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Testing the Efficiency of a Commercial Air Purification System at reducing airborne levels of Volatile Organic Compounds (VOC's)

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Commercial in Confidence

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A handwritten signature in black ink is written over a white background. The signature is stylized and appears to be 'V. Bergeron'.

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SUMMARY

Both room decontamination and single-pass studies were conducted to determine the volatile organic compound (VOC) abatement efficiency of a Plasmair T2006 air purification device. For a highly contaminated 50 m³ room, the unit operating at 563 m³/hr was able to reduce total VOC levels by greater than 97% in 15 minutes. Moreover, the single-pass reduction efficiency while operating at 830 m³/hr was found to be greater than 95 % for a wide range of common VOC pollutants.

Objective Test the volatile organic compound abatement efficiency of the *Plasmair™ T2006* air decontamination unit manufactured by the company AirInSpace.

Methods Both room decontamination and single-pass abatement efficiencies of the Plasmair T2006 unit are determined. Decontamination studies are conducted in accordance with the method outlined for Clean Air Delivery Rates (CADR) specified in the Standard ANSI/AHAM AC-1-2006 “Method for measuring the Performance of Portable Household Electric Room Air Cleaners”. In this standard the decontamination rate is compared with the natural decay rate so that the performance of the machine can be unambiguously determined. Total VOC (TVOC) levels are monitored in the room decontamination studies while single-pass studies are conducted with individual compounds.

Room Decontamination Rates

Studies were conducted in a closed 50m³ room at ambient temperature, 22°C. The Plasmair T2006 was placed against the wall on one side of the room and VOC sampling was conducted in the middle of the room approximately 2 meters in front of the device and 50 cm from the floor. A schematic of the setup is provided in Figure 1. Before each test 50 ml of a VOC mixture composed of equal portions of toluene, benzene, ethanol, chloroform and formaldehyde was placed in an open container in the middle of the room. A fan was also used to create well mixed conditions in the room. The TVOC levels were then monitored with a photo ionization detector (PID), model 103 from PID analyzers, with a 10.6 eV lamp. Once the level reached 4000 ppb (4 ppm), the open container was sealed and removed from the room and the mixing fan was switched off. TVOC room levels were then monitored for 15 minutes

at one minute intervals, first without the Plasmair T2006 operating to obtain natural decay within the room, and then with the unit operating at 563 m³/hr to determine the removal efficiency of the device.

Results

The room decontamination results are plotted in Figure 2. Filled squares represent the natural decay curve while the open circles correspond to room decontamination with the Plasmair T2006 operating at 563 m³/hr. A comparison of the two curves in Figure 2 indicates that the Plasmair T2006 has a pronounced effect on the kinetics of decontamination and within the first 15 minutes TVOC levels are reduced by greater than 97 %.

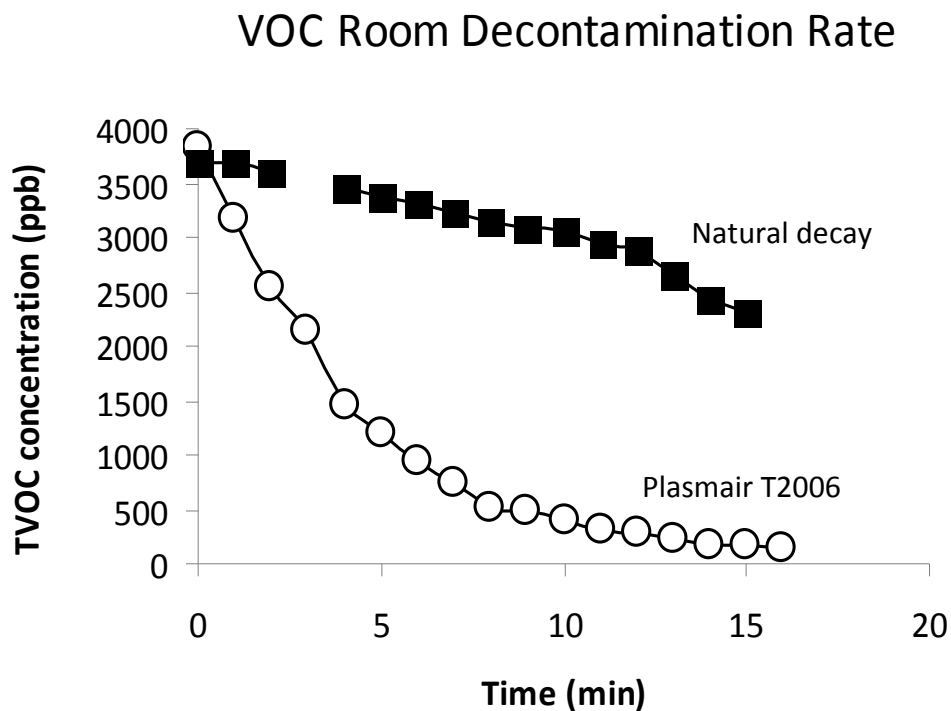


Figure 2. Plot of the TVOC decontamination kinetics in the test room. Filled squares portray the natural decay while open circles indicate the decontamination with the Plasmair T2006 operating at 563 m³/hr. In both cases the initial TVOC room levels were approximately the same at 4ppm and after 15 minutes the Plasmair unit reduced the TVOC level to approximately 50 ppb.

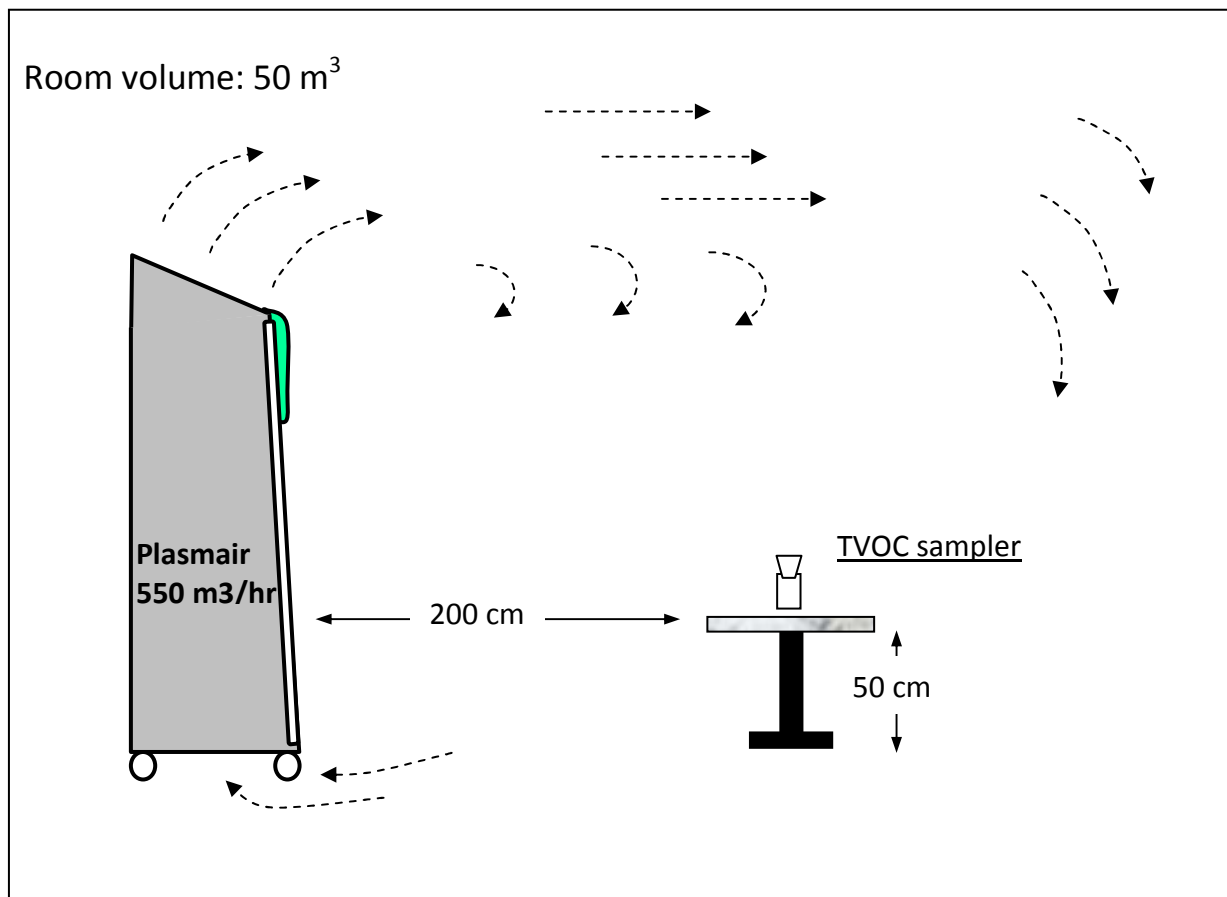


Figure 1. Schematic of the setup used for conducting room decontamination studi

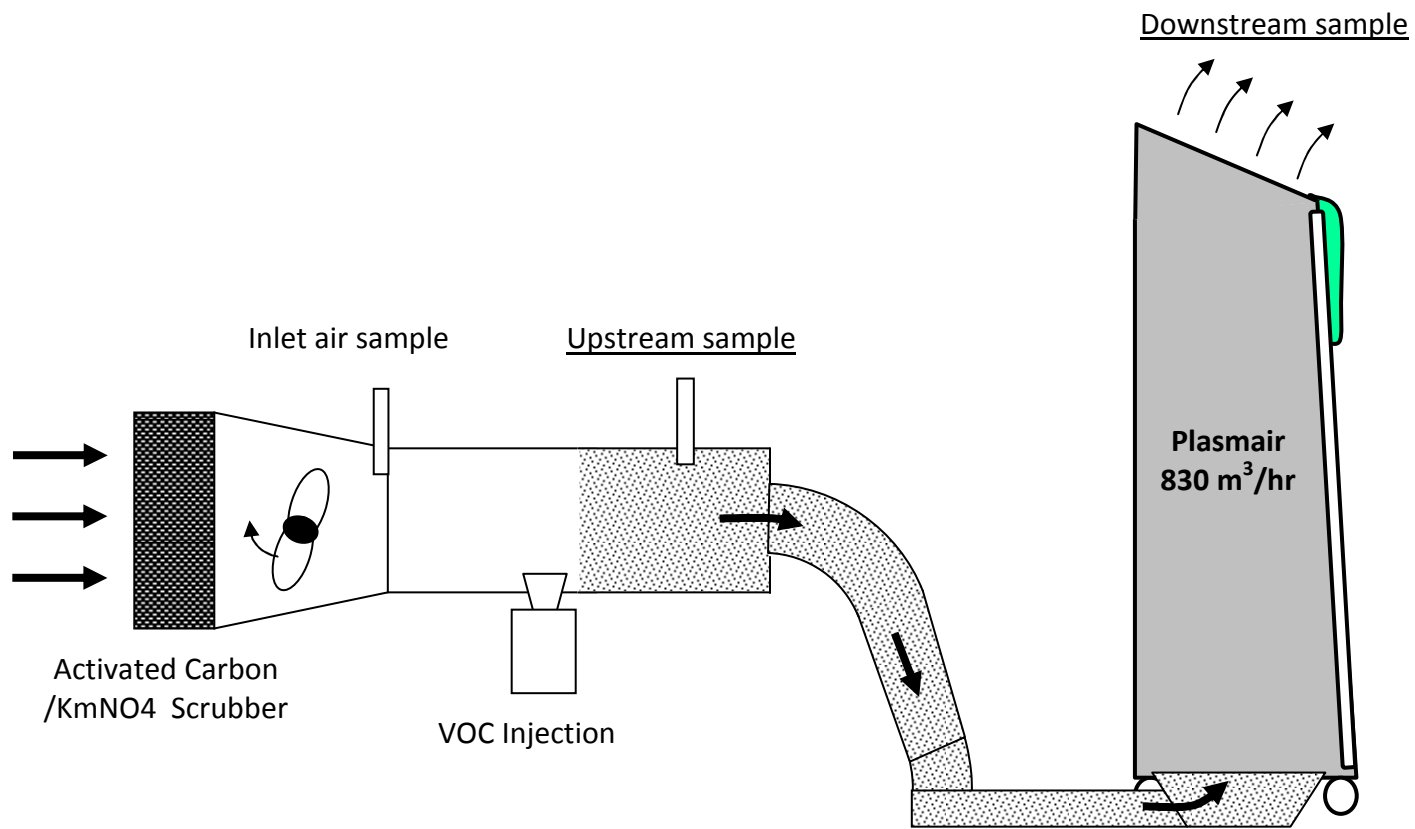


Figure 3. Experimental layout for conducting single-pass VOC efficiency measurements

Single-pass efficiency tests

The diagram in Figure 3 depicts the layout used to measure the single-pass efficiency of individual VOC's through the Plasmair T2006. Room air is first drawn through an industrial sized activated carbon/KMnO₄ scrubber unit to remove any trace levels of VOC's in the air and then subsequently forced into a stainless steel ductwork. The performance of the scrubber is verified by inline sampling of the air after the scrubber unit (e.g. inlet air sample in Figure 3). Individual VOC solutions are then placed into a container and nitrogen is bubbled through the solution which is then injected into the duct. After the VOC injection point another inline air sample is taken to determine the upstream VOC concentration. The conditioned air is then forced into the intake of the Plasmair T2006 as displayed in Figure 3. The airflow through the Plasmair is measured and determined to be 830 m³/hr. A downstream air sample is taken from the exit of the Plasmair exhaust.

Results

Figure 4. presents the upstream and downstream levels measured in the single-pass tests for toluene, benzene and ethanol. These results indicate single-pass VOC reduction efficiencies greater than 95 %.

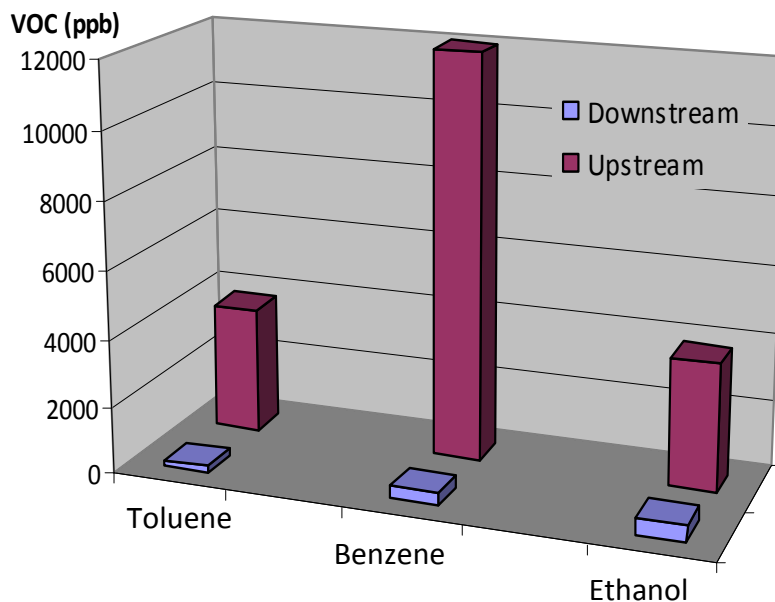


Figure 4. Upstream and downstream VOC concentrations measured in the single-pass tests of the Plasmair T2006.