



UNIVERSITÀ
DEGLI STUDI
FIRENZE

Development of a CO₂ Conditioning System for Experimental Purposes

PhD program in
Industrial Engineering



Among the refrigerants that can be used, it is considered preferable to use CO₂, which is safe, nonflammable, has a very low environmental impact, it is cheap, available everywhere and compatible with present or future environmental regulations. Supercritical CO₂ (sCO₂) is that type of carbon dioxide that reaches or **exceeds the critical temperature and pressure**. When this state is achieved, CO₂ **does not undergo a phase transition**, but its thermophysical properties change strongly near the critical point.

The goal of the present activity is to develop a facility able to **recirculate sCO₂** and make it **available for different tasks** in order to evaluate its potential as **refrigerating fluid** and to **estimate its heat transfer** capabilities when operating in a range of pressures and temperatures near the pseudo-critical line.

In recent years, CO₂ has become very appealing as a **replacement for water as a working fluid** in geothermal systems. In the scope of a **European project called HOCLOOP**, we will analyze the behavior of the CO₂ to demonstrate its benefits and to predict its **dynamic behavior**. On a separate test rig the effect of the addition of **nano-fluids** will be tested.



SERG Group
Geothermal
Energy



Provide CO₂ with the **desired pressure and temperature** for the researcher needs

HEAT TRANSFER AND
COMBUSTION GROUP

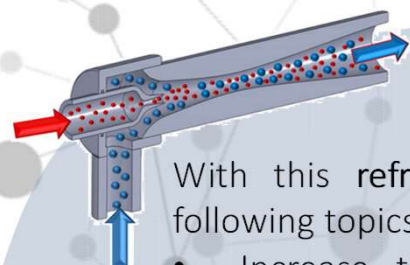


THC Group
Cooling System
for Turbomachinery



Allam cycle based power plants are expected to reduce the CO₂ emissions in the next decades by employing oxy-combustion and a **high-pressure sCO₂** working fluid in a highly recuperated Brayton cycle:

- Starting from the baseline refrigerating system, a fluid line is derived from the compressor discharge in order to **feed a test section** with sCO₂ at given pressure and temperature conditions;
- The test section will house metal coupons embedded with different cooling schemes in order to benchmark the sCO₂ heat transfer potential when the coupons are heated up.



With this **refrigeration** plant we want to analyze the following topics:

- Increase the performance of the **ejector** used to recover the expansion work by means of **optimization** algorithms coupled with **multiphase CFD** model that is able to simulate the flash evaporation phenomena;
- Study the behavior of single components through the use of python integrated with CFD models in order to optimize its global efficiency;
- Coupling between python model and experimental results in order to find **optimum conditions**.



Thermo Group
THERMODYNAMICS AND
HEAT TRANSFER
THERMO Group
Refrigeration Systems



VOTE!



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