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Air Cleaner Home Textiles to Reduce Indoor Air Pollution: A Preliminary Study

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***Abstract*:- Indoor pollution sources that release gases or particles into the air are the primary cause of indoor air quality problems. Inadequate ventilation can increase indoor pollutant levels by not bringing in enough outdoor air to dilute emissions from indoor sources and by not carrying indoor air pollutants out of the area. High temperature and humidity levels can also increase concentrations of some pollutants. In this study cotton fabric is treated with natural mineral (expressed as natural mineral1) and exposed with carbon mono oxide, carbon dioxide, nitrogen dioxide and sulphur di-oxide gases individually. After passing through the fabric samples (untreated and treated with mineral), these gases were analysed quantitatively. Study indicated that there was a sharp reduction of these gases after passing through the mineral treated fabric as compared to the untreated fabric.**

Key words: Mineral, Home textiles, Indoor, Pollutants, Toxicity tester

1. INTRODUCTION TO INDOOR AIR POLLUTION

Indoor air quality (IAQ) has been of concern to scientists since long but recent trends of IAQ in north India especially in winters is big matter to concern. It is recognized that exposure to air pollutants, found in the indoor environment, plays a significant role in human health. Generally a human spend a significant proportion of his/her time indoors (1,2). Some effects on health may show up shortly after a single exposure or repeated exposures to a pollutant. These include irritation of the eyes, nose, and throat, headaches, dizziness, and fatigue. Such immediate effects are usually short-term and treatable. Sometimes the treatment is simply eliminating the person's exposure to the source of the pollution, if it can be identified. Soon after exposure to some indoor air pollutants (CO, CO_2, NO_2, Formaldehyde etc), symptoms of some diseases such as asthma may show up, be aggravated or worsened. Exposure concentrations vary and depend on a number of factors including individuals' behaviour and activities, pollutant sources, and geographical location etc. The statistics suggest that "the world's largest single environmental health risk", where 3.3 million deaths are blamed on indoor air pollution in contrast with 2.6 million deaths blamed on outdoor pollution in 2012 (3).In developing countries, health impacts of indoor air pollution far outweigh those of outdoor air pollution. Studies show that atmospheric pollutants concentrate indoors to high levels. Indoor concentrations are usually 2-5 times and sometimes 100 times higher than outside concentrations (4).

There are multiple and complex factors that affect the range and magnitude of indoor pollutants and associated health problems. Dampness is known as a major factor contributing to this, but the relationships are not fully understood (5). Hazards induced by these pollutants vary, but can be summarised to exacerbating known respiratory diseases, sensitising to airborne agents, and reducing lung functionality. A comprehensive Italian study on children (n = 20,016, mean age = 7 years) and adolescents (n = 13,266, mean age = 13 years) concludes that avoiding mould and dampness alone decreases the occurrence of related illnesses by 4 to 7% (6). Of course, the actual case of exposure is to a wide array of different pollutants in situations where complex social factors are at play (7).

The industry in response has already introduced a wide range of 'air cleaning/treating' products to the market, and the removal of both chemical and biological indoor contaminants.

A plethora of devices have been designed to enhance indoor air quality through the use of filters, UV light, chemical or biological agents. Such devices can be energy intensive, contribute to some other form of contamination, and have a short operational life. It is possible that a passive solution can overcome such limitations. For example, Home textile which is widely used in every household around the world such as curtains, bed sheets, sofa covers and carpets etc. In the present study, effect of natural mineral treated cotton fabric, in reduction of indoor pollutant gases is experimented.

2. EXPERIMENTAL

2.1 Material

Natural mineral1 was procured from the local supplier and cotton fabric with 250 gsm plain weave (1 up 1 down) woven fabric was used in the study.

2.2 Methods

2.2.1 Preparation of mineral dispersion

For this study 2 %, 4%, 6%, 8% and 10% natural mineral1 dispersion were prepared using water as solvent. These dispersions were ultra sonicated for 20 mins to for stable dispersion. These various concentrations of mineral dispersion were further used to treat the cotton fabric.

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2.2.2 Application of mineral on cotton fabric

The natural mineral1 dispersion was applied on to the cotton fabric by using padding technique. The fabric was padded in prepared dispersion of natural mineral1 and followed by nip. 2 dip and 2nip was done for each fabric sample. These samples were dried at 60^0C for 15 minutes. In this way 5 treated samples were prepared. These samples were investigated for pollution absorption capacity for four major gases responsible for indoor pollution.

2.2.3 Testing pollutant gases

To check the pollution absorption capability of treated fabric a fabric toxicity tester was used. This tester consists of a smoke generation chamber. The smoke is generated by burning textile materials and the gasses (namely carbon mono oxide, carbon dioxide, nitrogen dioxide and sulphur di-oxide) so liberated gases were analyzed using colorimetric detector tubes. These tubes can detect and quantify the concentration of these gases. Figure-1 shows the toxicity tester. In this study a PVC coated textile material was used to generate these pollutant gases. These gases were detected using colorimetric tubes placed in the narrow gas exit hole located on the chamber as well as using air quality monitoring system. In the first part of the study, these gases were allowed to pass through the untreated cotton fabric and then the concentration of these librated gases was measured using air quality monitoring system. The concentration of these gases treated as blank. In the next study, instead of untreated fabric, mineral1 treated fabric samples were used and similarly the liberated gases were analyzed.

Figure 1: Toxicity Tester

3. RESULT AND DISCUSSION

All the five treated fabric samples along with one untreated fabric were exposed to various pollutant gases for different time periods to observe the effect of treatment on gaseous pollutants. After exposure for different time period of untreated and treated fabric with various gases, the concentrations of these gases were measured using colorimetric detector tubes and air quality monitoring system. The results of the gas absorbing capacity of the treated fabrics along with untreated fabric at different interval of time are shown in the Figure 2 to 5. From the figures it is clear that untreated fabric allows to pass 10,000 ppm of CO_2 gas, 50 ppm CO gas, 15 ppm SO_2 gas and 15 ppm NO_2 gas. On the other hand, if the natural mineral1 treated fabric samples are used, sharp reduction concentrations of these gases were observed. This study showed that natural mineral1 helps in absorbing these gases. The earlier study has shown that this natural mineral1 has very good CO_2 absorption property (8). Beside this, with the treatment of fabric with natural mineral1, the porosity of the cotton fabric is reduced which may also be additional cause of reduction of concentration of the gases. It was also noticed that with the increase of natural mineral1 concentration on the fabric, the reduction of these gases improved. The time period for exposure of gases on the treated fabric also play an important role to reduce concentration of gas. This may be due to the further reduction of porosity of the treated fabric due to accumulation of gas particles on the treated fabric. .

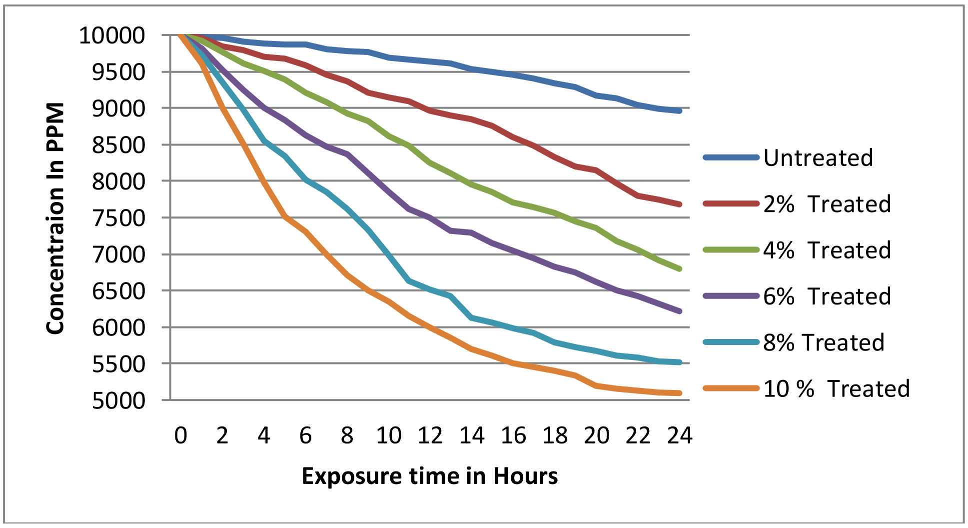

Fig.2 : Absorbency of various fabrics for CO_2 gas

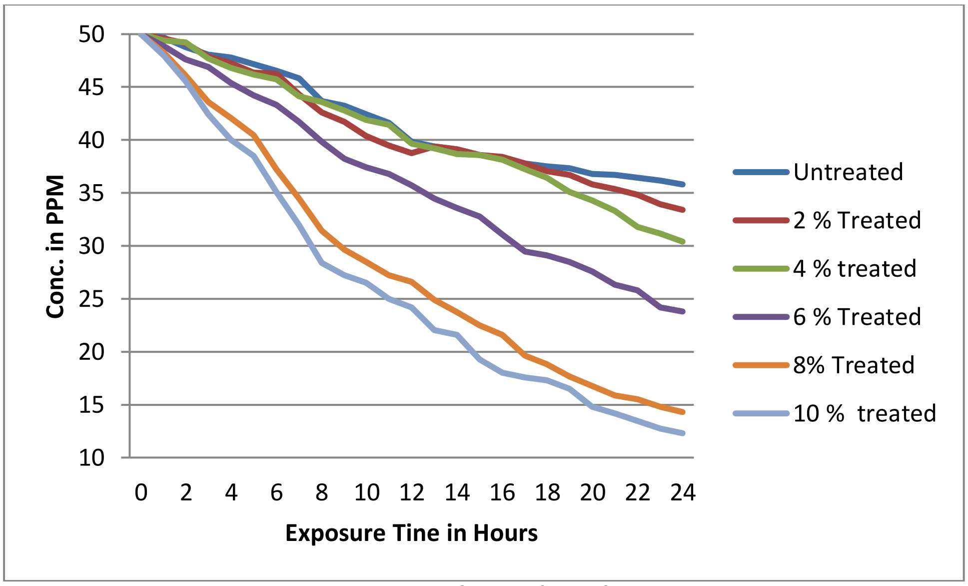

Fig. 3: Absorbency of various fabrics for CO gas

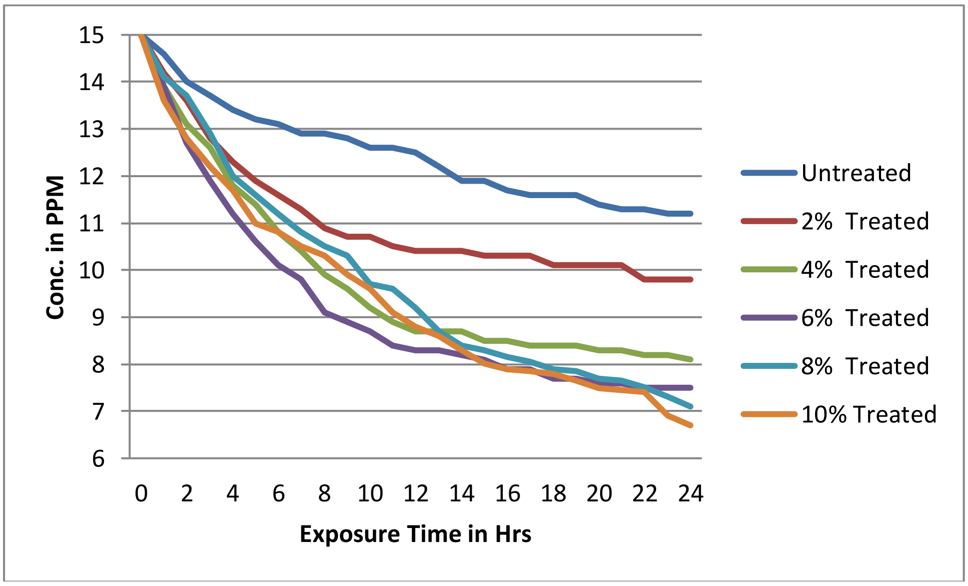

Fig.4 : Absorbency of various fabrics for SO_2 gas

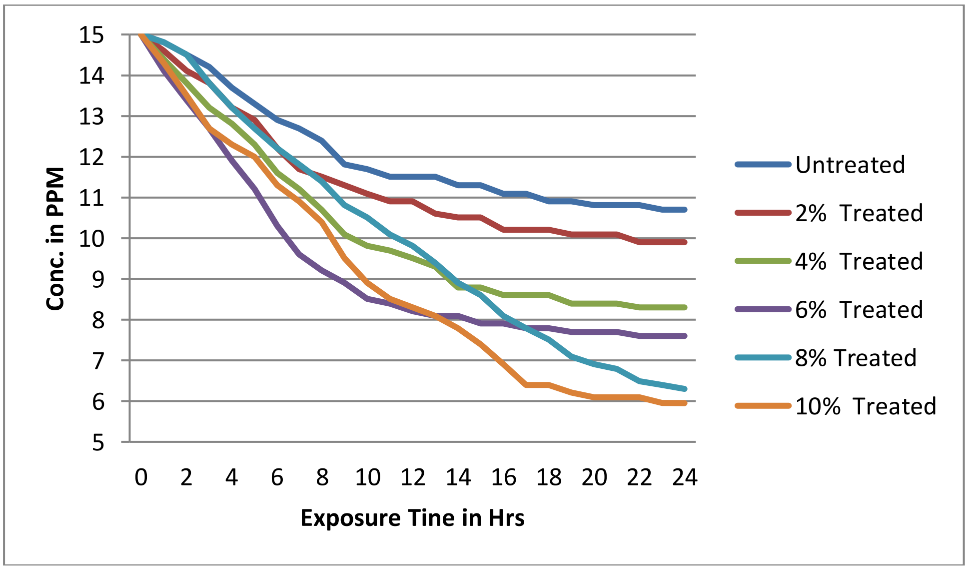

Fig.5: Absorbency of various fabrics for NO_2 gas

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4. CONCLUSIONS

The study indicated that application of mineral1 on home textiles is one of the ways to reduce indoor pollutant gases. With the increase in concentration of natural mineral1 in the solution, used for the treatment, the reduction of pollutant gases also improves. This may be due to the ability of natural mineral1 to absorb these gases and reduction of porosity of the treated fabric compare to untreated fabric. Study also showed that if the exposure time is increased the reduction of concentration of gases also improved. This may be due to the further reduction in porosity of the fabric due to accumulation of gas particles on the fabric.

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