Introduction
Carbon capture and storage (CCS) has emerged as a promising approach for reducing or mitigating anthropogenic CO₂ emissions into the atmosphere [1]. A classification of the carbon capture technologies positioned pre-combustion capture (PCC) as a potential solution for separating CO₂ from a gasification or reforming process [2]. CO₂ removal at high temperature is conducted through solid sorbents that have the ability to be carbonated and regenerated by a simple reversible reaction. CaO has been conceived as the most cost-effective CO₂ sorbent owing to its high carrying capacity in regards to other sorbents such as Li₂O, Li₂O, etc., thermodynamics and low production cost [3, 4]. However, the main drawback of natural or synthetic CaO is the drastic reactivity loss over the progress of the carbonation and calcination cycles caused by microstructural changes arising through sintering [5]. In order to cope this effect, this research proposed the use of a refractory material such as the Saffil fibres (β-Al₂O₃ catalytic grade) to enhance the thermal properties of CaO ad thus inhibit or attenuate sintering.

Methodology
CaO/Sa-%-U sorbents were prepared by precipitation method using urea as precipitant agent. In order to conduct the synthesis method, Saffil fibres, calcium nitrate tetrahydrate (Ca(NO₃)₂•4H₂O), urea and water were used as the raw materials. The procedure for loading CaO over the periphery of the Saffil fibres is described and schematized intuitively in the Figure shows below.

Carrying Capacity Evaluation
A thermal profile that includes the operating parameters used for running 30 continuous carbonation-calcination cycles is presented. The conditions used in this program was set up to evaluate the carrying capacity and thermal stability of the CaO/Saf%-%-U sorbents at a harsh scenario.

Surface Area and Pore Size Distribution
Specific surface area, pore volume and pore radius values obtained by BET and BJH methods in CaO/Saf%-%-U sorbents prepared with different mass contents of CaO active phase.

Results
XRD patterns of the CaO/Saf%-%-U sorbents registered a 2θ range between 10 to 90°. The phase identification analysis elucidated that CaO and Ca(OH)₂ are the crystalline species obtained through the thermal decomposition of the CaO precursor.

Scanning Electron Microscopy – Energy Dispersive X-ray Spectroscopy (SEM-EDS)
Morphological analysis of the CaO/Saf%-%-U sorbents loaded with 25% of CaO active phase and EDS mapping aimed to observe the distribution of CaO along the surface of the fibrous support.

Conclusions
- The preparation of the sorbents via urea allowed the nucleation and growth of structures with a peculiar morphology such as nanosheets.
- The highest CO₂ capture capacity was attained by the sorbent loaded with 25 wt.% of CaO.
- An enhancement in the thermal stability of CaO was not only accomplished by using Saffil fibres as a sintering inhibitor but also by the CaO morphology acquired by means of the nucleation-growth mechanism.

References

Sorption capacity (mg of CO₂/mg of sorbent)
Number of cycles
CaO/Saf-25%-U
CaO/Saf-15%-U
CaO/Saf-5%-%-U