REGENERATION PROCESS INTENSIFICATION OF VOC SPENT CARBON ADSORBENTS

by

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Submitted

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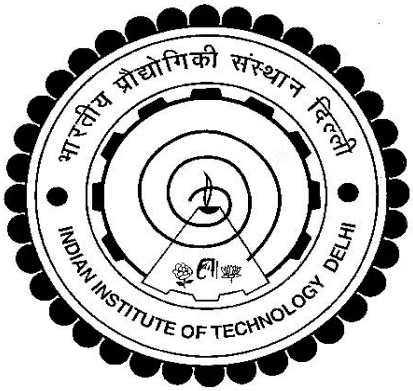

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CERTIFICATE

This is to certify that the thesis titled *"**Regeneration Process Intensification of VOC Spent Carbon Adsorbents"*** being submitted by ***Irfan Khursheed Shah*** in the Department of Civil Engineering, Indian Institute of Technology, Delhi, for the award of the degree of ***Doctor of Philosophy***, is a bona fide record of the research work carried out by him under our supervision and guidance. The thesis has reached the standards fulfilling the requirements of the regulations relating to the degree. The results contained in this thesis have not been submitted to any other university or institute for the award of any degree or diploma.

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ABSTRACT

Process of adsorption has been widely used in many industries at large scale for purification, separation and compliance purposes. Industries are always in search of adsorbent which has high surface area and also is specific to the target compounds.

After the adsorbents are exhausted, they are either to be disposed off or regenerated for use. This depends upon the demand, economics involved, and the kind of pollutant that was adsorbed. In many cases, spent adsorbents are to be treated as hazardous waste. Trace compounds can be concentrated on the adsorbent during its use. They may be toxic and flammable or explosive. Exposure of spent adsorbent to ambient air may accumulate heat and desorb toxic materials creating a hazardous environment. Dumping spent adsorbents may also cause odour nuisance. Spent adsorbent needs to be stabilized after being discarded. Because of the involvement of high cost of production, stabilizing or proper disposal seems unwilling operation. Under such circumstances, regeneration of the spent adsorbent could prove double rewarding by reducing the amounts of hazardous wastes to be disposed and by recovering the carbon resource, thereby minimizing the demand for virgin adsorbents.

Regeneration process intensification was studied for VOC spent activated carbon. Two specific cases were considered. In the first case where adsorbate VOCs (Acetone & MEK) was nontoxic the process of thermal regeneration was studied and modified using humid air streams. A protocol was proposed where in higher regeneration efficiency was attained at lower temperatures. In second case where adsorbate VOC (benzene) was toxic, recovery is never desired moreover in such cases spent adsorbent is considered as hazardous waste. For this case activated carbon adsorbent was modified by metal impregnation. Non toxic and low cost transitional metals were used for impregnation Effect of metal impregnation on adsorption capacity and regeneration efficiency was evaluated. Cu impregnated activated

carbon (AC-1) was found to have reasonable adsorption capacity and also regeneration efficiency was higher than virgin activated carbon. Impregnated activated carbons were evaluated for benzene catalytic combustion activity. Bi-metal (Cu-Mn) impregnated activated carbon showed good enough catalytic activity to be used after adsorption unit for catalytic destruction of toxic benzene.

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