REGENERATION OF ACTIVATED CARBONS LOADED WITH NITRO COMPOUNDS

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Introduction

Activated carbons are potential adsorbents for the treatment of process water and ground water contaminated with various nitro organics from explosives manufacturing plants (1,2). Disposal of large quantities of this laden carbon, by land filling is not only a costly practice but also unacceptable under growing stringent environmental protection rules. Regeneration and reuse of spent carbons is an accepted method for minimising the waste and make the technique economically viable.

Various techniques such as thermal desorption, solvent extraction and hydrolysis etc. are known but only to a limited extent for regeneration of activated carbon loaded with nitro compounds. Heat treatment is the most widely used method for the regeneration of spent carbons regardless of the nature of the adsorbates. The present paper reports the effect of various parameters like temperature, steam-air flow rate ,time and surface area on thermal regeneration of granular activated carbon(GAC) saturated with trinitrotoluene (TNT) and nitro benzene (NB), in the presence of steam- air mixture.

Experimental

Three different grades of commercially available coconut based granular activated carbons (GAC -30, GAC-50 and GAC- 80) having surface area 650 m^2/g, 1000 m^2/g and 1500 m^2/g respectively were used for adsorption and desorption studies. The dynamic adsorption experiments of TNT and NB on virgin and regenerated (upto two cycles) GACs were carried out using a column of 1.7 cm ID and with a bed height of 30 cm. The solutions of TNT and NB(100 ppm) were gravity fed at a fixed flow rate of 2.5-2.7 LPH. These loaded carbons were then thermally desorbed under a blanket of air enriched with steam at an optimised flow rate of 10 LPM and temperature of 450°C and an exposure time of three hours.

The concentration of the solutions before and after adsorption were measured by GBC-916 UV-Vis-spectrophotometer while BET (N2)surface area of the virgin and regenerated GACs were determined on Micromeritics Gemini-2360 surface area analyser.

Results and discussion

TNT and NB loaded GACs were subjected to thermal treatment for desorbing the nitro bodies under several regenerating media such as nitrogen, air, oxygen, steam and steam-air mixture. It is observed that heat treatment in presence of steam - air mixture gives the best regeneration, without damaging the carbon surface. This also conforms to the earlier studies reported by Smith(3).

Adsorption capacity of virgin and regenerated GACs for TNT and NB was studied under dynamic conditions, while surface area was determined by BET (N2) method. The representative results for GAC-50 (Table-I) shows recovery of surface area upto 85 % in TNT loaded and 93% in NB loaded carbon ,while the adsorption capacity was found to be 95-98% and 97-99% respectively. It appears that NB being volatile in nature was easier to desorb from the surface compared to TNT.

An interesting observation was that the adsorption capacity of the regenerated carbon increased with the increase in surface area of the carbon (Fig.I). Regenerated GAC-80 showed about 25% increase in adsorption capacity in the first cycle. This may be due to the widening of micropores during heat treatment (4), which constitute the major portion of the carbon surface in higher surface area carbons.

Conclusions

It is evident from the above results that the thermal regeneration with respect to adsorption capacity of spent GAC, loaded with explosives under steam - air depends upon the temperature, steam - air flow rate and the surface area of the original carbon.

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SNo.	Carbon used	TNT Loaded GAC		NB Loaded GAC	
		Adsorption capacity (mg/g)	BET(N2) surface (m/g)	Adsorption capacity (mg/g)	BET(N2) surface (m/g)
1.	Virgin	133	793	242	793
2.	Regenerated Ist Cycle	130	670	239	737
3.	Regenerated IInd Cycle	126	670	235	735

Table-I:Adsorption capacity and Surface area values for Virgin and regenerated GAC (GAC-50)

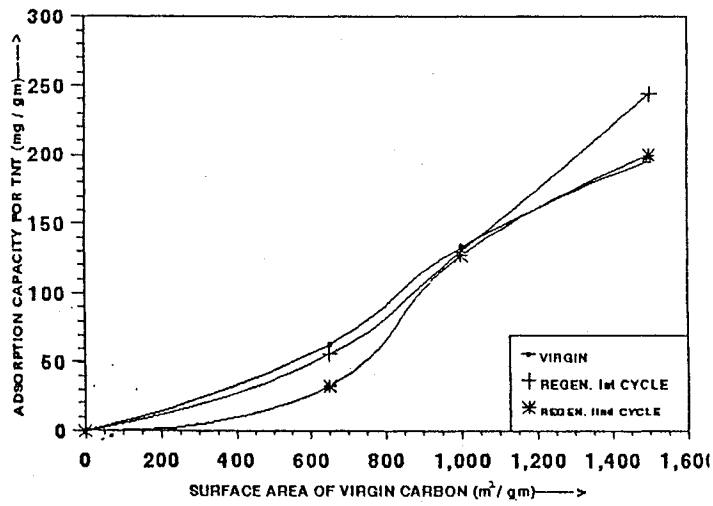

Fig. 1 . ADSORPTION CAPACITY Vs SURFACE AREA(VIRGIN & REGENARATED GACS)