THE EFFECTS OF NEGATIVE IONS ON THE HUMAN BODY IN AN INDOOR ENVIRONMENT USING CHARCOAL COATING MATERIAL

M. Terasawa *, T. Shirahama**, and M. Yoshimatsu**

*Tamagawa University, Faculty of Engineering,
6-1-1, Tamagawa Gakuen, Machida-shi, Tokyo, Japan
** Atech Kobo Co. Ltd., 176, Nippa-cho, Kohoku-ku, Yokohama-shi, Kanagawa, Japan

tera@eng.tamagawa.ac.jp, atech@sweet.ocn.ne.jp

Abstract: Past studies of charcoal paint (Healthcoat) environment effectiveness in rats have suggested that charcoal provides positive physiological effects such as low blood lactic acid level and liperoxide inhibition, even in an environment with increased positive air ions. This study further examined the effects of charcoal paint on negative ion count with a normal group (no charcoal paint) , Healthcoat group (a charcoal paint) and an adapter group (charcoal paint connected to a charcoal-filled circular cylinder metal laid 1500mm underground). Then, the effects of negative ions on the human body in an indoor enviroment were assessed between the normal group and adapter group.

Two groups of 11 subjects (4 women and 7 men were selected for each group) participated in this study. For each subject, blood lactic acid level, blood glucose level, blood pressure and hemagglutination inhibition effects were examined in the two enviromental conditions.

Positive changes in the adapter group were observed: subjects' blood lactic acid and blood glucose levels were decreased, blood pressure was stabilized and hemagglutination inhibition was observed. These results suggest that the adaper enviroment will be beneficial for health.

Introduction

The world we live in has been facing serious environmental threats. Global atmospheric pollution is causing global warming, stratospheric ozone depletion and acid rain. Among the causes of air pollution are industrial emissions, industrial waste water, and car exhaust fumes. Also, unhealthy synthetic materials (coatings and insulators in particular) are commonly used as house building materials, and are causing indoor air quality concerns with negative health effects in many homes.

For example, in 2003, the Building Construction Standard Act recognized these unhealthy ingredients which cause health problems like headaches, dizziness, sore throats, as cases of "Sick Building Syndrome (SBS)." However, these unhealthy materials are not the only cause of the worsening living environment. Newer home designs for lower cost and energy use are highly airtight which results in poor air ventilation. In such an environment, positive air ions increase and negative air ions decrease, contributing to an unhealthy environment that facilitates oxidation in biological systems.

As a countermeasure to indoor air pollution, charcoal paint, finely powdered charcoal, was used to paint room walls and a ceilling. Then one of the walls was connected to the charcoal powder-filled metal cylinder laid at a subterranean depth of 1500mm (adapter environment) to improve interior air quality.

The purpose of this study is to investigate the positive physiological effects in terms of blood lactic acid level, blood glucose level, blood pressure and hemagglutination inhibition in 11 subjects (all adult males and females) in the adapter environment.

Materials and Methods

Three indoor environments (normal, Healthcoat and adapter) were created to perform air ion counts for positive and negative air ions. The three indoor environments have exactly the same room capacity. For the Healthcoat environment, indoor walls and a celling were painted with Healthcoat. For the adapter environment, indoor walls and a celling were painted with Healthcoat, then the wall was connected to the adapter. Also, hemagglutination inhibition conditions were examined.

Room design

Normal environment

Plaster boards of thickness (t= 15mm) was used to create three types of temporary indoor environment. All three rooms are exactly the same size: 2.6m (height) X 3.6m (width) x 3.6m (length). The floor is a layer of plywood covered with insulated sheets.

Healthcoat environment

The room design is the same as the normal environment, but charcoal paint is applied to 4 internal walls and the ceiling. Charcoal paint is a product called "Healthcoat (by Atech Kobo Co. Ltd.)", and approximately 300 g/m^2 was applied. The rooms' walls and ceiling were constructed from plaster boards painted charcoal powder of thickness 3 μ m thickness.

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The floor is a layer of plywood covered with insulated sheets. NBR rubber with highly insulated material insulated the floor.

Adapter environment

The room design is the same as the Healthcoat environment.

Adapter is a product called "Ion Control Adapter (by Atech Kobo Co. Ltd.)". The adapter connects the Healthcoat-painted walls to a container underground with a 3C coaxial cable. The adapter is connected to a charcoal powder filled pillar-like container of the following size: 165 mm in diameter x 850 mm in height. The floor is a layer of plywood covered with insulated sheets.

Figure 1 shows the adapter room design.

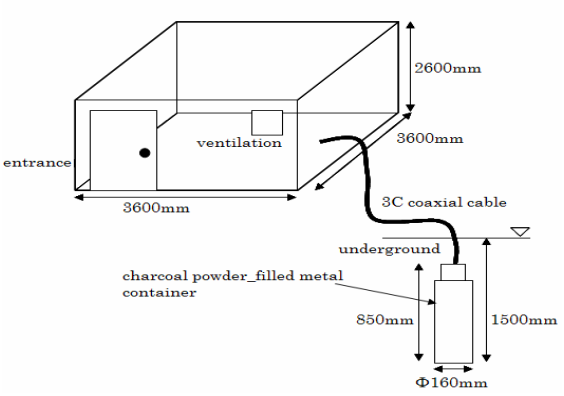

Figure 1: Adapter room design

When we used a metal container filled with charcoal powder buried 1500 mm underground, we measured a negative voltage of 1.5 coming from the container. The voltage was connected to a special room by a 3C coaxial cable.

Comparative tests of the positive ions to negative ions inside an ordinary office building rooms.

An ordinary office building room usually has about 100 to 200 negative ions/cm^2. Generally the number of positive ions is higher in a concrete house with electrical appliances than ordinary house made of wood. Generally, the earth has 0 voltage. Airflow is necessary to circulate the negative ions within a closed room.

Experiment 1:Measurement of the number of ions in different room environments

Procedure

(1) The room was kept air tight and no air ventilation was allowed in order to keep room air condition constant.
(2) Indoor humidity and temperature were measured.
(3) Indoor positive and negative air ion count was performed.

Temperature and humidity measurement

A temperature hydrometer was used to measure temperature and humidity of each environment when air ion count was performed. Measurement was taken for ten days.

Air ion count

The device used to count air ions is called "AIR ION DENSITY Cada 5 7 (by Kobe Ion)." Both positive and negative air ion concentrations were measured. The measuring device was placed at the center of the room and 1000mm above the floor. The measurement was conducted for 10 days.

Experiment 2: Effects of room environments on living bodies

Two rooms with exactly the same indoor capacity were prepared, one room without Healthcoat (normal environment) and the other with the Healthcoat connected to the adapter (adapter environment). 11 subjects for each environment (males and females aged 20 to 35, average age 29) participated in this study. Subjects' blood lactic acid level, blood glucose level, blood pressure and hemagglutination inhibition conditions were monitored on two occasions: before going into the room and after a 2-hour stay in each room.

Procedure

(1) Blood lactic acid level, blood glucose level, blood pressure and hemagglutination inhibition conditions were measured for each subject before they entered their assigned rooms.
(2) Blood lactic acid level, blood glucose level, blood pressure and hemagglutination inhibition condition were measured for each subject after they had stayed in their assigned rooms for two hours.

Blood lactic-acid level reading

Blood samples were collected from each subject's fingertips before they entered their assigned environment and after they had stayed in the assigned environment for 2 hours. A fingerstick lactic acid reading device was used. Average reading value and standard deviation were determined to analyze the data.

Blood glucose level reading

Blood samples were collected from each subject's fingertips before they entered their assigned environment and after they had stayed in the assigned environment for 2 hours. A fingerstick blood glucose reading device was used. Average value and standard deviation were determined to analyze the data.

Blood pressure measurement

Blood pressure was recorded from each subject before they entered their assigned environment and after they had stayed in the assigned environment for 2 hours. Recorded systolic pressure and diastolic pressure were averaged and standard deviation was determined to analyze the data.

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Hemagglutination Inhibition Effect

Hemagglutination status was recorded for each subject before they entered their assigned environment and after they had stayed in their assigned environment for 2 hours. Hemagglutination status was observed with a phase-contrast electron microscope at a magnification of X1600.

Statistics

A/B comparison T-tests were performed on collected data to determine the significance of results.

Results

Indoor air quality measurements (temperature, humidity and air ions)

Indoor temperature, humidity,negative and positive air ions were measured at 12:00 p.m. for 10 days.

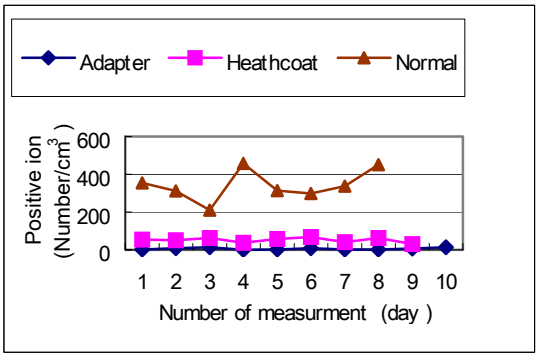

Figure 2: Changes of positive air ion density over time.

Figure 2 demonstrates the positive air ion density difference in each environment. In the adapter environment, number of positive air ions were significantly decreased when compared with normal and Healthcoat environment ($p<0.05$) .

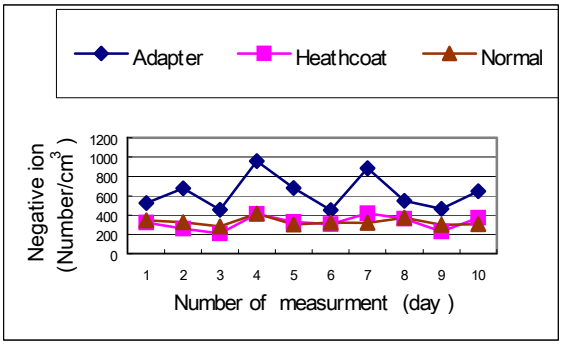

Figure 3: Changes of negative air ion density over time.

Figure 3 demonstrates the positive air ion density difference in each environment. In the adapter environment, number of negative air ions were significantly increased when compared with normal and Healthcoat environment ($p<0.05$) .

Effects of room environments on living bodies

Blood lactic acid reading

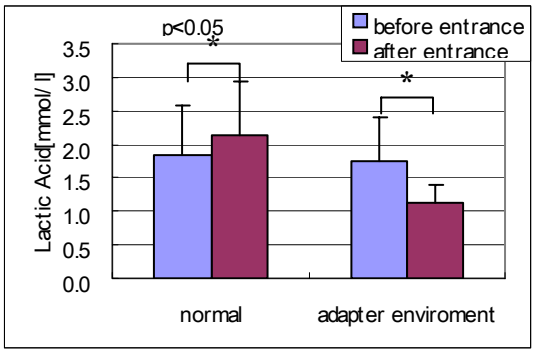

Figure 4: Blood lactic acid reading.

Figure 4 indicates blood lactic acid reading average value and standard deviation. In the normal room (no Healthcoat), lactic acid levels were significantly increased after subjects stayed in the room for 2 hours ($p<0.05$). In the adapter room, lactic acid level was significantly decreased after subjects stayed in the room for 2 hours ($p<0.05$).

Blood glucose reading

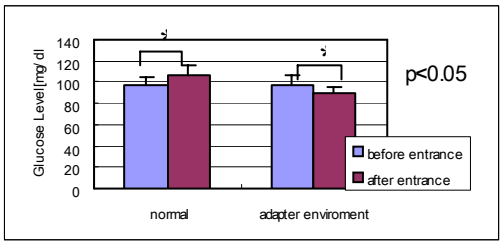

Figure 5: Blood glucose reading for normal and adapter environment.

Figure 5 indicates the blood glucose level reading average and standard deviation for the two groups before they entered the room and after they had stayed in the room for 2 hours. There was no significant change in the blood glucose level in the subjects in the normal environment. Blood glucose level was significantly decreased in subjects who stayed in the adapter environment ($p<0.05$).

Blood pressure reading

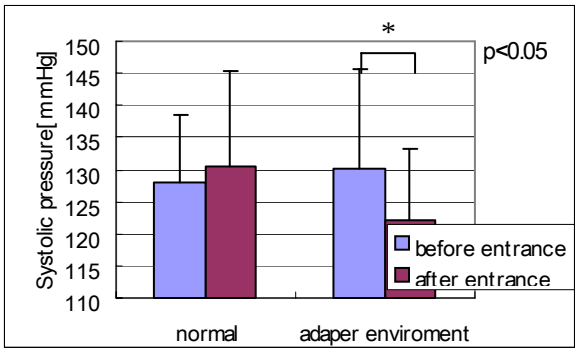

Figure 6: Systolic pressure reading for normal and adapter enviroment

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Figure 6 indicates the blood pressure reading average and standard deviation of two groups before they entered the room and after they had stayed in the room for 2 hours.
No significant change was observed in subjects in the normal environment.
In the adapter group, a significant decrease in systolic pressure was observed ($p<0.05$).

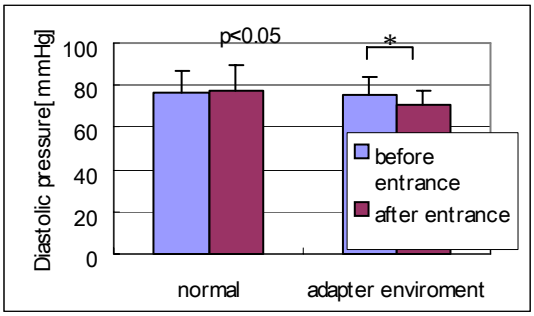

Figure 7: Diastolic pressure reading for normal and adapter environment.

Figure 7 Diastolic pressure average and standard deviation in controlled and adapter groups before they entered and after they had stayed in the room for 2 hours. No significant change in systolic pressure was observed in the normal group. A significant decrease in diastolic pressure was observed in the adapter group ($p<0.05$).

Analysis of the data indicated that normalization of blood pressure was observed in the adapter environment: both systolic pressure and diastolic pressure were significantly decreased and stabilized in the adapter environment.

Hemagglutination inhibition effect

In the normal group, 1 subject of 11 showed a change in erythrocytes; however, no other changes were observed.

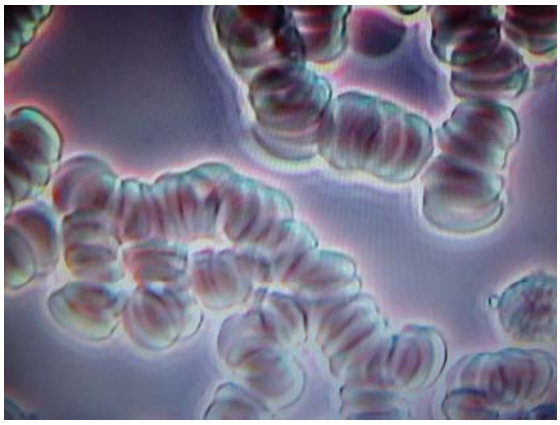

Figure 8: Picture of hemagglutination before entering the adapter environment

As shown in figure 8, before subjects entered the adapter room, the connection of erythrocytes was observed together.

However, as shown in figure 9, they separated and looked healthier after the two hours stay in the adapter room. Figure 9 Significant hemagglutination inhibition effects were observed in the adapter environment

In the adapter environment, positive changes in haemodynamic indicators (reduction of the speed of erythrocyte oxidation) were observed in 9 subjects out of 11.

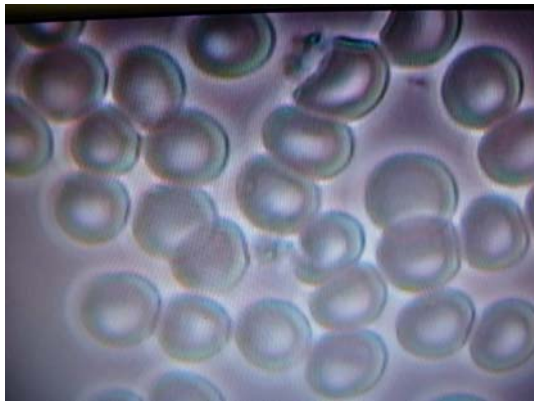

Figure 9: Picture of hemagglutination after two-hour-stay in adapter room

Discussion

When finely powdered charcoal paint is applied to residential walls with the adapter, test subjects' blood condition, blood lactic acid level, blood glucose level and blood pressure was significantly improved. Charcoal does not produce negative air ions, however, it absorbs and neutralizes positive air ions, thus removing solid pollutants and allergens in the air and improving the indoor environment.
The results of this investigation showing positive effects of charcoal on lactic acid, blood glucose, blood pressure and hemagglutination inhibition suggest further studies of charcoals in clinical fields.

Conclusion

This investigation found that when a finely powdered charcoal paint was applied to residential walls and connected to an underground charcoal powder-filled metal cylinder, the indoor environment was significantly improved. Test subjects' lactic acid levels, blood glucose levels, blood pressure and hemagglutination inhibition conditions were all improved. Further, studies of the effects of charcoal suggest that it may have applications in medical equipment.

References

[1] TERASAWA M., FUZIWARA H., SHIRAHAMA T., YOSHIMATSU M. (2005) : 'Effect of charcoal in positive ion environment', Proc. of IFMBE Vol. 8, 6th Asian-Pacific Conference on Med. and Biol. Eng. Tsukuba, Japan., 2005, PA-2-15

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