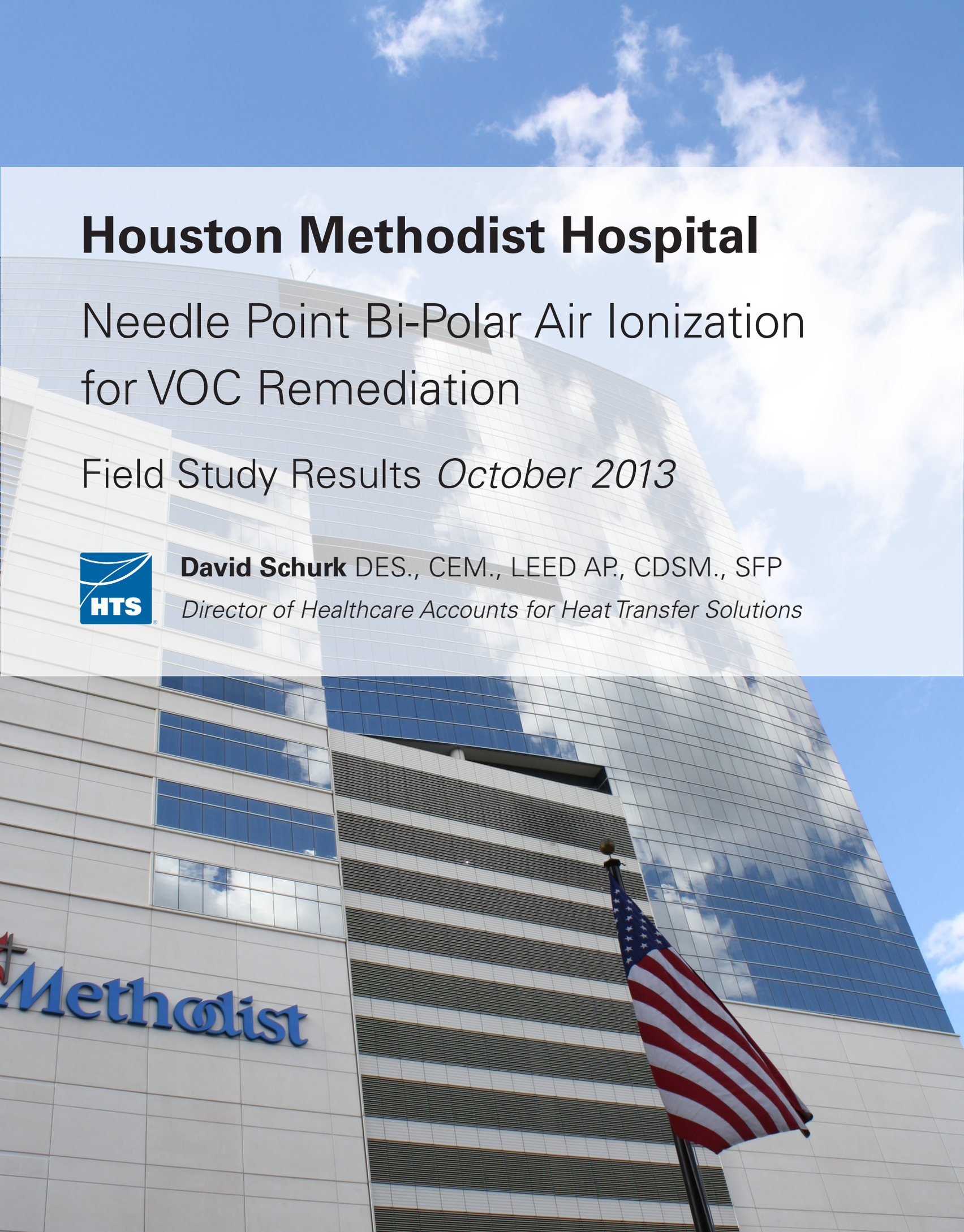

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The Problem:

An existing 60,000 CFM, 100% outdoor air ventilation pre-treat air handling unit (AHU) at *Houston Methodist Hospital* (HMH) in the Texas Medical Center is located in a 5th floor mechanical space with an emergency diesel generator located at grade below. The high velocity air-intake louver serving the AHU pulled in unacceptable levels of odorous Volatile Organic Compounds (VOCs) from the operation of the generator and the intermittent landing and idling of helicopters. Also contributing to the excessive levels of VOCs delivered through the AHU and into the hospital were exhaust hoods, loading docks, trash dumpsters and street-level automobile traffic. Whenever the generator was running, patients, nursing staff and doctors (particularly in operating suites) complained about poor air quality. Charcoal filters installed to remediate odor issues were found to be extremely costly to maintain and ineffective, leading the engineering staff at HMH to select *Needlepoint Bi-Polar Air Ionization* (NBPI) technology as a means to reduce objectionable VOC's; with the added benefit of keeping microbiological growth from accumulating on cooling coils.

The Project:

The project involved refurbishing the existing pre-treat AHU supplying code-required, conditioned air to ventilate various spaces within the hospital. The main scope of the work consisted of upgrading the existing pre-filters and cooling coils, and abandoning the ineffective UVC lights and charcoal filtration system in favor of the patented NBPI technology; manufactured by *Global Plasma Solutions* (GPS) and supplied by *Heat Transfer Solutions* (HTS) of Houston, Texas.

The Equipment:

Shielded Cable System with Integral Ground Wire

Black Flex Water Tight Design using Cooling Coil as Ground

The NBPI system installed at Methodist utilizes a method of artificially generating both positive and negative ions (which naturally occur in the air) without generating an ozone byproduct. These ions possess the beneficial power to surround harmful substances such as airborne mold, viruses, bacteria, volatile organic compounds and allergens. The ions cluster around the mold spores and pathogens, inactivating them by robbing them of their life-sustaining hydrogen molecule, severing the protein on the cell membrane and preventing reproduction. In a similar fashion, when electrons are artificially added and removed from a volatile organic compound through the NBPI process, a chemical reaction occurs at the molecular level that breaks down the compound into one or more of the four basic elements already prevalent in the atmosphere; oxygen, nitrogen, carbon dioxide or water vapor; effectively eliminating odors.

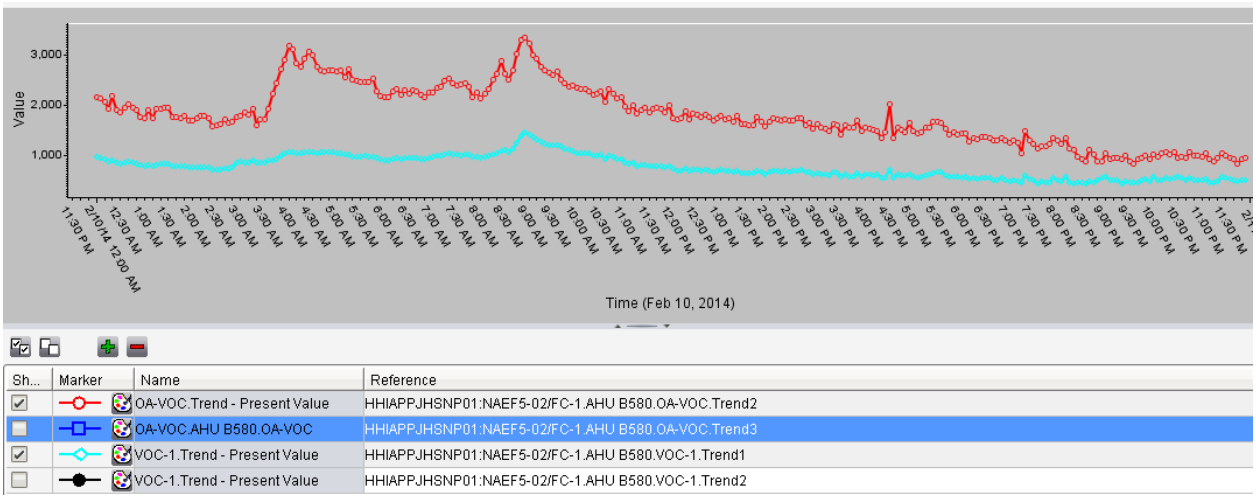
The NBPI system was installed on the upstream side of the chilled water cooling coils, and attached to the coil frame with no obstruction to airflow. This location helped maximize key benefits delivered by the technology. First, it replaced existing UVC lights installed to keep the wet cooling coils free of bacteria, mold and fungal growth. Second, unlike the UVC lights which require annual replacement and kill only contaminates on surfaces directly exposed to the UV light; the ions produced by NBPI flow through the entire coil depth, into the fan, and if unrestricted by filters, are delivered through ductwork into the occupied space, effectively reducing overall surface and air pathogen counts (CFU's, colony forming units) in all of those areas.

A recent clinical trial was performed at a prominent Pittsburgh, PA area hospital. In twelve patient rooms (six with NBPI and six without) results showed that gram-negative bacteria was reduced to zero CFU's on the five common touch areas of the patient rooms with NBPI, as compared to the control rooms without it. The CFU's in those rooms were above 100; considered to be "outbreak" level by the microbiologist performing the testing and the doctor managing the project. Both the microbiologist/infection control officer and the managing doctor were employees of the hospital. There is hope that this technology will result in an observable reduction in hospital acquired infections (HAI).

NBPI Benefits

Various forms of gas-phase filtration had previously been added to HMH's HVAC designs to remove pollutants from incoming outdoor air. Activated carbon had been widely used with varying levels of success. Some carbon filters were found to load quickly with pollutants, leaving them ineffective. In humid areas like Houston, they absorb water vapor before other chemicals, limiting their efficacy. Additional fan motor horsepower was required to overcome the internal resistance imposed by the carbon and post dusting filters. Carbon systems also use expensive filters which require replacement and disposal at varying intervals. NBPI was substituted for the traditional gas-phase filtration, completely eliminating associated air-flow resistance and reducing down-time and maintenance costs resulting from dirty and expensive carbon filter replacement. The NBPI systems require no regular replacement parts, virtually no maintenance, and impose little operating expense. The system design for HMH consumes only 120 watts of power.

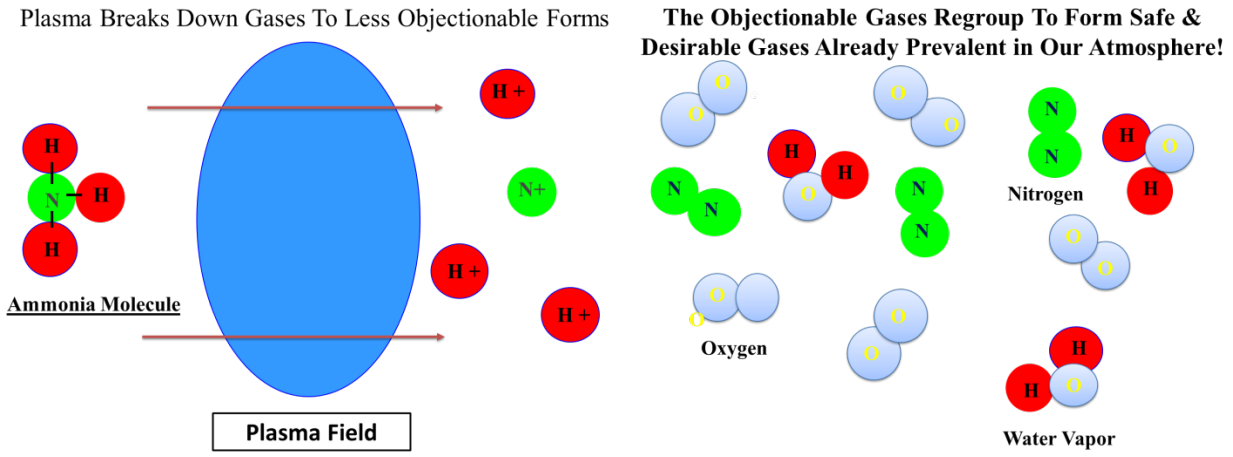
The Results:



To add hard science to what has sometimes been considered “smoke and mirrors,” Total Volatile Organic Compound (TVOC) sensors manufactured by BAPI (Building Automation Products, Inc.) were installed on the AHU outdoor air inlet, upstream of the NBPI device, and also immediately downstream of the cooling coils (after NBPI) for measurement and verification. As seen in the results of the BAS trend log, (above) incomming TVOC levels (red line) were substantially reduced from a high of aproximately 3500-ppm TVOC to about one-third that level (blue line) leaving the NPBI device.

With the diesel generator running, a slight increase in the supply air (outlet) TVOC levels can be seen (blue line) due to the fact that the beneficial ions produced by NPBI can actually be detected by these sensors, and thus may lead to slightly higher counts. Otherwise supply air TVOC levels remained steady and acceptable.

Most importantly, NPBI is actually breaking down VOC's, so a single contaminant (harmful gas) will be broken down to elements that are already naturally prevalent in our atmosphere. For example, it breaks down ammonia (NH3) to oxygen, nitrogen and water vapor. Many hundreds of these compounds are present in the atmosphere. Even though the VOC levels may increase slightly in count after the NBPI system, the air leaving the device is actually much cleaner and healthier for the occupants because it has broken down the “bad” molecules to oxygen, nitrogen, water vapor or carbon dioxide. What is more important to the occupants is that the air simply smells better so complaints cease as each human nose ultimately proves the success of GPS’ NBPI.



The bottom line is that even with the diesel generator running; creating elevated TVOC levels in the ambient air, the NBPI system is able to provide ventilation to the occupied space at levels consistent with fresh outdoor air. According to Bruce Flaniken, P.E., Manager of Engineering and James Law, Manager of Operations for Houston Methodist Hospital, the system has worked as promised and they anticipate that ongoing energy and maintenance cost will be all but eliminated compared to the previous systems. Since the installation of the Global Plasma Solutions NBPI system there have been no complaints from patients or staff of odors resulting from diesel or helicopter operation.

The Economics:

By eliminating all associated air-flow pressure drop and scheduled replacement parts cost, NBPI is arguably one of the most energy efficient technologies for combating VOC pollutants, mold and pathogens. Additional benefits include the fact that NBPI is mercury-free, unlike UVC lamps, nor does it contain titanium dioxide (Ti02) used in photo-catalytic oxidation (PCO) systems, which is now listed as a carcinogen by the CDC**.** With additional cost savings from reduced maintenance, materials and labor, NBPI systems are considered one of the safest and most economical choices for improving indoor air quality while producing simple paybacks within two months to less than two years when compared to alternative solutions.

Houston Methodist is ranked by *U.S.News & World Report* as one of America's "Best Hospitals" in twelve specialties and designated as a Magnet hospital for excellence in nursing.

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