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Modification of Animal Room Odor by Passing the Room Supply Air Through a Complex Electrical Field

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The objective of this experiment was to determine if the perception of animal room odors, which have a substantial ammonia component, would be influenced by passing the room supply air through a complex high frequency, high voltage (HF,HV) field that was located in the room air supply duct. There were several reasons to believe that there might be such an effect. One was that there were reports (personal communications) that operation of such in-duct fields reduced perceived odor. The physical analyses and experimental findings of FREY (1968, 1983) also suggested the possibility that there would be a modification in perceived odor.

METHODS AND MATERIALS

An odor panel consisting primarily of male college students was formed. The panel was trained in odor intensity discrimination using several odorants, i.e., amyl acetate, butyl alcohol. They were trained to make odor intensity discriminations using as a scale a graduated series of odorant concentrations in a series of ten identical amber 250 cc bottles. Each bottle held 10 cc of liquid, consisting of the odorant and solvent sufficient to bring the volume up to standard. These ten bottles were held in a rack in order of concentration and thus odor intensity.

After initial intensity discrimination training which involved scaling bottles of unknown odor intensities, the subjects were moved to the second stage of intensity discrimination training. In this stage, the unknown odorant intensity was presented as an airborne odorant in the exposure room and the scale bottles were located outside of the room. The subject now walked into the exposure room in order to smell the odorant that was in the room. He then walked out of the room and smelled the odor in any of the scale bottles he wished in order to select which was most similar in intensity to the intensity of the one in the room. The order of unknown intensities presented in the room was determined by using a table of random numbers. After this second stage was completed, the hypothesis under consideration was tested.

Since the personal communications indicated that animal room odors were among those that were perceived as of lower intensity after passing through HF,HV fields, and there was available a

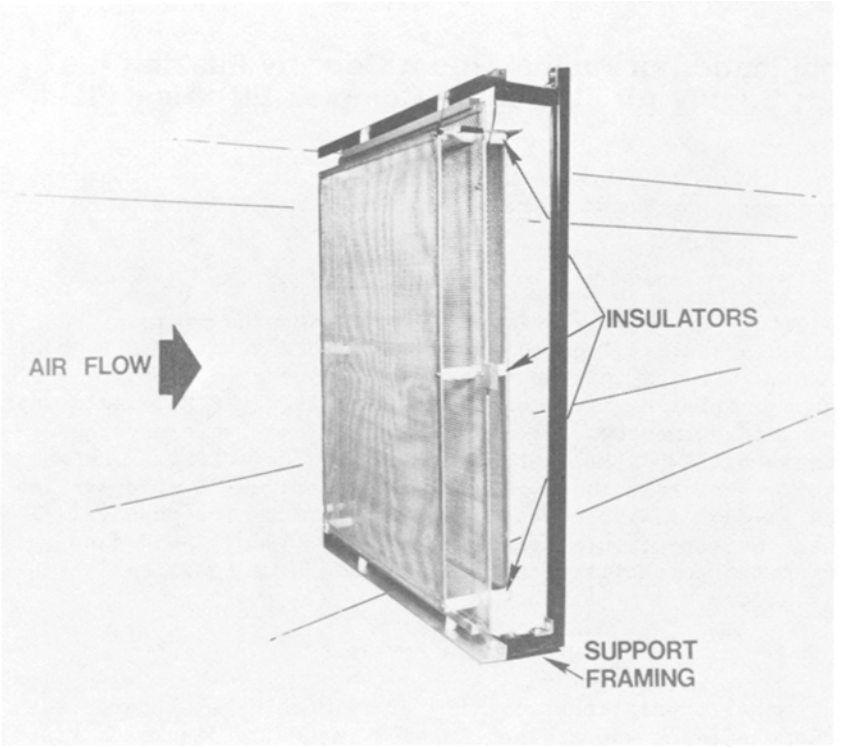

Figure 1: Electrical field screens (2 x 2 feet with 4-inch separation) as they were positioned in the duct.

facility with HF,HV air treatment capability installed, we carried out our test in this facility. The electric field generator supplied a 700 V peak-to-peak 0.177 MHz HF signal that was applied to the center screen, and a 25 kV DC HV signal applied to the two outside screens. The current was less than 3 ma. The 2 x 2 foot screens, made of 0.5 inch mesh hardware cloth, are shown in Figure 1 as installed in the duct. The screen separations are 4 inches.

Ozone is not produced by this system. Ozone tests have been done with this system using a Mast Oxidant Monitor, Model 724-5, which can measure down to 0.001 PPM. Ozone levels were measured three times a day over five days in seven locations, i.e., outside the building, inside the test room with only the fan running, inside the test room with the electric fields on, and inside the plenum, both 6 inches upstream and 6 inches downstream with the fields on

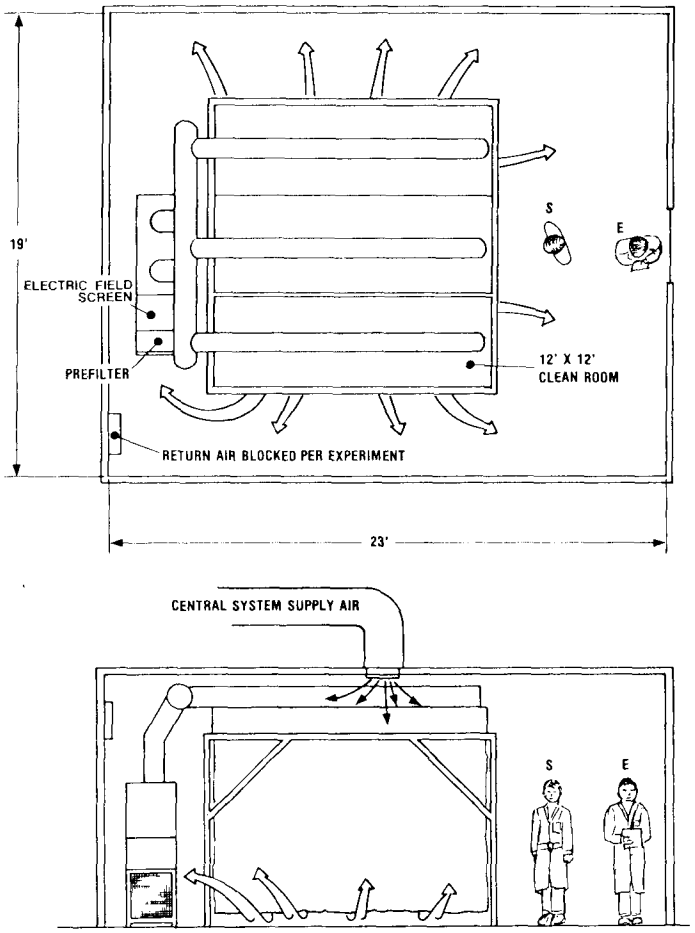

Figure 2: Test room showing position of subject with reference to the source of odor.

and then off. An analysis of variance statistical test was used to determine if there was a significant difference in ozone measured when the fields were on vs off. The F ratio (.987) showed that there were no significant differences. The ozone readings recorded were consistent with outdoor ozone levels provided by the Environmental Protection Agency for the area at those times.

The trained subjects were their own controls within the experimental design, and they did not know the conditions of the experiment. The experimentation consisted of four

sub-experiments. The twenty minute cycles called for in the design allowed the use of four subjects in each sub-experiment. The electrical field alternated between off and on for a total of five periods, each consisting of two cycles.

The exposure room was approximately 23 x 19 feet by 10 feet high. Within this room was a 12 x 12 foot clean room enclosure made of vinyl nylon fabric. Approximately 48 rabbits and 6 cats lived within the clean room enclosure at the time of each sub-experiment and provided the odor. The air within the enclosure was changed 170 times per hour. This was accomplished by blowing ambient room air through a prefilter, the electrical field screens, a HEPA filter, and then through a vinyl nylon fabric duct into the enclosure. The air blown into the enclosure was then exhausted into the exposure room through an opening between the enclosure skirt and floor. The exposure room had an air circulation system which normally involved 17 air changes per hour. Air from the common building ventilation system was blown into the room. This mixed with the air exhausted from the clean room enclosure and the mixture in part exhausted from the room and in part recirculated through the screens and into the clean room enclosure. During this experimentation, the room air change rate was reduced to 7 changes per hour (according to the building engineer) by partially blocking the exhaust ducts in the room. This was done to increase the odorant level. Except for the last sub-experiment, the temperature in the exposure room was 70^{o}F and the relative humidity was 50%. At the last sub-experiment, the temperature was 75^{o} and the relative humidity was 52%.

Animal room odor is complex, so we prepared an aqueous extract of pan sweepings to make up our scale. A twenty-step scale was used. The odorant prepared consisted of distilled water extract of rabbit pan sweepings which included the wood chips used as bedding, urine, feces, and also some of the alfalfa food which was always available in the cages. Because of deterioration of the scale odorants after several days, a new odorant scale was prepared from extracts of fresh pan sweepings before each sub-experiment.

The subjects were briefed prior to each experiment. It was made clear to the subjects that they were the measuring instruments in this situation. It was emphasized that on the basis of their judgments, important decisions would be made concerning the nature of odor perception. In this way, their responsibilities were emphasized and their interest and motivation were peaked. They were asked not to discuss the experiment with other subjects.

Each subject, individually with the experimenter, walked into a small room (bottle room) off the subject waiting room where he smelled from various bottles of the scale for reference. He then walked with the experimenter approximately 40 feet and through two doors to the exposure room. The experimenter would open the

door to the exposure room and the subject would step in five feet to a standard position two feet from the clean room enclosure. The experimenter closed the door, the subject smelled the air, and they then returned to the bottle room. There the subject would sniff several scale bottles and pick one whose odor intensity matched that of the room. Then the experimenter and the subject would repeat the procedure. This was done with each subject in turn and a cycle with all subjects was completed within twenty minutes. At the end of twenty minutes, a new cycle began.

It was explained to the subjects that we would not make any deliberate changes in exposure room odor level between each pair of judgments which were normally separated by a minute or so in each cycle. They were told that changes in odor intensity might be made, however, on a pre-determined schedule after certain of the cycles.

At the end of each day's experimental session, the subjects were separately debriefed by the experimenter to gather additional information.

RESULTS AND DISCUSSION

Using the combined data from pre-determined test points, i.e., cycles prior to period change, the independent sub-experiments 1, 2, and 4 data were evaluated and the null hypothesis was rejected at the .001 significance level using the Wilcoxon matched-pairs signed-ranks test. This indicated that the HF,HV electrical field did have an effect on perceived odor intensity. The effect amounted to a reduction by half in perceived ordor intensity.

Sub-experiment 3 data is not included in the analysis. Two-thirds of the way through the data collection in sub-experiment 3, the experimenter noticed that the data indicted there was little odor in the room in the control as well as in the test condition. This suggested that the exhaust ducts in the room were not blocked as they should have been. It was found, on investigation, that the building engineer had not blocked the ducts due to a scheduling error. Thus, sub-experiment 3 was discontinued, and the data discarded as not being valid within the context of the experimental design.

Some rather useful incidental information, however, was obtained from sub-experiment 3. This amounted to a double blind experiment and it showed that the experimenter was not inadvertently biasing the subjects. The fact that the fault in the air handling system could be identified from the data indicates that the subjects were fulfilling their role quite well.

It is clear that the complex electrical field is significantly reducing the perceived odor in the test room. The reduction in

this particular set of circumstances is equivalent to reducing the perceived concentration of odorant by about 50%. According to the subjects at the final debriefing, this reduction was enough to change an unpleasant room to an acceptable one.

It appears that it takes approximately 45 minutes of air recirculation through the field to make such a reduction in perceived odor. The effect continues for approximately 20 to 30 minutes after the electrical field is turned off. It should be kept in mind that these numbers are specific to this test situation.

ACKNOWLEDGEMENTS

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