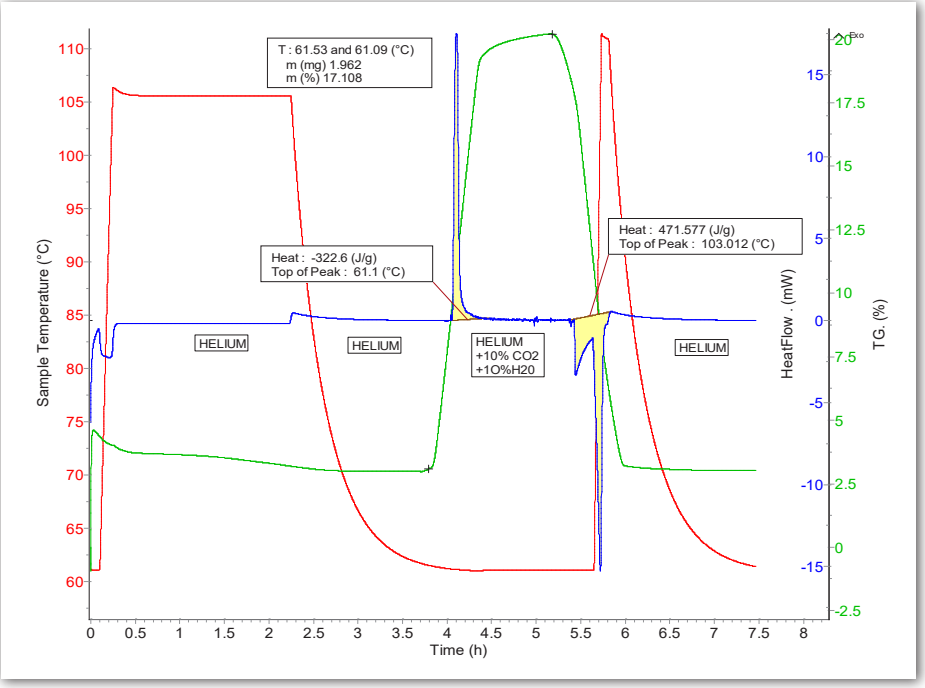
# Adsorption and desorption of $CO_2$ on hydrophilic amine polymer in humid atmosphere

## INTRODUCTION

Adsorption is becoming one of the most promising technologies for the capture of $CO_2$ from flue gases. For post-combustion capture, such an approach depends on the development of adsorbents that can operate competitively at relatively high temperatures and also in humid atmosphere. Solid sorbents, such as hydrophilic amine polymers, are known to have a large capacity of $CO_2$ adsorption with a full regeneration after heating. To investigate such a process, the TG-DSC technique, combined with the relative humidity generator FLEXI WET, is the ideal tool:

- The thermogravimetric signal provides the amount of $CO_2$
  - adsorbed that defines the capacity of adsorption for a given sorbent
  - desorbed that characterizes its level of regeneration
- The DSC signal measures the corresponding enthalpy
  - exothermic during adsorption that means a temperature increase during the capture process
  - endothermic during desorption that meaning cooling during the regeneration process




## EXPERIMENT

- Sample: hydrophilic amine polymer
- Mass: 11.47 mg
- Temperature and atmosphere program:
  - Isotherm at room temperature during 5 minutes under a flow of Helium (60ml/minute)
  - Room temperature ➔105°C at 5°C/minute under helium
  - Isotherm at 105°C during 120 minutes under helium
  - Cool down to 60°C and isotherm during 90 minutes under helium
  - The atmosphere is changed by adding 10% CO2 and 10% of humidity (helium balance) and maintained during 90 minutes
  - Ramp to 110°C at 10°C/minute under pure helium (60ml/minute)
  - Isotherm at 110°C during 5 minutes
  - Cool down to 60°C under helium.

## RESULTS AND CONCLUSION

**Preparation of the sample**

The first step of the program is used to prepare the material (hydrophilic amine polymer) before starting the adsorption process. The TG curve shows a mass decreases under helium flow during the ramp to 105°C and the following isotherm and reaches stabilization at 60°C. This phase change corresponds to water desorption (humidity adsorbed on the sample). A corresponding endothermic peak is recorded on the DSC curve.

**$CO_2$ adsorption**

When the mixture (10% $CO_2$ and 10% humidity) is introduced in the helium flow, the mass increase (17.1%) corresponding to the adsorption phenomena is detected together with a sharp exothermic peak providing the corresponding enthalpy of adsorption (322 $J.g^{-1}$).

**$CO_2$ desorption**

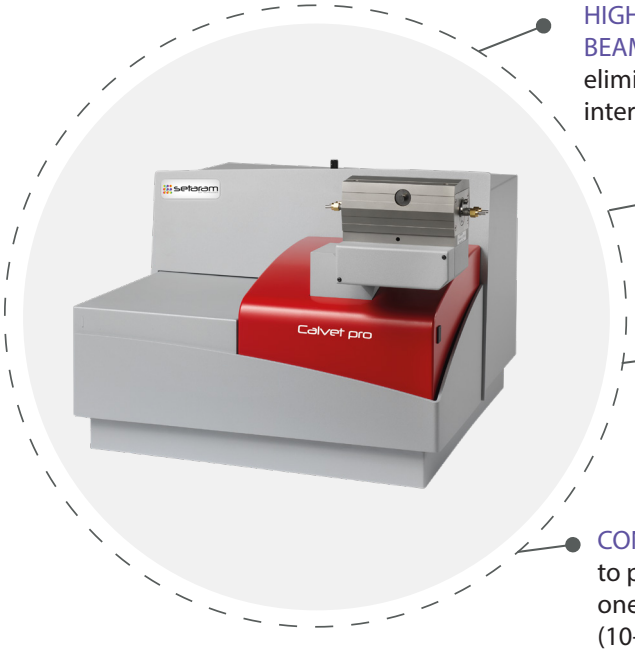
When the temperature is cooled down to 60°C under helium only, the desorption phenomena is recorded with the corresponding endothermic peak.

It is noticed that the mass decrease is equivalent to the corresponding mass increase. No $CO_2$ seems to remain after desorption, suggesting that the process is fully reversible;

## INSTRUMENT

**CALVET PRO TG-DSC**

***-120 to 830°C***

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