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Review on -Regeneration of Activated Carbon

Pratibha R. Gawande*[1], Dr. Jayant P. Kaware[2]
*[1] Datta Meghe College of Engineering, Airoli, Navi Mumbai, Maharashtra, India
[2]Sant Gadgebaba Amaravati University, Amaravati, Maharashtra, India

ABSTRACT

As adsorption is one of the important process which is used for desulphurization of fuels. This paper reviews on regeneration of activated carbon and related methods. Disposal of spent adsorbents is one of the major issue.so it is necessary to regenerate and recover used adsorbent to avoid disposal problem. Adsorbents can be regenerated and put to reuse in the same process line.Reviews on various regeneration methods was carried out.

Keywords: Regeneration, Adsorption, Desulphurization, Activated Carbon

I. INTRODUCTION

To develop certain sorbents for hot gas desulfurization process, which have superior reactivity with gaseous sulphur, stability at high temperature, and character of low-cost regenerable materials is very difficult task [1].Different techniques can be used to restore the activity of a spent (exhausted) activated carbon. Various chemical methods can effectively restore the activity of spent carbon from which only single or defined adsorbates need to be removed or recovered [2]. The reactivity and regenerability of these sorbents were improved when the composite metal oxides were supported on suitable supports, such as activated carbon fibers (ACFs), activated carbons (ACs), and activated chars[3]. There appears to be no information on the optimum conditions for regeneration when the activated carbon is to be used repeatedly in adsorption-regeneration cycles [4].Regeneration refers to removal of adsorbate and restoration of previous adsorptive capacity of the original activated carbon. The currently available regeneration mrthodologies include thermal deposition,wet air oxidation, steam,infrared radiation and solvent extraction has been reviewed[5]. Bio-regeneration of desulfurization adsorbents with magnetic cells can separate magnetic cells from regenerated adsorbents[8].Regeneration process can be either carried out on the site or can be carried offsite. Off site regeneration is generally carried out when the spent adsorption generation is very high[9].The research on regeneration and recovery is the area of investigation which needs to be explored. The reuse of adsorbent is required in order to make the process economical and environmental friendly.[11]Important factors influencing regeneration efficiency are regeneration time, regeneration temperature, and initial loading Taking operating time and energy consumption into consideration, complete regeneration is not the major interest [12].

II. REVIEW ON REGENERATION OF ACTIVATED CARBON

S. Raharjo et.al.were studied hot gas desulfurization and regeneration characteristics with molten alkali carbonates. Regeneration experiments were carried out by used MACs using thermo gravimetric analyser and gas chromatography-flame photometric detector. Authors were showed that Na_2S as one of the main components of used MACs can be around 80% regenerated at 650K by using CO_2 as regeneration agent[1].The regeneration of activated carbon was studied by B.M. Van Vliet.Author was studied regeneration of activated carbon for renewed use in the recovery of precious metals or the purification of water .And also studied thermal regeneration with the operating conditions that can be controlled to give the required degree of activation[2].Yu Feng et.al Regeneration of Fe−Zn−Cu Sorbents Supported on Activated Lignite Char for the Desulfurization of Coke Oven Gas. Authors were studied regeneration characteristics of activated-char-supported Fe−Zn−Cu sorbents.Investigators were carried out desulfurization and regeneration experiments were carried out using a

quartz fixed-bed reactor at ambient pressure and examined the effects of regeneration conditions, such as space velocity, temperature, and steam concentration, on the regeneration performance.On the basis of experimental results they were concluded that the char-supported Fe−Zn−Cu sorbents can be regenerated at temperatures above 500 °C[3].K.Chihara et.al cyclic regeneration of activated carbon in fluidized beds .Investigators were studied cyclic thermal regeneration of powdered activated carbon containing adsorbed sucrose in fluidized beds at 1151°K and 101.3 kPa.and were found 98.5% recovery after each regeneration. removed an amount of carbon equal to the residual adsorbed carbon after thermal decomposition [4].Keon Sang et.al. Regeneration of exhausted activated carbon by counter current oxygen reaction. Investigators were developed counter current oxygen reaction for regeneration of exhausted activated carbon. Authors were examined various parameters like the reaction temperature, loss of activated carbon ,surface area pore volume ,surface structure, adsorptive capacity for determination of countercurrent oxygen reaction[5].Haochen et.al desulfurization and regeneration performance of sorbent prepared by subcritical water impregnation. Authors were investigated a series of metal oxides sorbents supported on γ-Al_2O_3 were directly prepared by subcritical water impregnation method using an autoclave reactor. Investigators were also investigated that after regeneration, the mechanical strengths of the sorbents were higher than that of raw support and the breakthrough time at the desulfurization efficiency of above 99% was not decreased [6].S.Velu et.al regenerable adsorbents for the adsorptive desulfurization of transportation fuels for fuel cell applications.Authors were developed new regenerable adsorbents based on zeolites, mesoporous materials, activated carbon, supported metal. They were concluded that the adsorbed sulfur compound could be recovered by solvent washing and the adsorbent could be completely regenerated for subsequent use[7].Wangliang et.al.desulfurization and bio-regeneration of adsorbents with Magnetic P. delafieldii R-8 Cells. Investigators were studied regeneration of adsorbent in biodesulfurization of model oil.They were developed a regeneration system contained n-octane, aqueous phase, lyophilized cells and spent adsorbents [8].Irfan K.Shah et.al. steam regeneration of adsorbents, an experimental and technical review. Authors were investigated that steam can be utilized for regeneration of spent adsorbents with special reference to technical and experimental aspects. They were concluded that use of steam for regeneration has multiple benefits [9].Desulfurization of liquid fuels by adsorption on carbon-based sorbents and ultrasound-assisted sorbent regeneration was studied by Yuhe Wang and Ralph Yang. They were showed that the amount of sulphur desorbed was higher with ultrasound, 65 wt % desorption vs. 45 wt % without ultrasound in a static system at 50 °C.Several carbon-based adsorbents were studied by authors for desulfurization of a model jet fuel by selective adsorption of thiophenic molecules [10].Regeneration and recovery in adsorption was reviewed by Sunil Kulkarni and Dr. Jayant Kaware .Authors were studied summery of research carried out for recovery and regeneration of adsorbent. They were observed that various methods like solvent washing, chemical and electrochemical and thermal methods were used effectively [11].Meng Yao et.al. adsorption and regeneration on activated carbon fiber cloth for volatile organic compounds at indoor concentration levels. Authors were used ACFC as a regenerative adsorbent for the removal of VOCs from indoor air. Impacts of operating variables on the adsorption/regeneration performance of the ACFC were assessed. They were investigated that. The use of Joule heating regeneration technique showed that the ACFC was rapid and efficient in removing the low initial loading of toluene [12]. Seiki Tanda et.al.adsorption of an activated carbon investigated on the basis of adsorption isotherm, isobaric heat of adsorption compressed volume of condensed styrene. Regeneration of spent activated carbon was examined by the extraction of styrene with organic solvents [13]. Pei Jen et.al. chemical regeneration of activated carbon used for dye adsorption. Authors were investigated that the chemical regeneration of activated carbon presaturated with two different dyestuffs by various organic solvents, redox agents, acids, and bases using batch and column experiments[14].Regeneration methods to restore carbon adsorptive capacity of dibenzothiophene and neutral nitrogen heteroaromatic compounds was studied by Han, Lin, Zheng. Activated carbon spent by model diesel fuel was regenerated using thermal, ultrasound and solvent approaches. Authors were studied the variations of physical and chemical properties of activated carbon in adsorption and desorption [15].

III. CONCLUSION

As adsorption is one of the important unit processes so after completion of adsorption process, adsorbent is treated as waste. If these adsorbent get regenerated then we can reduce the need of new adsorbent and also reduce the problem of disposal of used adsorbent. Various regeneration methods were used by different investigators such as solvent washing, thermal, chemical and electrochemical regeneration.It can be concluded that regeneration and reuse of adsorbent is very economical method.

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