

Activated Carbon – A Textile Material

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Abstract:- Activated charcoal is a globally accepted antidote. It has a wide range of functional properties among which the self air filtering property is demanding. The same could be incorporated in textile materials. As well as its anti microbial properties, odor reduction properties etc highlight the importance and requirement of activated charcoal in medical and industrial textiles. This paper showcases the properties of activated charcoal, how it could be produced and its application on textile materials along with the modified properties on textile materials after the application of activated charcoal over it.

Keywords:- Activated Charcoal, Carbon, Textile Materials, Self Filtering, Anti Microbial.

I. INTRODUCTION

During burning or combustion, there will be incomplete burning which results in the formation of unburned residuals or leftovers. These unburned residuals are known as charcoal. During the heating of coconut shells or wood or even coal for industrial applications, in heating chambers or in vacuum chambers, there will be the combustion taking place. In the process of combustion, there will be release of all type of volatile compounds leaving behind the unburned or partially burnt carbon particles known as charcoal. When the same leftover charcoal are subjected to high temperature heating the activation process will take place. The output of high temperature heated leftover carbon is activated charcoal. Activation of charcoal results in the modification of internal structure of carbon atom like increased carbon atom surface area or reduced pore size. The increased pore sized activated charcoal will entrap toxins and chemicals and prevent further absorption, along with that the negative electrical charge of these pores will attract all positively charged molecules (toxins and gases). These properties of activated charcoal could be implanted in textile fields or in textile materials.

Major advantages of using activated charcoal as textile materials are

- It acts as air filters
- It has anti odor properties
- It acts as cleansing agent

II. ACTIVATED CHARCOAL

Being a universal anode, activated charcoal continued as a potent natural treatment agent. It has a wide range of benefits ranging from medical values to industrial applications. These are fine black powder made by burning things like coconut shell, wood, bone char, petroleum coke, sawdust, coal, etc. By the activation of charcoal, its internal structure, surface area as well as pores size are modified. The activation process reduces the pore size of carbon atom in charcoal and it will result in the increased surface area. Thus activated charcoal will be more porous than normal charcoal. One of the major advantages of activated charcoal over regular charcoal is activated ones does not cause any harm as it does not contain any kind of toxins. But regular charcoal contains toxins that may harm humans during its usage.

III. WORKING OF ACTIVATED CHARCOAL

Air around us contains lots and varieties of toxin gases and chemical particles, which easily gets absorbed by normal clothing material. But the presence of activated charcoal in the clothing material will entrap those toxin gases and chemical particles in the pores present in its internal structure and further prevents the absorption process to any another medium. The anionic charge i.e., negatively charged ions present in the pores of activated charcoal will attract the cations i.e., the positively charged ions like toxins and chemicals present in the air around and will entrap it in the pores. As the size of pores and number of pores in the internal structure activated charcoal is high, it can entrap a large volume of those chemicals and toxins.

➤ Activated charcoal for noxious treatment

Activated charcoal is a commonly used antidote for noxious treatment and even for overdosed drug control. It repels the absorption of toxins and drugs by the body and thus helps in hindering the effects of those poisonous materials once it gets consumed by the body. After the intake of any drugs or poisonous materials, immediate consumption of activated charcoal will reduce the absorption of those drugs into our body by almost 74%. Even after a delayed consumption of poisonous drugs, intake of activated charcoal could control the negative effect of drugs to a great extend.

➤ *Reduces the fish odor syndrome symptoms*

TMAU known as trimethylamineuria is a fish odor syndrome which causes the generation of unpleasant odors in individuals. It happens because of the accumulation of a genetic compound called trimethylamine (TMA) causing the emergence of rotting fish smell. The treatment of those people with activated charcoal with a quantity of 5 grams for ten days reduced the secretion of TMA in their body.

➤ *Odor reduction properties of activated charcoal*

Thierry Le Blan and Arnaud Vatinel (2018) conducted a study on the odor reduction properties of textile materials. A part of their study dealt with activated carbon treated fabrics. They stated that activated carbon was used as a functional material for Anti-Microbial and odor control finishing on textile fabric. It was applied on fabric surface by coating technique and tested the active sites. They also added that on the active sites odorous substances are chemically or physically fixed (Vander Waals or ionic bonds (+ chemical functionalisation to increase reactivity)). Chemical selectivity depends on (a) pore size (macro pores: from 50 to 2000 nm, meso pores: from 2 to 50 nm, micro pores:

➤ *Is Activated Charcoal Safe?*

Activated charcoal is considered safe in most cases, and adverse reactions are said to be infrequent and rarely severe. That said, it may cause some unpleasant side effects, the most common of which are nausea and vomiting. In addition, constipation and black stools are two other commonly reported side effect. The usage of activated charcoal as an antidote, it might reach lungs and not to the stomach. This is especially true if the person receiving it vomits or is drowsy or semi-conscious. Because of that, it is preferably advised to give the activated charcoal to the ones who are in a conscious state. Moreover, activated charcoal may worsen symptoms in individuals with variegate porphyria, a rare genetic disease affecting the skin, gut and nervous system. In some cases, activated charcoal could be used to remove any kind of blockages. If a person consumes medication in an over dosage, the the consumption of activated charcoal will reduce the effect of that particular medicine or drug inside his body. Therefore, individuals taking medications should consult their healthcare professional prior to taking it.

TSM Eza et al., (2013) found the effectiveness of activated carbon produced from coconut and oil palm shells as anti-odor on textile fabrics. In their work they prepared activated charcoal from coconut and oil palm shells. It was then applied on polyester and cotton fabrics with different concentrations. The method they followed for the application of activated charcoal on the fabric was through coating and pigment printing techniques. They conducted two types of odor measurements one human olfactory tests and the other with the help of portable electronic nose 3 (PEN 3) devices which evaluate the effectiveness of the finished anti-odor activated carbon on samples. As the result of their work they found out that fabrics containing activated carbon are able to reduce odor to a great extend. By their study, they concluded that the coated activated

carbon fabrics are comparatively better than the printed ones. Also they added the higher the concentration of activated carbons on the fabrics, the lower it generates odor intensity and odor annoyance.

IV. ACTIVATED CARBON FABRIC

Activated carbon fabric: An adsorbent material for chemical protective clothing, a study conducted by Nagesh K. Tripathi et al., (2018) found that activated carbon fabric has many advantages over other commercial porous storage materials such as granular activated carbon and powdered activated carbon in terms of adsorption capacity, well defined micro porous structure, stability, flexibility and ease of lamination to various substrates. Activated carbon fabrics showed a greater demand utility as an adsorbent material in different areas like nuclear, biological and chemical (NBC) protection suit. ACF is prepared by pyrolysis to obtain enhanced specific surface area and micro pore volume. Before starting heat treatment process, it is also ensured that suitable precursors or raw materials are selected to achieve desired quality of activated carbon fabric. The type of precursors such as PAN, pitch and rayon affects the conditions of heat treatment. Stabilization, carbonization and activation processes were optimized to achieve desired quality of activated carbon fabric. Activated carbon fabrics are used in adsorptive removal of toxicants such as hydrocarbons, hydrogen sulphide, chloride, ethers, acids, formaldehyde, sulphur dioxide, nitrogen and other sulphur compounds. It could also be used for adsorptive removal of waste liquids from different industries. It also removes toxic metal content from active sites.

➤ *Fabric selection procedure for work wear*

Ilze Baltina et al., (2017) proposed the procedure for fabric selection for work wear during procurement. In their study, the compliance of the fabric used in the supplied field uniform with the requirements of the technical specification and the sample submitted within the tender was analyzed along with its geometric characteristics, structural characteristics, as well mechanical and physical properties. They stated that the procurement of protective work wear can be divided into two parts: first - buying fabrics, second - sewing products from the purchased fabrics. In fabric procurement, the fabrics should be tested and their conformity with technical specifications should approve mandatory. The technical specification of any work wear should include such characteristics as tensile strength, elongation; tear strength, abrasion resistance, air permeability, and water vapor permeability.

➤ *Functional Properties of activated carbon treated textile materials*

Functional properties of activated carbon treated textile material were analyzed by R. Pragadheeswari and Dr. K. Sangeetha (2017). In their work activated carbon was used as a functional material for anti-microbial and odor control finishing on textile fabric. It was applied in the surface of the fabric by direct application and Micro encapsulation methods. Finished fabrics were assessed the

effectiveness of the anti-microbial property through disc diffusion method and odor measurement are conducted to evaluate the effectiveness of the anti odor property through organoleptic test (in house method). Their assessment results shows that the anti bacterial, anti- Fungal, anti odor and moisture absorbency assessment value were maximum for coated fabric than the ones finished by charcoal spraying method.

➤ *Neem – Charcoal treatment and functional properties*

A study on the effect of neem-charcoal application on functional properties of cotton fabric was conducted by G. Gunasekaran et al., (2015). For their study the neem charcoal particles were prepared in a simple way and were applied on to 100% cotton fabric which was used mainly for shirting. For the application of the paste of activated charcoal over fabric, they followed pad-dry-cure method. As per their study, they concluded that the anti-bacterial activity of treated fabric increased by the application of neem-charcoal.

➤ *Activated Carbon for diffusion control sorption in apparels*

Dianchen Gang et al., (2007) made a quaternized poly (4-Vinylpyridine) coated activated carbon for diffusion controlled sorption of chromium (VI). In their work the adsorption of Cr (VI) was investigated at different initial concentrations. An analytical derivation of a finite bath diffusion control model was made which also have changing bulk concentrations. It also introduced a constant which could relate the radius of the absorbent particle and the fractional attainment of adsorption. The results indicated that the adsorbent provided fast adsorption kinetics and the modified diffusion-control model fitted the experimental data well. The observed sorption kinetics was consistent with the finite bath diffusion, with an average value of 4.1010–6 cm²/s for the product of the distribution coefficient and the effective diffusivity in the adsorption of Cr (VI) on the quaternized poly4-vinylpyridine coated activated carbon.

➤ *Activated charcoal treated mask –Design and development procedure*

V.Parthasarathi (2014) did the development of dual layered non woven mask with activated charcoal finish for healthcare. She developed dual layer needle punched polypropylene nonwoven fabric. It was finished with activated charcoal. The pore size of the non woven fabric was characterized using a polarized microscope. Activated charcoal was charcoal treated with oxygen to open up tiny pores between the carbon atoms. The dual layer mask was developed using fusing machine. Bacteria filtration efficiency along with its mechanical properties were analysed as well as evaluated. Her inferences were as follows. She focused in developing a two layered and thin mask with activated charcoal finish that would provide extra filtration of the airborne particles than a normal surgical mask. The effects of filtration, structural variables, air permeability and mechanical properties of the fabrics were studied by various tests like the tensile strength, tearing strength, stiffness, air permeability, bacterial

filtration efficiency, and bursting strength. Those test results had also shown a positive inclination in favor of the mask.

➤ *Non-woven activated carbon fabrics*

Robert D. Giglia et al., (2000) developed a non-woven activated carbon fabric. The developed non-woven fabric material contained, a toxic vapor absorptive ingredient therein, activated carbon particles and/or 35 activated carbon fiber, by the wet-laying process, utilizing fibrillated acrylic fibers as the binder material. The product was air and water vapor permeable and provides the user with protection from dangerous chemicals in liquid or gaseous form. The usage of both activated carbon fiber and activated carbon particles improved the results and showed a better performance rating than the others.

V. CONCLUSION

Activated charcoal is a safe universal anode with no side effects. It has versatile functional properties which doubles the value of its existence in textile industries. Activated charcoal finishes on textile material improves its anti microbial properties, anti bacterial properties, self air filtering properties, anti odor properties and all these are practically proved too. So the future existence of Activated charcoal in textile as well as in apparel industry will be very notable.

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