Houston Methodist Hospital
Test Study Results
Needle Point Bi-Polar Air Ionization for VOC Remediation

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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 the 5th floor penthouse above an emergency diesel generator which is positioned at grade level. The high velocity air-intake louver serving the AHU pulls in unacceptable levels of odorous Volatile Organic Compounds (VOCs) resulting from the operation of the generator during intermittent times throughout the week. Additionally, helicopter landings, kitchen exhaust hoods, medical exhaust, a loading dock, trash dumpsters and street level automobile traffic contribute to overall excessive levels of various VOCs being delivered through the AHU and into the hospital. Complaints were regularly generated from patients, nursing staff and doctors, particularly when the generator was running. Existing charcoal filters, originally installed to remediate the odor issues, were found to be ineffective and extremely costly to maintain, leading the engineering staff at HMH to select *Needlepoint Bi-Polar Air Ionization* (NBPI) technology as a better way to reduce objectionable VOC's as well as keep air-handles free of microbial growth.

The Project:

The project revolved around the refurbishment of the existing pre-treat AHU which was supplying code required conditioned ventilation air to various spaces within the hospital, including critical cardiovascular operating rooms. The main scope of the work included an upgrade of existing pre-filters and cooling coils along with the adbandonment of existing UVC lights and charcoal filtration (found ineffective and costly to maintain) in favor of the patented NBPI technology manufactured by Global Plasms Solutions (GPS) and supplied by Heat Transfer Solutions (HTS) Texas.

The Equipment:

GPS -IPANEL

GPS-IBARS

The NBPI system installed at Methodist utilizes a method of artificially generating both positive and negative ions, which are found naturally occurring in the air, without generating an ozone byproduct. These ions have the beneficial property of clustering around and surrounding harmful substances such as airborne mold, virus, bacteria, volatile organic compounds and allergens. These mold spores and pathogens are inactivated by the ions clustering around them and robbing them of their life sustaining hydrogen molecule thereby severing the protein on the cell membrane and preventing reproduction. As for odors, when electrons are artificially added and removed from a volatile organic compound through the NBPI process, a chemical reaction occurs at the molecular level and the compound will break down to one or more of the

four basic elements already prevalent in the atmosphere; oxygen, nitrogen, carbon dioxide or water vapor.

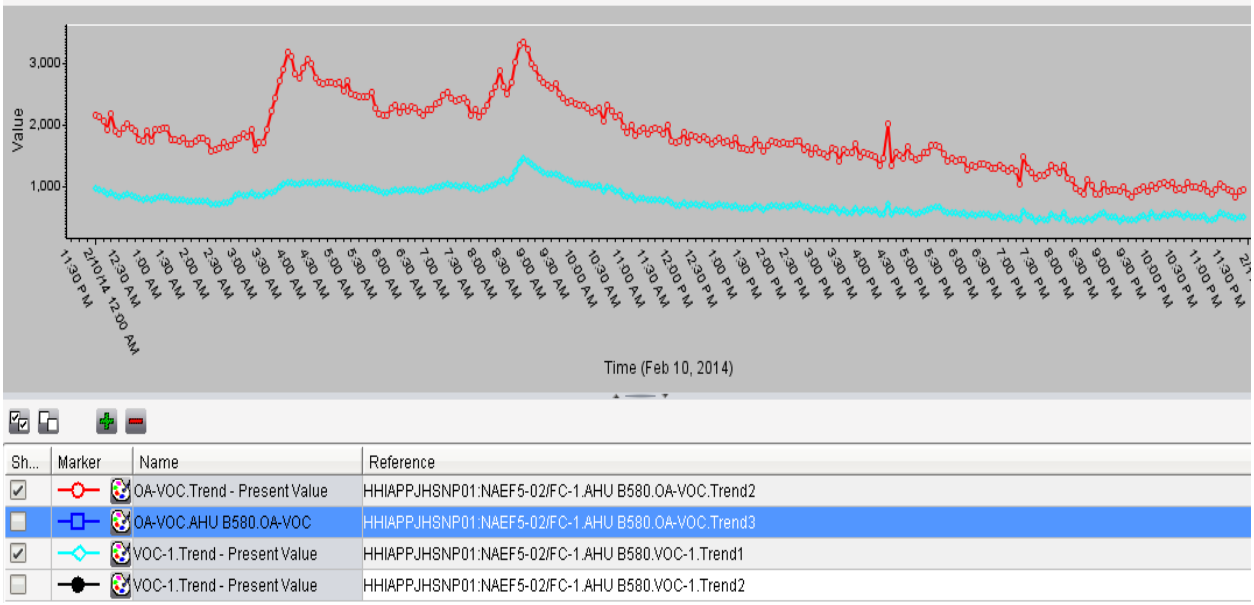
The NBPI system was conveniently located on the upstream side of the chilled water cooling coils, and attached to the coil frame unobtrusive to airflow. By placing it in this location it could help contribute several key benefits delivered by the technology. First it replaced the existing UVC lights, installed to keep the wet cooling coils free from bacteria, mold and fungal growth. Second, unlike the UVC lights which require annual replacement and will only kill contaminates on surfaces exposed directly to the UV light, the ions produced by NBPI will flow through the entire coil depth keeping it clean, into the fan (keeping it clean) and if unrestricted by filters will be delivered through ductwork and into the occupied space effectively helping reduce overall surface and air pathogen counts (CFU's, colony forming units).

A recent clinical trial using GPS' NBPI product in 12-patient rooms, 6-with NBPI and 6-without, at a prominent hospital in the Pittsburgh, PA area showed that the gram negative bacteria was reduced to 0 CFU's on the five common touch areas of the patient's rooms, as compared to the control rooms without NPBI that had CFU's above 100, which were considered "outbreak" levels 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.

The Benefits:

In the past, various forms of gas-phase filtration had been implemented into HMH's HVAC designs to remove pollutants from the entering 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 of the U.S., like Houston, they will absorb water vapor before any other chemicals, which also limits their effectiveness. Additional fan motor hp was necessary to overcome the internal resistance imposed by both the carbon filters and post dusting filters. Carbon systems also required regular disposal at varying intervals which necessitate down-time and costs resulting from dirty and expensive filter maintenance. NBPI was substituted for traditional gas-phase filtration, eliminating associated air-flow resistance and carbon replacement. The NBPI system requires no replacement parts, virtually no maintenance, and imposes little operating expense. The system design for HMH consumes only 120-watts of power.

The Results:

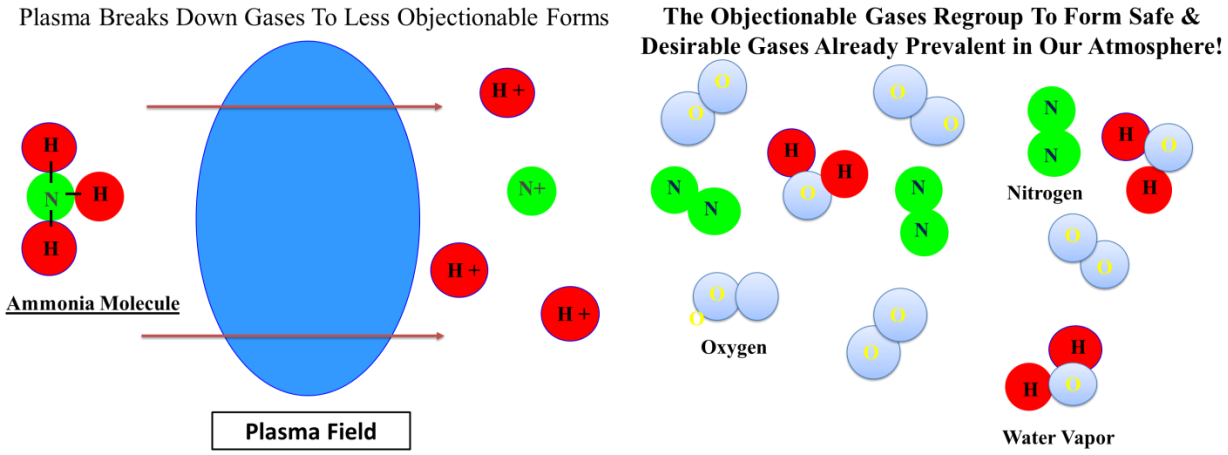


To add science to what was previously considered “smoke and mirrors” Total Volatile Organic Compound (TVOC) sensors manufactured by BAPI were installed on both the AHU outdoor air inlet, before the NBPI device and also immediately downstream of the cooling coils, after the device for measurement and verification purposes. As can be seen in the results from the BAS trend log (above) incoming TVOC levels (red line) were substantially reduced during the generator test from a spike of approximately 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 (leaving) TVOC levels can be seen in the trending due to the fact that the beneficial ions produced by NPBI can actually be read by the sensors and thus may lead to slightly higher partial counts, otherwise supply air TVOC levels remained steady and acceptable. According to Bruce Flaniken P.E, Manager of Engineering for Houston Methodist Hospital; “The GPS device reduced the incoming VOC’s in the outdoor ventilation air to where there were absolutely no objectionable odors detectable by the human nose”.

More importantly NPBI is breaking down harmful VOC's, so a single contaminant (gas) is broken down to more gases, but gases already naturally prevalent in our atmosphere. For example, it breaks down ammonia (NH3) to oxygen, nitrogen and water vapor; another example would be formaldehyde (CH20), which breaks down to carbon dioxide and water vapor. Chemicals containing hydrogen (H), carbon (C) and possibly other elements that evaporate easily are known (with the exception of methane (CH4)), as volatile organic compounds. Many hundreds of these compounds are present in the atmosphere and while 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 the “bad” molecules down to oxygen, nitrogen, water vapor, or carbon dioxide. The contaminant entering the NBPI field will dictate how it reacts to the NBPI and what it breaks down to. As noted by Flaniken (and removing all science from the discussion) the occupants “nose” and more importantly the lack of complaints received is what has proved the GPS NBPI success.



The bottom line results are that even with the diesel generator running, which creates elevated TVOC levels in the ambient air, the NBPI system is able to deliver ventilation air to the occupied space at levels consistent with fresh outdoor air. According James Law, Manager 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 as compared to the previous systems. Since the installation of the Global Plasma Solutions NBPI system there have been no complaints of odors from patients or staff resulting from the diesel generators operation.

The Economics:

By eliminating all associated air-flow pressure drop and 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 does not contain mercury like UVC lamps, nor does it contain titanium dioxide (Ti02) used in some 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

simplest choices to improve indoor air quality while producing paybacks of anywhere from 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 12 specialties and designated as a Magnet hospital for excellence in nursing.