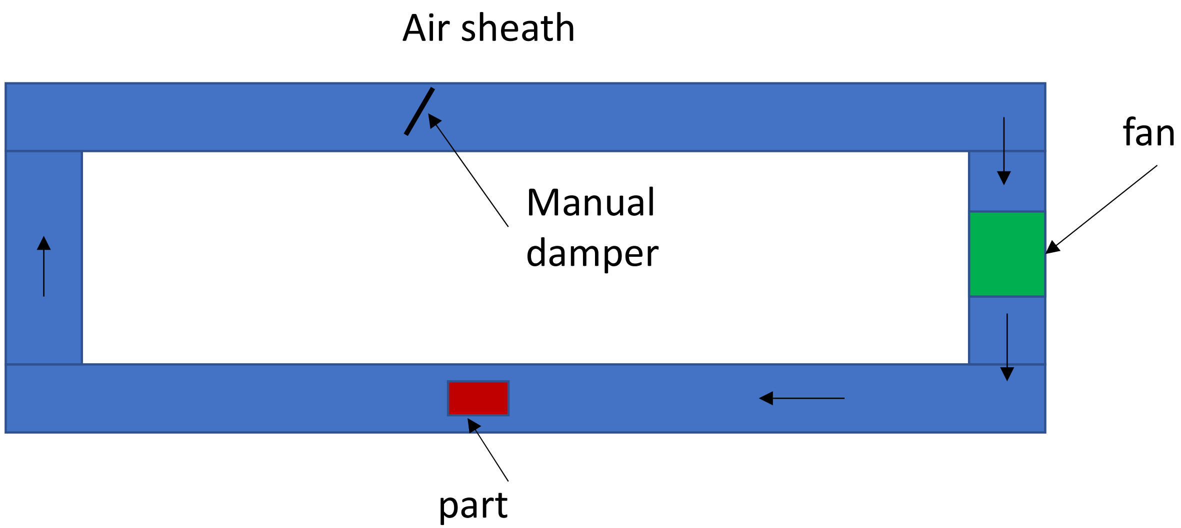
Heating tests of simple geometry parts at 150°C in forced convection in an air sheath

- The air speed in the air stream is controlled by a fan with frequency inverter + manual dampers
- The speed is measured by Pitot probes averaging along the horizontal and vertical axes.
- The air sheath has a section of 400 x 400 mm. The air sheath is mechanically welded in sheets steel, without external insulation. -> The wall temperature of the sheath is measured close to the parts to take into account the average radiation temperature.
- The temperature of the part is measured at several points (a point in the mass is taken as a reference), the difference between all the measurement points is negligible; the conduction in the volume is greater than the exchanges by convection. Number of Biot < 0.1



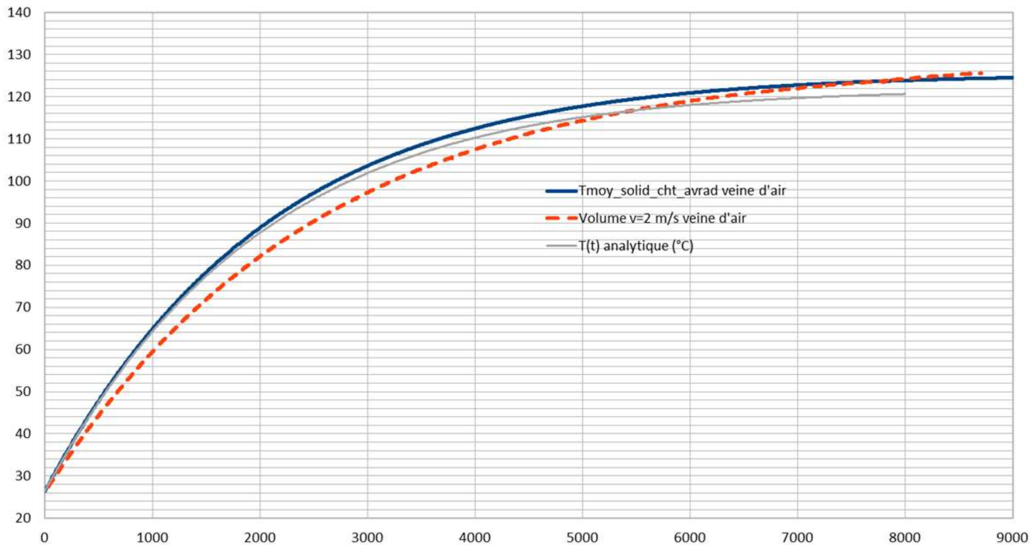
- We study simple shapes to be able to use the known correlations of the Nusselts number and to cross-check the simulations with the theory.

$$\overline{Nu} = 0.927 Re^{1/2}$$

- Case of a cylinder in an axial air flow
- The free software OpenFoam is used for comparison with the experimental data _ solver CHTSimpleFoam.
- The mesh is carried out with SnappyHexMesh and the CAD with Salome (EDF).
- The flow is turbulent, the chosen model is komegaSST with wall law. (y+= 30) Re varies between 10,000 and 40,000
- Natural convection is neglected
- The flow is calculated stationary by fixing the thermal properties of the air at the heating temperature. (density, viscosity and constant thermal conductivity) -> Frozen flow
- When the flow is stabilized, we use the transient solver to calculate the heating of the part
- The radiation are taken into account by a heat source on the surface of the part (radiation with the ambient we are in the situation of a closed box, no need of surface to surface radiations)

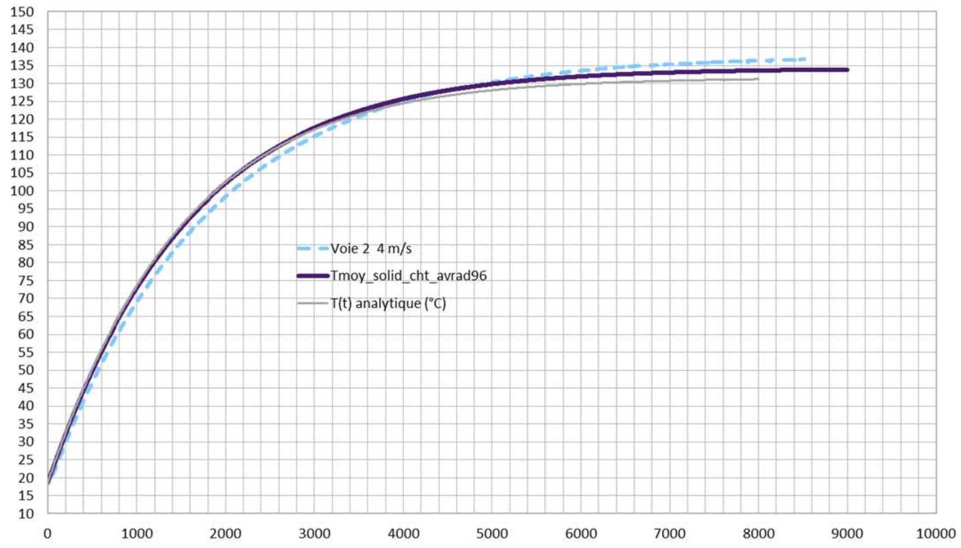
- Air velocity impact

V air = 2 m/s



Conditions:
Tair = 139.5°C
Tray = 81.3°C
Tini = 26.5°C
Ø120 mm Lg110 mm
Steel
Emi = 0.9

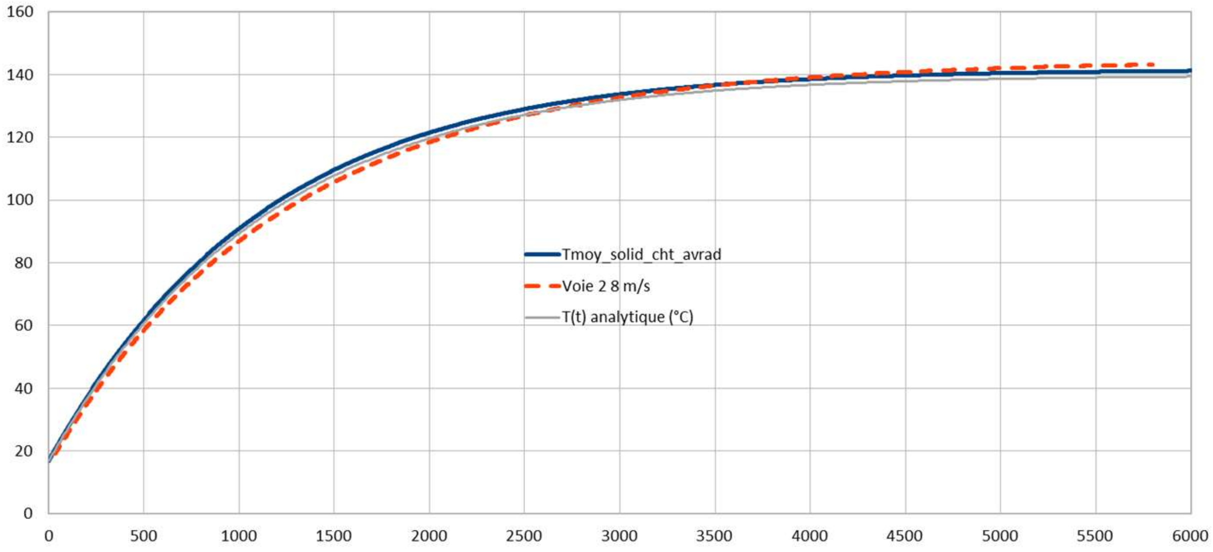
V air = 4 m/s



Conditions:
Tair = 143.5°C
Tray = 96°C
Tini = 19°C
Ø120 mm Lg110 mm
Steel
Emi = 0.9

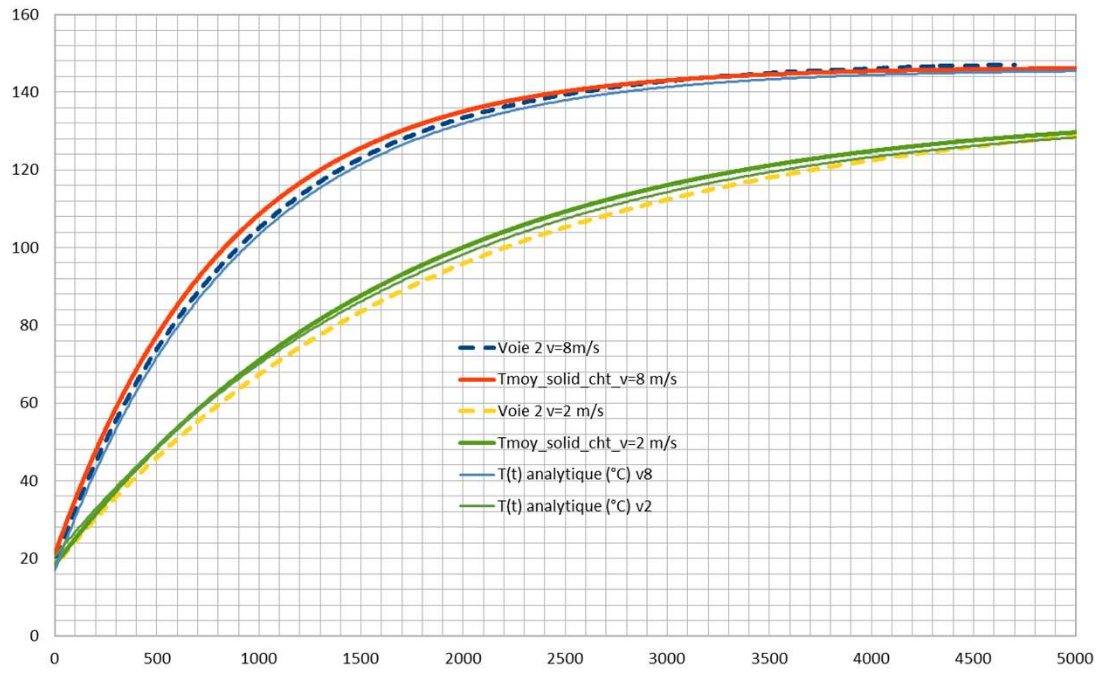
- Air velocity impact

V air = 8 m/s



Conditions:
Tair = 147.5°C
Tray = 110°C
Tini = 17°C
Ø120 mm Lg110 mm
Steel
Emi = 0.9

- Material impact



Conditions:
V=2 m/s
Tair = 138.8°C
Tray = 82.2°C
Tini = 20.5°C
Ø120 mm Lg110 mm
ALUMINIUM
Emi = 0.15

Conditions:
V=8 m/s
Tair = 147.5°C
Tray = 113°C
Tini = 21°C
Ø120 mm Lg110 mm
ALUMINIUM
Emi = 0.15