Application of thermogravimetric analysis to the evaluation of aminated solid sorbents for CO_2 capture

INTRODUCTION

CO_2 Capture and sequestration (CCS) involves separating CO_2 from other gases, compressing and transporting it to an adequate storage site. At present, the preferred technology for post-combustion capture is amine scrubbing. The enhancement of a specific adsorption capacity may be carried out by promoting chemisorption through impregnation with chemicals that react reversibly with CO_2, such as amines

EXPERIMENT

Materials:
- diethylenetriamine (DETA)
- diisopropanolamine (DIPA)
- triethanol- amine (TEA)
- 2-amino-2-methyl-1,3- propanediol (AMPD)
- pentaethylenehexamine(PEHA)
- polyethyleneimine (PEI)

Instruments: THEMYS coupled to a Nicolet Nexus FTIR analyzer
Scanning rate: 15 K/min
Flow rate: 50 ml/min of Argon.

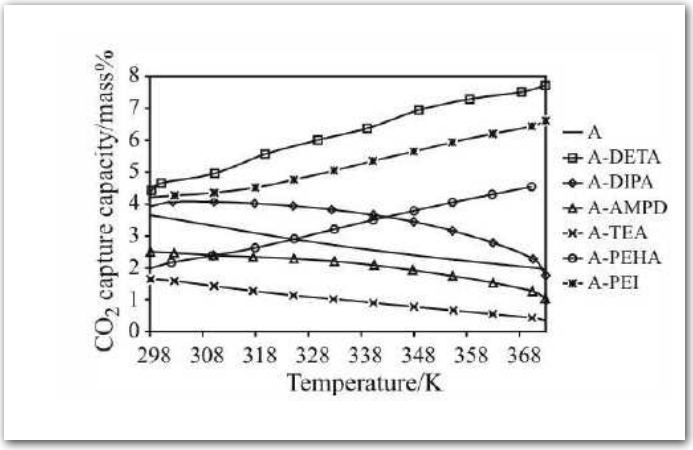

Figure 1: Figure: Effect of temperature on the CO_2 capture capacity of the commercial alumina, A, and the immobilized amines

RESULTS AND CONCLUSION

The alumina support (A) and the alkanolamine-impregnated samples (A-TEA, A-AMPD and A-DIPA) showed a decrease in CO_2 adsorption with increasing temperature while the alkylamine-impregnated samples (A-DETA, A-PEHA and A-PEI) presented an increase in CO_2 capture capacity from 298 to 373 K. For the raw support, A, CO_2 capture could only be due to physisorption occurring within its pore structure. Due to the absence of water in the system, the only possible reaction between amines and CO_2 would be the formation of carbamates:

$R_2NH+CO_2 \rightarrow R2NCOO- + R_2NH_2^+$

Carbamates can be formed only by primary and secondary amines but not by tertiary amines, such as TEA

Reference : Application of thermogravimetric analysis to the evaluation of aminated solid sorbents for CO_2 capture, M. G. Plaza, C. Pevida, B. Arias, J. Fermoso, A. Arenillas, F. Rubiera and J. J. Pis, Journal of Thermal Analysis and Calorimetry, Vol. 92 (2008) 2, 601–606.

INSTRUMENT

THEMYS TGA

HIGH ACCURACY & VERSATILITY
hang-down symmetrical beam balance, specifically designed for TGA applications

ULTRA-HIGH TEMPERATURE CAPABILITY
to 2400°C with a single furnace.

MODULAR ADAPTIONS ALLOWING
TGA only, DTA only, TG-DTA, and TMA up to 2400°C, DSC only and TG-DSC up to 1600°C all in one instrument.

EXTERNAL COUPLING CAPABILITY
designed for evolved gas analyzers (FTIR, MS, GCMS, MSFTIR, or FTIR-GCMS)