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Synthesis & X-Ray Diffraction Characteristic Study of Agricultural Waste Activated Carbon and AC/Fe_3O_4–NANO PARTICLES

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ABSTRACT

Adsorption is an powerful exterior performance in industrial polluted water treatment for separation of dyes and other impurities. Among many types of farm waste adsorbent used, based on the high adsorption capacity and its low cost. In this paper we have to prepare the activated carbon from cajanus cajan stem as a farm waste by physical method and synthesis of Fe_3O_4/Activated carbon nano particles by hydro thermal method. The cajanus cajan stem activated carbon and Fe_3O_4/Activated carbon nano particles are characterized through X-ray Diffraction study. From this study we have to confirm the acquired material is a nano particle.

KEY WORDS: Activated Carbon, Adsorption, Nanoparticle, Pores, Cracks.

1. INTRODUCTION

Earliest people in India used charcoal for drinking water filtration. Egyptians used carbonized wood as adsorbent in health centre and water cleansing agent. The mass level production of activated carbon from the agricultural waste material was began in the earliest year of 20th century and used in cleaning color of sugar solution . In the United States they extracted activated carbon from black ash which was found to be more effective than that of produced from agricultural waste in decolorizing liquids (Jambulingam, 2007). The disposal of effluents from industries has become a major threat and a most challenging task and issue in environmental science as it directly deals with significance importance of controlling water pollution .The synthetic dyes are majorly used in various branches of industrial processes, such as the textile industry, paper printing. Although dyes are not only hazardous it can also induce some medical disorders, like increasing heart beat rate, shock, Heinz body formation, cyanosis, jaundice, quadriplegia, and tissue necrosis in humans (Ebrahimian Pirbazari, 2014). Recently textile printing and other similar industries are undergoing issues of treatment and removal of dye wastewater. Many industries expel their polluted water into surface water without any treatment because of technological and economical limitations (Kah Aik Tan, 2012). Recently a number of methods are available for waste water purification discharged from dyeing industries, the important and economic method is adsorption process (Krishnaa & Sivaprakashb, 2015). Nano technology is the most advanced fast and cheapest method for waste water treatment. Nanoparticles are mostly studied due to various applications in functional group and structural applications (Adeleh Aftabtalab Hamed Sadabadi, 2015). In comparison of other waste water treatment methods the commercial carbon adsorbent method is best removal of dissolved organic compounds. However, the commercial carbon is more costly so the researchers are ideally used low cost activated carbon are for removal of dyes from dyeing industry waste water (Kah Aik Tan, 2012). The application of magnetic nano materials are drug target, clinical diagnosis image and used as a reaction catalyst etc (Poedji Loekitowati Hariani, 2013). Ion Oxides nano materials are used in broad areas of physical science. Fe_3O_4 (magnetite) is a most important nano particle in comparison with the other nano particles. There are many various methods used to produce Fe_3O_4 nanoparticles, all the different procedures are explained in different articles. Further reason for using magnetic iron oxides is, it is not easily affected by other chemicals, it having very low toxic nature and good adsorbing capacity so this method is used widely for separating toxic components and organic contaminants from the waste water (Babak Kakavandi, 2013). Various scientists have used this method based on its attracting applications. Extremely small size of nano-materials provides advantageous characteristics with a size reduction, mostly atoms being placed on the surface layer of the particle provides with a remarkable development of surface area of nanopowders [Hashem FS 2014]. In this article, Fe_3O_4/Cajanus cajan stem activated carbon magnetic nano particles are produced by the process of Hydrothermal method. The resulting Fe_3O_4-AC nano materials were studied by X-ray diffraction method (XRD) (Yankai Du, 2014]. In this article nanoparticles of Fe_3O_4 supported on cajanus cajan stem activated carbon (AC) (Igor Bychko, 2012). The present research investigates the obtained Fe_3O_4/AC magnetic nanoparticles are confirmed as a nano composites and it will be used as cheap and effective adsorbent (Seyed Mohammad Mostashari, 2012).

2. EXPERIMENTAL

Materials: Agricultural waste cajanus cajan stem was collected from fallow lands in and around Erode District, Tamil Nadu, India and are rinsed with tap water followed by washing in distilled water (Gopala, 2014). The substance is cut into pieces of 2-4 cm size sun dried for one week. The adsorbent is prepared as per the following procedure with the dried mass (Riaz Ahamed, 2013).

Preparation of Activated Carbon by Physical method: A dried sample of cajanus cajan stem introduced to muffle furnace and heated at 800^0C for two hours. It is followed by cooling and washing in distilled water to maintain a pH value of 7, oven dried at 105^0C for four hours and grounded. It was sieved with a 53µ mesh to obtain a fine powdered cajanus cajan stem activated carbon and it is kept in an air tight container and used for various experiments (Jiao Chen & Julia Xiaojun Zhao, 2012).

Synthesis of Nano composites by hydrothermal method: Hydrothermal synthesis is a typical solution-based approach, which is usually employed under high temperature and pressure. Apart from the thermal decomposition method which can be only used as an organic compound as a solvent, the synthesis from hydrothermal method can take place in a water-based system and it is followed at lower reaction temperature (160–220 °C) in a relatively environment friendly approach. It is highly efficient and convenient process in preparing nono composite materials (Wankhade Amey & Ganvir, 2013). The Fe_3O_4/ACMNCS is manufactured/synthesized by an effective process of hydrothermal method. In typical experiment 50 mg of cajanus cajan stem AC were suspended in 50ml of de-ionized water to form stable black color solutions. Subsequently, 30ml of $FeCl_2{\cdot}4H_2O$ and 80ml of $FeCl_3{\cdot}6H_2O$ were dissolved in to the solution prepared above and pH value was adjusted 10-11 by adding 30 % of ammonium hydroxide solution (NH_4OH). After that, the final solution is shifted into the 75 ml Teflon-lined stainless steel autoclave were placed in an oven at 180^0C for 12 hours. The autoclave was cooled to room temperature after the hydrothermal process and a black color precipitate is washed with ethane and double distilled water repeatedly. Finally, the prepared Fe_3O_4/ cajanus cajan stem AC MNCS sample was dried in vacuum oven at 700^0C for overnight (Mohd Adib, 2015).

Characterization: Solid state scientists used mainly the XRD techniques which are the most important characterization tools used in solid state chemistry, nanochemistry, thin film technology and material science. The structural studies can be obtained from XRD method the result of structural study are obtained from peak positions of diffraction pattern (Bykkam Mohsen Ahmadipour, 2015).

3. RESULT AND DISCUSSION

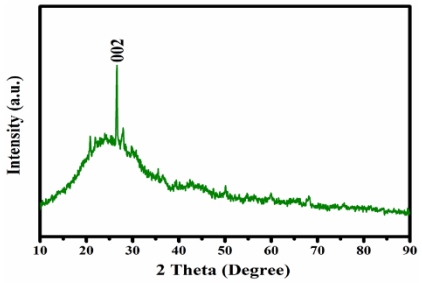

Figure.1. X-ray Diffraction Analysis of Activated Carbon

The X-ray diffraction (XRD) measurements of pure cajanus cajan stem AC were prepared at 25^0C using a PAN analytical (X-Pert- Pro) diffractometer with a Cu $K\alpha_1$ radiation (λ= 1.5406 Å) over a scanning interval (2θ) from 10 to 90° (Youjun He Faqi & Yu Wenjuan Guo, 2013). The (002) peak of the sample in the observed diffraction profile (Fig.1) is almost at around 26^0 reveals to amorphous type of carbon (Sarkar, 2014).

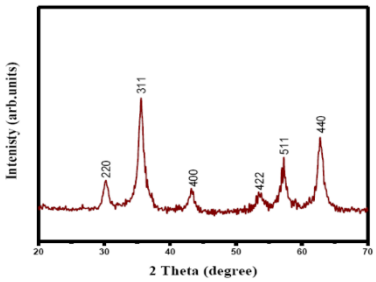

Figure.2. X-ray Diffraction Analysis of Fe3O4/Activated Carbon Nano composite

The powder XRD studies for synthesized magnetite (Fe_3O_4) nanoparticles was recorded by a Rich Secifer, X-ray diffractometer using monochromatic nickel filtered CuK (= 1.5416 Å) radiation (Amala Jayanthi, 2013). The structure of crystal and the phase purity of the synthesized cajanus cajan stem activated carbon magnetic (Fe_3O_4) nanoparticles were examined (Javier, 2010). In Fig.2 displays the typical XRD result of the cajanus cajan stem activated carbon magnetic (Fe_3O_4) nano particles samples (Sunil, 2014). The stronger peaks reveal the high purity, good crystallinity and the peak widening indicates the development of cajanus cajan stem activated carbon Fe_3O_4 nanoparticles (Issa El-Nahhal Shehata, 2012). For cajanus cajan stem activated carbon Fe_3O_4 magnetic nanoparticles shows various peaks similar to planes (220), (311), (400), (422), (511) and (440) are observed (Obaid ur Rahman, 2012). The structure of crystal is found to be face centered cubic in lattice point a = 8.4272 Å and result well matched

with JCPDS (89-3854) data (a=8.393(Å) (Theivasanthi, 2012) Urai Seetawan Suwit Jugsujinda Tosawat Seetawan Ackradate Ratchasin Chanipat Euvananont Chabaipon Junin Chanchana Thanachayanont Prasarn Chainaronk 2011, Yoshikazu Todaka, Masahide Nakamura Satoshi Hattori Koichi Tsuchiya Minoru Umemoto 2003) . The peak value also shows that the particle size is 30 nm were calculated from scherrer formula (Theivasanthi, 2014).

4. CONCLUSION

Cajanus cajan stem activated carbon/Fe_3O_4 Magnetic nanoparticles were successfully synthesized using low-cost, renewable, eco-friendly bio templates. The activated carbon and nanoparticles were analysed using X-ray diffraction technique. From this analysis we obtain the characteristics of activated carbon (002) peak is observed diffraction is almost at around 26º reveals to amorphous nature of carbon. The characteristics of Fe_3O_4/Activated carbon nano particles in X-ray diffraction technique various peaks similar to planes (220), (311), (400), (422), (511) and (440) are observed so the structure of crystal is found to be face centered cubic with lattice constant and its mean particle size is 30 nm. So the Fe_3O_4/Activated carbon nano particles are confirmed as a nano particles and it should be very effective in removal of dyes when compared to normal activated carbon.

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