

P1 SELECTIVE ORGANIC GAS SEPARATION WITH ACTIVATED CARBON FIBER CLOTH FOR REUSE OR MORE EFFECTIVE DISPOSAL

Mark Rood, University of Illinois

Development and evaluation of an activated carbon fiber cloth (ACFC) adsorption system using either electrothermal swing adsorption (ESA) or microwave swing adsorption (MSA) regeneration will be described from bench-scale laboratory tests, pilot-scale field tests, and full-scale field tests. Initial evaluation of ACFC to adsorb environmentally relevant compounds at environmentally relevant concentrations began this research. Consideration of multiple component adsorption for relevant organic gases and water vapor or other organic gases followed to make results more relevant. Tests became more complicated to evaluate continuous treatment of laboratory gas streams while alternating between adsorption and ESA or MSA. The resulting organic gases were then captured with cryogenic cooling for recovery and potential reuse. Energy balances, material balances, and isotherm analyses were evaluated with models to improve the evaluation of the experimental and modeled results. ESA was then improved to allow for in vessel condensation of the organic vapors and eliminate cryogenic condensation to make the system more economically competitive. Such results lead to the system's first patent. Adsorption followed by ESA was then evaluated for three different activated carbon morphologies (i.e., fibers, monolith, and beads) to better assess the appropriate morphology for activated carbons for adsorption-ESA systems. Our research group then modified the ACFC-ESA/MSA systems to allow for concomitant adsorption and regeneration to pretreat gas streams allowing for stable organic gas concentrations as inlet gas streams to thermal oxidizers and biofilters. We recently completed a life cycle assessment comparing ACFC-ESA, granular activated carbon-steam and regeneration, and thermal oxidation systems to better understand future research directions. We then developed a technique to control adsorption and regeneration cycles while using measurement of electrical resistance of the ACFC without using temperature and hydrocarbon sensors. Challenges to complete full-scale field testing will also be discussed. Also challenges to publish > 30 high-quality peer-reviewed manuscripts, obtaining three patents, graduating students, and obtaining funding from the private sector, National science foundation, and Department of Defense to achieve these accomplishments will also be discussed.