IMPLEMENTATION OF VPSA TECHNOLOGY TO SEPARATE CO_2 FROM FLUE GASES USING A METAL-ORGANIC FRAMEWORK

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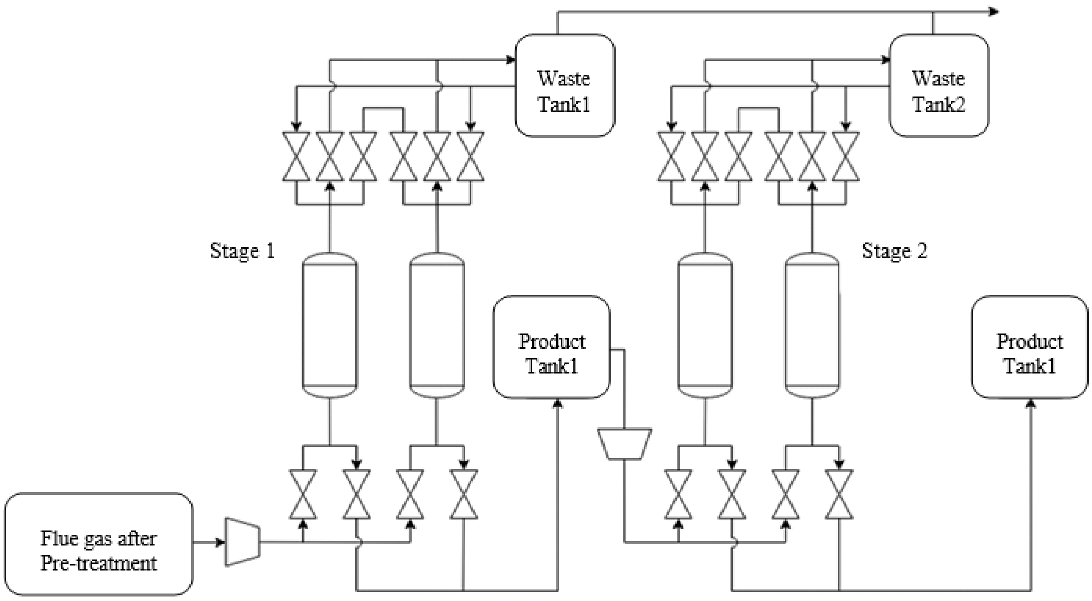
The CO_2 emissions from large stationary sources like power plants and energy-intensive industries (cement, chemicals, steel,..) have been identified as major sources of global warming and climate change. Roughly, over 60 % of global warming effects are relevant to carbon dioxide emissions to the atmosphere [1]. In this study, an adsorption process (VPSA-vacuum pressure swing adsorption) using electricity from renewable sources was proposed and implemented for the reduction of CO_2 industrial emissions. The VPSA technology seems to effectively separate CO_2 from flue gases with relatively low energy consumption, flexible operation conditions, low operation cost, and low environmental impacts compared to absorption/regeneration technology using amine (3800-4000 kJ/kg CO_2). Al-MOF MIL-160 [Al (OH)(O_2C-C_4H_2O-CO_2)] was selected as an adsorbent because it exhibited: good working capacity, good selectivity to capture CO_2 from post-combustion conditions, green synthesis, water stability, and the possibility of scaling-up and shaping [2]. Hence, a two-stage (the first one to increase the concentration, the second one for purification) VPSA process composed of two columns in each stage was designed. A five-step Skarstrom cycle including a pressure equalization step in each stage was employed, and the impacts of various operation parameters were studied. The overall process performance of the two-stage VPSA process resulted in a CO_2 purity of 95.01% and a CO_2 recovery of 90.04% with CO_2 productivity of 0.1165 gCO_2/g ads.h. The total energy consumptions were 993 kJ/kgCO_2. The simulation results are well conformed with the U.S. Department of Energy (DOE) requirements in terms of product purity and recovery.



References :

[1] A. Yamasaki, *J. Chem. Eng. Jpn*, 36(4), 361-375 (2003).

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