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AMBIENT AIR QUALITY'S STATUS DURING THE MANUFACTURING OF ACTIVATED CARBON FABRIC BY CONVENTIONAL AND MICROWAVE TECHNIQUE

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Abstract- On growing awareness against environmental pollution for sustainable development, the international chemistry community has made efforts to rectify pollution problems by greener alternatives. The activated carbon manufacturing industries have been included in the RED category by Central Pollution Control Boards and have to follow the stringent environmental norms. Most of the industries complies environmental norms and some are deviating from the norms, so need to develop the greener technology.
In the present study, Activated carbon was prepared from biological waste raw material, by conventional muffle furnace and modern microwave pyrolysis technique (MWT). The paper discusses comparative studies of ambient air pollution generated during the preparation of activated carbon by conventional and microwave pyrolysis technique. MWT requires less energy and less time and the manufactured products shows high adsorption capacity. The MWT is found to be less polluting compared to the conventional method and it should be applied in large scale production of activated carbon for sustainable development.
Keywords- Ambient Air Quality, Activated Carbon, Conventional Method, Microwave Technique, Sustainable Development

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Introduction

Activated carbons have long been used as adsorbents in industry due to the superior adsorption capacities. Their properties depend on the pore structure which in turn depends on the preparation conditions as well as the chemical nature of the carbon surface [1].
The entire activated carbon manufacturing unit's uses conventional method (Rotary Kiln) for manufacturing of activated carbon. It require large amount of fuel for initial carbonization then require high temperature for activation and this process require a longer time. The by-products of these method is ash, pebbles etc. along with some gaseous by-products are also eliminated.
Today's processing industries are facing increasing global competition, more stringent environmental regulations higher operational cost and low product yield. In the foreseeable future processing industries will be looking for high performance conventional as well as non-conventional processing technology. This is the point at which processes based on microwave energy will get favorable consideration [2].
Moreover, a systematic lab scale study was undertaken by making use of jute sack an agro waste to explore its efficiency in preparing activated carbon by using conventional and non conventional pyrolysis techniques and to study the potential of microwave induced treatment as a viable alternative for conventional pyrolysis by comparing both the techniques. The products were characterized for various quality control parameters.
The present study was carried out to determine the ambient air pollution generated during the preparation of activated carbon by conventional and microwave pyrolysis technique (MWT). It also highlights the advantages of MWT over the conventional process.
To study the gaseous elimination during conventional and modern technique HVS was used. In India, the ambient atmospheric conditions have progressively deteriorated due to urbanization, industrial development, lack of awareness, poor maintenance etc. [3]. This paper examines the significant difference in variation of air pollutants concentrations during conventional and modern Micro-

wave technique. Suspended particulate matter (SPM) PM_{10} (RSPM), Sulphur dioxide (SO_2), Oxides of Nitrogen (NO_x) were collected during the manufacturing of activated carbon by conventional and microwave manufacturing techniques. The present study deals with the effect of industrialization and emission on ambient air quality during conventional and microwave manufacturing process.

Experimental

Activated carbon Fabric synthesis by Conventional Method

Jute Sack used in this experiment was obtained from local suppliers in Nagpur. After washing with deionized water, the raw materials were oven dried at 105°C for 24 h. The method of activated carbon Fabric synthesis was modified .The sample was carbonized using horizontal Stainless Steel Container and kept in furnace. The carbonization was carried out by heating at the rate of 10°C/ min from room temperature up to 600°C and hold at that temperature for 1 h. The sample was then cooled to room temperature and was washed with hot distilled water several times to remove residual impurities. Finally, the activated carbon Fabric was dried at 90°C for 24 hour [4]. Percentage yield was calculated by calculating the difference between the average weights of initial and final weight of the Activated carbon Fabric. Muffle Furnace was designed in such a way that outlet coming from muffle was attached to impingers containing absorbing medium for Sox, NOx. High volume air sampler was used for determination of Air Quality. Glass Fibre Filter papers were used for determination of SPM and RSPM [5].

Activated carbon Fabric synthesis by Microwave Method

Initial preparation of Raw Material was same as that of conventional method. The preparation of activated carbon from Jute Sack with microwave energy was carried out at 300^{0}C for 30 min in Silica container. The characteristics of Microwave activated carbon fabric and its adsorption study was carried out. The variables studied were: activation time (range of 30 - 180 min), activation energy (range of 225-500 watt), and Temperature of activation. The optimum conditions from experimental results were obtained [6]. Percentage yield was calculated by calculating the difference between the average weights of initial and Final weight of the Activated carbon Fabric. Air quality during synthesis of activated carbon fabric was also done by using high volume air sampler.

Ambient Air Quality Monitoring

The conventional such as suspended particulate matter (SPM), Respirable Suspended Particulate Matter (RSPM), Sulphur Dioxide (SO2), oxides of Nitrogen (NOx) were monitored. All these pollutants were monitored as 8 hourly averages. The high volume samplers with cyclone separator were used for collection of air samples for suspended particulate matter as well as Respirable particulate matter by drawing air at (1.0-1.5 m3/min) flow rate and gaseous pollutants at sampling flow rate of 0.5 to 1.0 lpm. Gravimetric method was followed to determine SPM and RPM concentrations whereas standard wet chemical (Spectrophotometric) methods have been followed to evaluate the concentrations of individual gaseous pollutants.

Results and Discussion

The ambient air quality status observed during the study period is presented in Table 1. The average concentrations of SPM, RSPM, SO_2, and NO_x during ambient air monitoring were observed as 2.07 mg/m^3, 1.20 mg/m^3, 1.14 mg/m^3 and 0.62 mg/m^3 respectively. While the individual observations of 8 hourly SPM, RSPM, SO_2, and NO_x concentrations were recorded in the range of 0.36-3.72 mg/m^3; 0.28-2.22 mg/m^3; 0.16-1.62 mg/m^3 and 0.08-0.94 mg/m^3 respectively.

The average concentrations of SPM, RSPM, SO_2, and NO_x during symthesis of activated carbon by conventional method were observed as 6.87 mg/m^3, 5.21 mg/m^3, 3.23 mg/m^3 and 1.58 mg/m^3 respectively. While the individual observations of 8 hourly SPM, RSPM, SO_2, and NO_x concentrations were recorded in the range of 2.86-9.14 mg/m^3; 0.48-6.64 mg/m^3; 0.52-4.38 mg/m^3 and 0.21-2.28 mg/m^3 respectively.

The average concentrations of SPM, RSPM, SO_2, and NO_x during ambient air monitoring were observed as 4.74 mg/m^3, 4.36 mg/m^3, 2.94 mg/m^3 and 1.12 mg/m^3 respectively. While the individual observations of 8 hourly SPM, RSPM, SO_2, and NO_x concentrations were recorded in the range of 2.78-8.22 mg/m^3; 0.54-5.92 mg/m^3; 0.52-3.78 mg/m^3 and 0.18-1.36 mg/m^3 respectively.

The variation of SPM, RSPM, SO_2, and NO_x during the overall study is shown in Figure 1. It was noticed that the SPM and RSPM levels during manufacturing of activated carbon by conventional manufacturing process exceeds as compared to microwave manufacturing process. Apart from this SO_2 and NO_x level were also high in case of conventional method than microwave method.

In this study it was analyzed that the time required, temperature range and energy consumption for synthesis of activated carbon fabric by Microwave method was economical, clean technology and better result were obtained as compared to that of conventional method with muffle furnace.

Table 1- Ambient Air Quality Status during the study period

Sampling Location	SPM	RSPM	SO_2	NO_x
	Average ± Standard Deviation (Range)			
Ambient Air	2.07±1.23 (0.36-3.72)	1.20±0.73 (0.28-2.22)	1.14±0.57 (0.16-1.62)	0.62±0.33 (0.08-0.94)
Conventional Technique	6.87±2.41 (2.86-9.14)	5.21±2.66 (0.48-6.64)	3.23±1.56 (0.52-4.38)	1.58±0.90 (0.21-2.28)
Microwave Technique	4.74±2.04 (2.78-8.22)	4.36±2.02 (0.54-5.92)	2.94±1.06 (0.52-3.78)	1.12±0.60 (0.22-1.36)

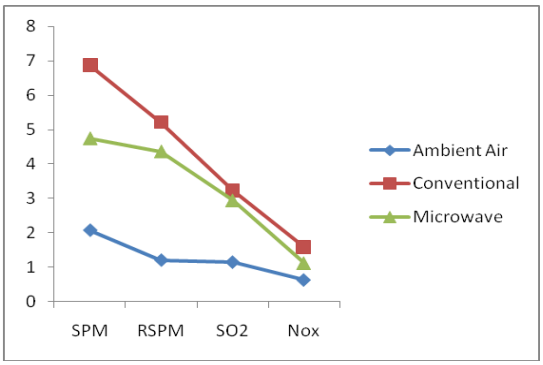

Fig. 1- Variation of SPM, RSPM, SOx and NOx concentrations during study period

Conclusions

The emphasis of this study is to optimize processes involved with the production of activated Carbons Fabric with prescribed surface properties (micro- or meso porous structure) and specific end uses. The higher purity, negative cost, high rate of production, strong carbonaceous structure. High absorptive properties and highest range of application of jute sack activated carbon fabric makes them most useful advanced material.

Ambient air SPM, RSPM, SO_2, and NO_x concentrations were comparatively decreases during microwave synthesis of activated carbon. Hence, this study shows that there is a need of new greener and environmentally sustainable microwave technology for the synthesis of activated carbon.

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