Development of activated carbon included natural rubber latex pillow

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Introduction

Latex is a milky white liquid tapped from the trunks of rubber trees (*Hevea brasiliensis*) and then combined with water to create a thick suspension. In manufacturing natural latex foam rubber, the latex suspension is whipped to a froth and poured into carousel moulds, onto a conveyor, or into sheets and then heated to the point of vulcanization (Polyurethane Foam Association, 2000). Activated carbon(AC) is a non-graphite form of carbon which could be produced from any carbonaceous material. AC manufactured from coconut shell is considered superior to those obtained from other sources mainly because of small macro pores structure which renders it more effective for the adsorption of gas/vapour and for the removal of colour and odour of compounds (Coconut Development Board, 2013). AC has numerous applications due to its higher adsorption property. Thus it is capable to adsorbing volatile organic compounds which are also air pollutant in the atmosphere.

The incorporation of activated carbon into natural rubber latex foam pillow can provi de volatile organic compounds adsorption property apart from its cushioning effect. Many volatile organic compounds are toxic, posing a high risk to human health as a result of their widespread use and occurrence in laboratory, home and also workplace envi ronments (Magureanu, Mandache, Eloy, Gaigneaux and Parvulescu, 2005).

Therefore natural rubber latex foam pillow currently available in Sri Lankan market can be successfully value added by incorporating coconut shell based activated carbon to get the similar cushioning effects together with air purification ability upto a certain level .

Methodology

The current study was carried out at Richard Pieris Natural Foam (RPNF) Ltd, Malwana, Biyagama. Laboratory tests were done at RPNF, Richard Pieris Company plc and Bureau Veritas Consumer Product Services Sri Lanka (Pvt) Ltd laboratories. Two experimental trials with different treatments were conducted during this study. Experimental trial I was carried out to find out the appropriate activated carbon level suitable for the natural rubber latex foam pillow. It was compromised with eight treatment levels having 0% to 7% activated carbon levels with other compounding ingredients as different treatments levels. Each treatment was replicated 3 times.

Experimental trial II was done in order to find the air purification ability with respect to acetone adsorption capacity. In experiment II, both the control which has 0% activated carbon and 2% of AC treated pillow were used to investigate the acetone (a VOC) adsorption capacity. Both treatments were replicated 3 times. Complete Randomized Design (CRD) was conducted and

data obtained from both physical properties tests and acetone adsorption capacity was analyzed using analysis of variance (ANOVA) procedure of Minitab 16. Mean comparison of treatments were done using the tukey's test.

Results and Discussion

According to the physical properties evaluation (Hardness, compression set, density and tensile strength) the formulation with 2% of activated carbon has given a desirable physical structure and selected in experiment trial I.

Based on the data analysis of hardness, there is significant difference ($P<0.05$) between control (currently manufacturing latex pillow without AC) and the different treatment levels whereas no significant difference between the Control and 2% of AC treatment. Therefore similar hardness can be obtained by incorporating 2% AC into the present latex pillow formulation.

According to the results of compression set value, it is been observed that there is no significant difference between 2%, 3% of AC treatments and control. Whereas more economical benefit through the lower material cost can be obtained by incorporating 2% AC. As a rubber material is compressed over time, it loses its ability to return to its original thickness. This loss of resiliency may reduce the capability of a cushioning pad to perform over a long period of time (Compression Set of Elastomeric Materials, 2014). Therefore lower compression set value is better for the cushioning materials.

However density and tensile strength do not show the significant difference in all the treatments.

Generally, acceptable tensile strengths are above 0.006895 MPa depending to some extent on the final application of the flexible foam. There are some cases where lower tensile strength foams may be used, but it is generally advisable to use foams that have a tensile strength of at least 0.006895 MPa (Polyurethane Foam Association, 1994). In this study it shows that tensile strength for all the treatment levels have values which are more than the acceptable value.

In experimental trial II, activated carbon treated pillow was selected due to its high acetone adsorption capacity.

Table 01: Mean Adsorption Capacity at Different Treatment Levels

Treatment Levels	**AC %**	**Means of Acetone Adsorption Capacity (%)**
T1	0%	62.667[a]
T2	2%	100[b]

It shows that the treatment levels are significant for acetone adsorption capacity. According to the mean values of the sample, maximum (100%) acetone adsorption capacity was reported from activated carbon treated sample.

Previous study reported that the adsorption capacity of activated carbon increases as the molecular weight of the hazardous air pollutant increase. Cyclical compounds are more easily adsorbed than linear structured materials (Ray and Altshuer, 2002). Therefore volatile organic compounds which have higher molecular weight than acetone can also be adsorb by activated carbon.

Conclusions

Presently available natural rubber latex foam pillow can be successfully value added by incorporating 2% of coconut shell based activated carbon to get VOC adsorption capacity upto certain level while maintain the cushioning effect.

The developed AC incorporated pillow can be successfully used as an adsorption source of VOC in environment to reduce the possible air pollution while getting the cushioning effect too.

References

Coconut Development Board. (2013). *Activated Carbon Processing Technology*. Kochi: Government of India. Retrieved April 23, 2014 from http://coconutboard.nic.in

Compression Set of Elastomeric Materials. (2014). Retrieved August 13, 2013, from http://www.stockwell.com/compression-set-testing.php.

Magureanu, M., Mandache, N.B., Eloy, P., Gaigneaux, E.M. and Parvulescu, V.I. (2005). *Plasma-assisted catalysis for volatile organic compounds abatement*. Applied catalysis B: Environmental. India.

Polyurethane Foam Association. (1994). Information on flexible polyurethane foam. Wayne. Retrieved August 13, 2014, from http://www.pfa.org.

Polyurethane Foam Association. (2000). Information on flexible polyurethane foam. Wayne. Retrieved August 30, 2014, from http://www.pfa.org.

Ray, I. and Altshuer, B. (2002). *Economical Removal of Malodorous and Toxic Organics.* Adsorption with Activated Carbon. Westfield, NJ.