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Preparation and activation of activated carbon from waste materials-A review

Pratibha R. Gawande[1], Dr. Jayant P. Kaware[2]
[1]Datta Meghe College of Engineering, Airoli, Navi Mumbai, Maharashtra, India
[2]Bhonsala College of Engineering and Research, Akola, Maharashtra, India

***Abstract*— This paper gives information about different value added waste for preparation of activated carbon is used as adsorbent. There are different types of waste which can be converted into activated carbon by chemical activation using different activating agents like $Cacl_2$, H_2So_4, H3Po4, KoH, and $Zncl_2$.These activating agents are used by different investigators for activation of carbon prepared from waste at different performing conditions. Adsorption isotherms were developed by different authors with respect to their work.**

***Keywords*— Activated carbon, Adsorbent, Activating agents, Adsorption Isotherm.**

I. INTRODUCTION

T Activated carbon, which possesses highly developed pore structure, is widely used as adsorbents, catalysts and catalyst supports for the removal of pollutant species from gases or liquids and for purification or recovery of chemicalsThe properties of activated carbons depend on the activation process and the nature of the source materials [1]. Generally, the activation of a carbonaceous precursor can be performed through physical or chemical activation or a combination of both. The chemical activation is normally preferable over physical activation since it is a faster process with a lower activation temperature [2]. Traditionally, activated carbon was used to decolorize sugar syrup in order to produce white sugar. Nowadays, however, its application has been extended to the treatment of a wide variety of pollutants [3].The agro industrial waste generated Impact of the United Nations in the environmental sector and in health, for release of toxic substances. Currently they have developed strategies for managing Agro industrial Waste Handling & volume reduction Generated [5].Activated carbons are carbonaceous materials that can be distinguished from elemental carbon by the oxidation of the carbon atoms found on the outer and inner surfaces. These materials are characterized by their extraordinary large specific surface areas, well-developed porosity and tunable surface-containing functional groups [6].The most common chemical agents used are ZnCl2, H3PO4, KOH and Noah. The huge cost of the production of activated carbon has been the most challenging parts for commercial manufacturers. Therefore, the use of cheap raw materials with high contents of carbon as well as low inorganic compounds has been a focus of research efforts in the last decades.[7] Activated carbon is one of the most popular adsorbents used in numerous industries for the removal and recovery of organic and inorganic compounds from gaseous and liquid streams. It has high adsorption capability due to its high internal surface area and porosity formed during carbonization process. [8].

II. PREPARATION AND ACTIVATION OF ACTIVATED CARBON FROM WASTE MATERIALS

Sekirifa Mohamed Lamine et.al Chemical activation of an Activated carbon Prepared from coffee residue. Authors were used Coffee residue, a low-cost agricultural byproduct for preparation of carbon and activated by using phosphoric acid. The raw material was impregnated and then paralyzed respectively at 600 and 700°C for 1 h. The resulting products were characterized by adsorption of phenol at room temperature. Investigators were developed adsorption isotherms according to Langmuir and Freundlich models [1]. Tang Shu Hui and Muhammad Abbas was investigated Potassium hydroxide activation of activated carbon. Potassium hydroxide activation of activated carbon was investigated by Tang Shu and Muhammad Abbas. They were used Potassium hydroxide as an activating agent in activated carbon preparation. Authors were used activation temperature lower the boiling point of KOH 1327°C [2]. Billy T H Guan et.al. Physical preparation of activated carbon from sugarcane bagasse and corn husk and its physical and chemical characteristics Sugarcane Bagasse and Corn Husk were used for preparation of activated carbon Authors were prepared activated carbon by physical and chemical activation method. They were used 800°C temperature for activation with respect to the porosity of the carbon the best .

The activated carbons were prepared by carbonizing the raw fiber pellets at different temperatures under a nitrogen atmosphere for 2 h. This was followed by activation using air as a gasifying agent at different activation temperatures for 40 min. Investigators were achieved the highest Brunauer-Emmett-Teller surface area of 255.909 m^2g^{-1} was by SBCHAC4[3]. Arunrat Cheenmatchaya and

Sukjit Kungwankunakorn et.al Preparation of Activated Carbon Derived from Rice Husk by Simple Carbonization and Chemical Activation for Using as Gasoline Adsorbent. They were used by-product of rice manufacturing i.e. rice husk, for activated carbon preparation which was used for gasoline adsorption. They were used gas chromatograph-mass spectrometry for sample analysis for gasoline adsorption Authors were used phosphoric acid for activation at temperature of 450 °C, has the highest adsorption capacity. Physical characterization of the activated carbon obtained was performed by scanning electron microscopy [4].Martha Ruiz et.al.Preparation Of Activated Carbon by Chemical Activation Using NaOH. They were used and H3PO4, Wastes from Chicken Dung for production of activated carbon in their research. Authors were used potassium hydroxide and phosphoric acid as an activating agents at different temperatures350, 400 and 450°C [5].6 Production and characterization of granular activated carbon from activated sludge was investigated by Z. Al-Qodah, and R. Shawabkah. Authors were used activated sludge to prepare activated carbon using sulfuric acid as a chemical activation agent. They were obtained activated carbon having highly porous structure and a specific surface area of 580 m2/g. Authors were used XRD analysis for activated carbon for low content of inorganic constituents. Investigators were investigated that the maximum loading capacity of the produced activated carbon was 110 mg pesticides/g adsorbent and was obtained at this pH value [6]. Preparaton of Activated Carbon from Desiccated Coconut Residue by Chemical Activation with NaOH was studied by Mood Adib Yahya.Investigators were used agricultural waste for preparation of activated carbon. They were investigated the effect of temperature and impregnation ratio on the physicochemical properties of activated carbon prepared from desiccated coconut residue by chemical activation using sodium hydroxide. Authors were carried out carbonization of coconut residue at three different temperatures for 1 hour at 400°C, 500°C, and 600°C respectively. They were concluded that the specific surface area increased with temperature and decreased at highest desired temperature [7].

P.Y.L Foo and L.Y. Lee was investigated Preparation of Activated Carbon from Parkia Speciosa Pod by Chemical Activation. They were used Parkia speciosa pod which is known as stink bean or 'petai', for activated carbon preparation by activation with phosphoric acid. Investigators used temperatures ranging from 450°C to 650°C for carbonization for 1 hour. They were used Micromeritics 2020 surface analyzer for surface area and pore volume measurement and was found maximum surface area of 190 m2/g and pore volume of 0.0950 cm3/g [8].Tharapong Vitidsant et.al.Production of Activated Carbon from Palm-oil Shell by Pyrolysis and Steam Activation in a Fixed Bed Reactor. produce activated carbon from palm-oil shells .They were used fixed bed reactor for pyrolysis and steam activation .They were studied variables like activation temperature, activation time, palm-oil shell sizes and flow rate of air. Authors were used steam as an activating agent at 750oC for 2 hr with air flow rate of 0.72 ml/min. Investigators were observed that the maximum surface area and adsorption capacity could be obtained from using 200 g of 1.18-2.36 mm[9].Adsorption Capacities of Activated Carbons Prepared from Bamboo by KOH Activation was studied by Samorn Hirunpraditkoon and Nathaporn Tunthong. Low or zero cost of agricultural by-products or wastes such as bamboo waste were used by investigators for preparation of activated carbon. Authors were synthesized activated carbons from bamboo waste using KOH activation have greater specific surface areas (1281.7-1532.8 m2/g) and pore volumes (0.4246-0.4911 They were investigated influence of carbonization time on the properties and adsorption capacities of activated carbons. Their adsorption capacities of bamboo waste activated carbon were comparable to the adsorption capacity of a commercial activated carbon regarding to the reduction in COD, TDS and turbidity of the effluent water [10]. Xiao Iao-Juan Jin et.al, Preparation of activated carbon from lignin obtained by straw pulping by KOH and K2CO3 chemical activation. Activated carbon was prepared by investigators through chemical activation of lignin from a straw pulping precursor, using K2CO3 and KOH as chemical agents.

They were investigated iodine number and yield of activated carbon and the actions of the activating agents were compared. Authors were obtained BET surface area of 1104 m2/g.of activated carbon prepared by K2CO3, under optimum conditions and that of prepared by KOH under optimum conditions was of 917 m2/g[11].Preparation and Characterization of Activated Carbon from Reedy Grass Leaves in a Two- Step Activation Procedure was studied by Xu Jianzhong and Chen Lingzhi, Feng Xiaojie .Preparation of activated carbon from lignin obtained by straw pulping by KOH and K2CO3 Chemical Activation .Investigators were produced Activated carbons by chemical activation with potassium hydroxide (KOH) at 800oC for 2 hours and from chars that were carbonized from reedy grass leaves at 450oC in N2 atmosphere. They were examined the effects of activation temperature, duration time and impregnation time. Adsorption capacity was demonstrated with BET and iodine number. BET surface area, pore volume and pore size of activated carbons were characterized by N2 adsorption isotherms [12].Preparation and characterization of activated carbons from biomass material, giant knotweed (Reynoutria sachalinensis) was investigated by Hanna Faltynowicz, and Jan Kaczmarczyk. Activated carbons from biomass material of giant knotweed Reynoutria sachalinensis Nakai were obtained by investigators. They were applied Physicochemical (by steam and CO2) and chemical (by KOH) activation methods. Porosity of the elaborated sorbents was determined by benzene and carbon dioxide sorption measurements. Authors were

achieved highest highest BET surface area of 2541 m2 g-1[13].Arenst Andreas Arie, Vincent and Aditya Putranto were studied Activated carbons from KOH activation of salacca peels as low cost potential adsorbents for dye removal. Salacca peel was used to prepare activated carbon (AC) by chemical activation with potassium hydroxide (KOH). Authors were carried out batch adsorption experiments of methylene blue with the largest surface area and most developed porosity activated carbon with obtained surface area of around 1939 m2/g. They were investigated adsorption equilibrium and kinetics of MB dyes from aquaeous solution on activated carbon. It was revealed that the Langmuir adsorption equation was more appropriate to represent the adsorption procedure of MB dyes compared to the other equations. Authors were used simplified kinetic models including pseudo first- order and - second-order equations to evaluate the adsorption processes[14] M. S. Islam et.al.Preparation and characterization of activated carbon from bio-diesel by-products (Jatropha seedcake) by steam activation. They were prepared Activated carbon using bio-diesel waste (Jatropha seedcake) by conventional carbonization followed by steam activation process on a laboratory scale. Investigators conducted different Preliminary tests to investigate the influences of different operating parameters, such as initial material size, pyrolysis temperature and hold time on the properties of pyrolized chars. Authors were found The maximum BET surface area of 613.43 m2/g.They were carried out steam activation at a temperature of 800oC for a hold time of 1 hr..Authors were also studied the optimum conditions for producing activated carbon, the effect of activation temperature and activation time [15].

Charcoal Preparation characterization and Applications was studied by A. Mohammad and R. Ansari. Authors were studied different characteristics and applications of activated carbon [16]. Adegboyega Surajudeen Olawale et.al Preparation of phosphoric acid activated carbons from Canarium Schweinfurthii Nutshell and its role in methylene blue adsorption. Activated carbons were prepared by phosphoric acid activation of Canarium Schweinfurthii spent nutshell. Activation was conducted in nitrogen chamber for activation time of 20 to 60 min and temperatures of 200 and 400°C. Authors were found BET surface area and adsorption capacity of 741 m2/g and 8.5 gMB/g Carbon while those for 60wt% acid solution were determined as 779 m2/g and 9.2 m2 /g Carbon [17].Ozgiil Gerçel was investigated Adsorption properties of activated carbon from wild plant prepared by chemical activation. Authors were prepared activated carbon from renewable plant material, that is Euphorbia rigida, by chemical activation using zinc chloride as activating reagents. Authors were carried out batch experiments with respect to contact time, pH and temperature from aqueous solutions. They were calculated maximum adsorption capacity as 155.62 mg g–1 at 40oCby using Langmuir isotherm model [18].Hassan M. et.al Synthesis and Characterization of Activated Carbon from Saudi Arabian Dates Tree's Fronds Wastes Investigators were used date's fronds waste as a raw material for producing activated carbon. They were pyrolysed Date tree's fronds residue at 400°C temperature with hold times 3 hours to obtain char. Investigators were used phosphoric acid for activation and they were used Various concentration of H3PO4 .And was found 60% concentration of H3PO4 was the best with the highest surface area of 1139 m2g-1[19] .Mehdi Jahangiri et.al.Preparation of activated carbon from walnut shell and its utilization for manufacturing organic vapour respirator cartridge Walnut shell, as an agricultural by-product, was used by investigators for preparation of activated carbon. They were used chemical activation, using KOH to obtain high efficient adsorptive properties. and used temperature of 700°C to gave the highest BET surface area 737 m2/g. Surface and textural characterizations of activated carbon were respectively investigated by BET technique at a low temperature (77°K) of nitrogen and Scanning Electron Microscopy [20].

Characterization of Activated Carbon prepared from Albizia lebbeck by Physical Activation was investigated by K. Riaz Ahamed and T. Chandrasekaran. Authors were used Albizia lebbeck for preparation of activated carbon. and they were studied effects of activation temperature of the activated carbon .Investigators were used Scanning Electron Microscopy for porosities (SEM)and X-ray diffraction (XRD)for identification of nature of compound[21].Characterization of activated carbon prepared by phosphoric acid activation of olive stones was studied by S.M.Yakout and G.Sharat. Authors were studied the effect of activating agent concentration on the pore structure and surface chemistry of activated carbon derived from olive stone with chemical activation method using phosphoric acid. They were measured mass changes associated with impregnation, carbonization and washing process [22].Roozbeh Hosein et.al. Preparation and characterization of activated carbon from apple waste by microwave assisted phosphoric acid activation application in methylene blue adsorption. Authors were prepared activated carbon from apple pulp and apple peel by using phosphoric acid as an activating agent.They were studied the effects of microwave radiation power and time on the adsorption capacities of the activated carbon.Investigators were characterize the properties of prepared activated carbon by using SEM and FTIR results[23].

III. CONCLUSIONS

Thus the activated carbon can be produced from different low cost waste material .And these activated carbon undergo activation chemically or thermally. These activated carbon can be chemically activated by using activating agents like $Cacl_2$, H_2So_4, H3Po4,

Koh, NaOh and $Zncl_2$ High porosity activated carbon produces by using these chemical activating agents which are used as an better adsorbents for adsorption process.

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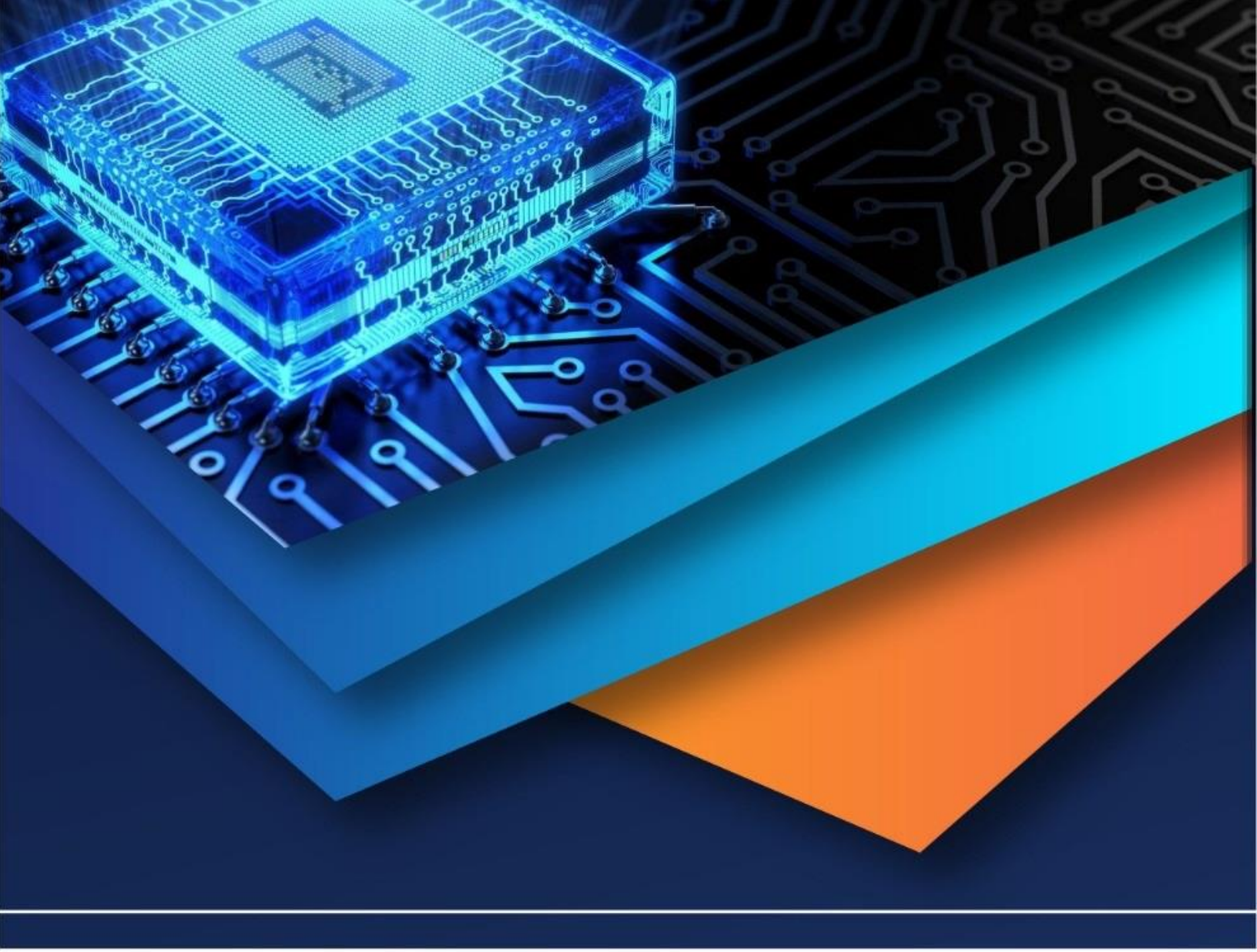

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