Hazardous dichloromethane recovery in combined temperature and vacuum pressure swing adsorption process

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a b s t r a c t

Organic vapors emitted from solvents used in chemical and pharmaceutical processes, or from hydrocarbon fuel storage stations at oil terminals, can be efficiently captured by adsorption onto activated carbon beds. To recover vapors after the adsorption step, two modes of regeneration were selected and could be possibly combined: thermal desorption by hot nitrogen flow and vacuum depressurization (VTSA). Because of ignition risks, the conditions in which the beds operate during the adsorption and regeneration steps need to be strictly controlled, as well as optimized to maintain good performances. In this work, the optimal conditions to be applied during the desorption step were determined from factorial experimental design (FED), and validated from the process simulation results. The regeneration performances were compared in terms of bed regeneration rate, concentration of recovered volatile organic compounds (VOC) and operating costs. As an example, this methodology was applied in case of dichloromethane. It has been shown that the combination of thermal and vacuum regeneration allows reaching 82% recovery of dichloromethane. Moreover, the vacuum desorption ended up in cooling the activated carbon bed from 93 ◦C to 63 ◦C and so that it significantly reduces the cooling time before starting a new cycle.