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Title: Numerical simulation of the combustion chamber for a new reference
combustion calorimeter computation simulation

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Introduction

Today natural gas is the third most widely used fuel in the world.

Measuring the amount of heat that would be released by the complete combustion in air of a specified quantity of gas (on a molar, mass or volume basis), superior calorific value (SCV) (ISO 15971:2010, 2008). **What is Superior Calorific Value?**

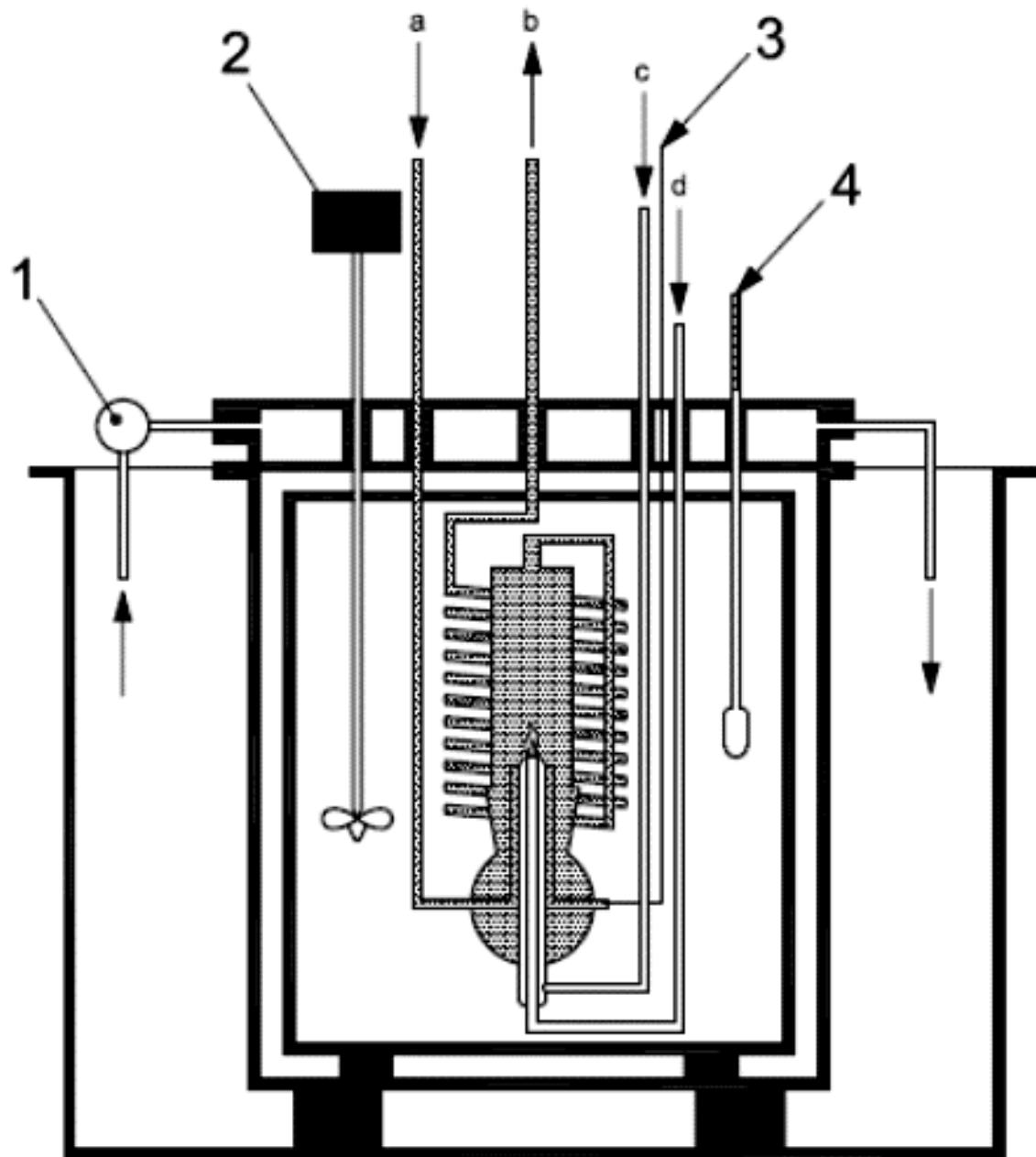
There are **different methods** (P. Ulbig, 2002), apparatus Cutlass hammer (P. Ulbig, 2002), there are instruments commercial falling in indirect methods and which are the most used. Such devices can calculate the SCV of natural gas by **chromatography**, supported with ISO 6976

Today **several institutions around the world** such as (P. Schley, et al., 2010), (Haloua, Filtz, & et.al, 2009) and (A. Dale, et al., 2009), have developed their own devices which operate under the same principle as the calorimeter by (F.D. Rossini, 1931) called **Class 0 mass-basis calorimetry** by ISO 15971 and its main feature is the accuracy of measuring the SCV of pure gases that can be achieved with this type of equipment,

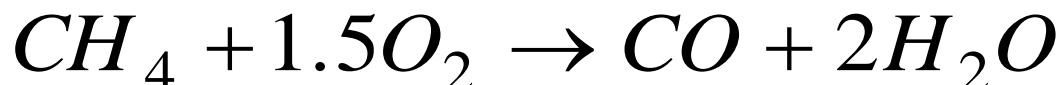
Introduction

Schematic diagram of class 0 calorimeter. (1) water pump; (2) stirrer motor; (3) spark ignition electrode; (4) thermometer; (a) secondary oxygen; (b) combustion products, (c) primary oxygen plus argon; (d) fuel gas; (CV) calorimeter vessel; (J) jacket; (CH) combustion chamber; (B) burner; (H) heat exchanger.

Source: (ISO 15971:2010, 2008)



Numerical model



Parameters:

Solver → Pressure-Based

Non Premixed

Transient State

Modelado 3D

Viscous model --> k-epsilon (2 eqn), Realizable
Combustion Eddy-Dissipation

3 zones, mixture methane-air; water and glass

Air 6.66 e-6 kg/s; 23.5°C; 0.9 O₂

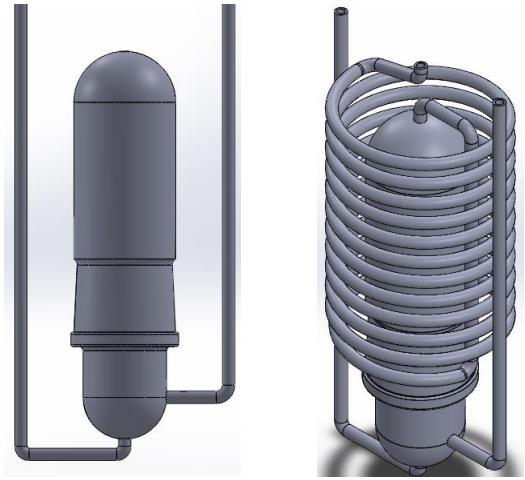
Methane 8.33e-7 kg/s; 23.5°C; 0.96 CH₄

Solution Methods; PISO

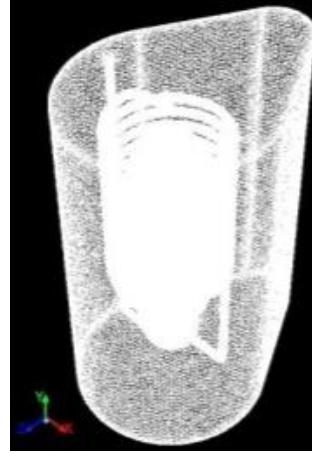
Convergence 1e-3 continuity and 1e-6 energy
time step size 0.01

time steps 500

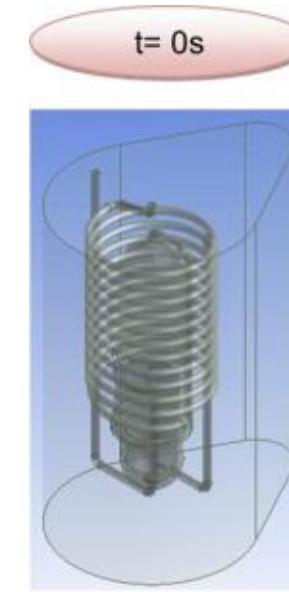
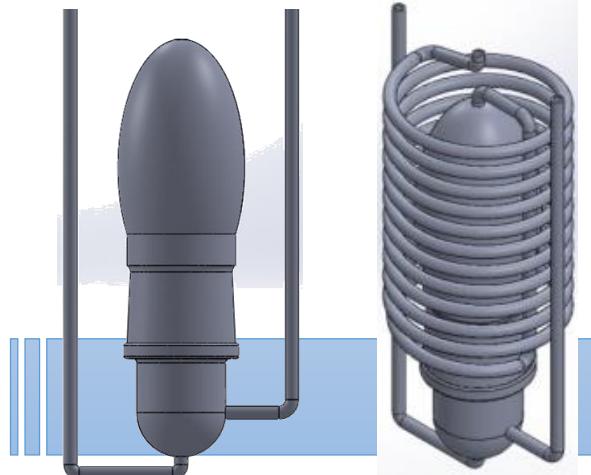
Methodology



ANSYS FLUENT

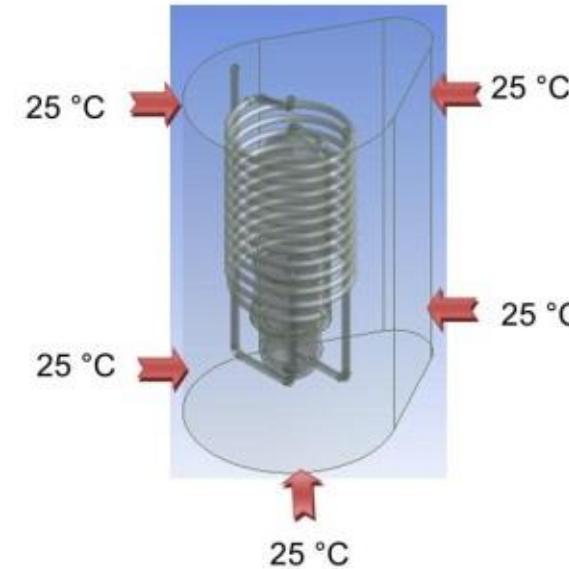


Aim: Increase
heat exchanged



t = 0s

T_o=23.5 °C
t > 0

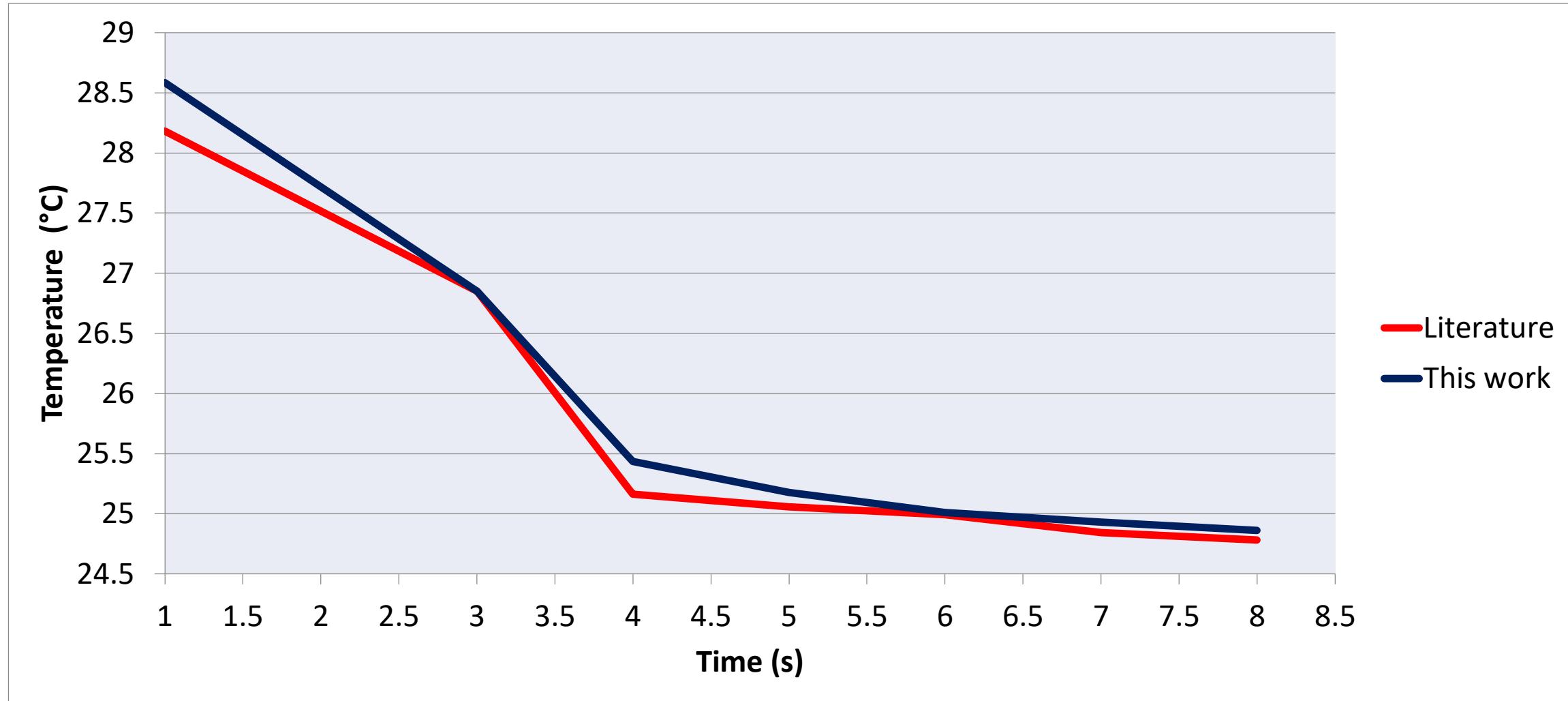


Criterium: The
Lower
temperature in
exhaust gases

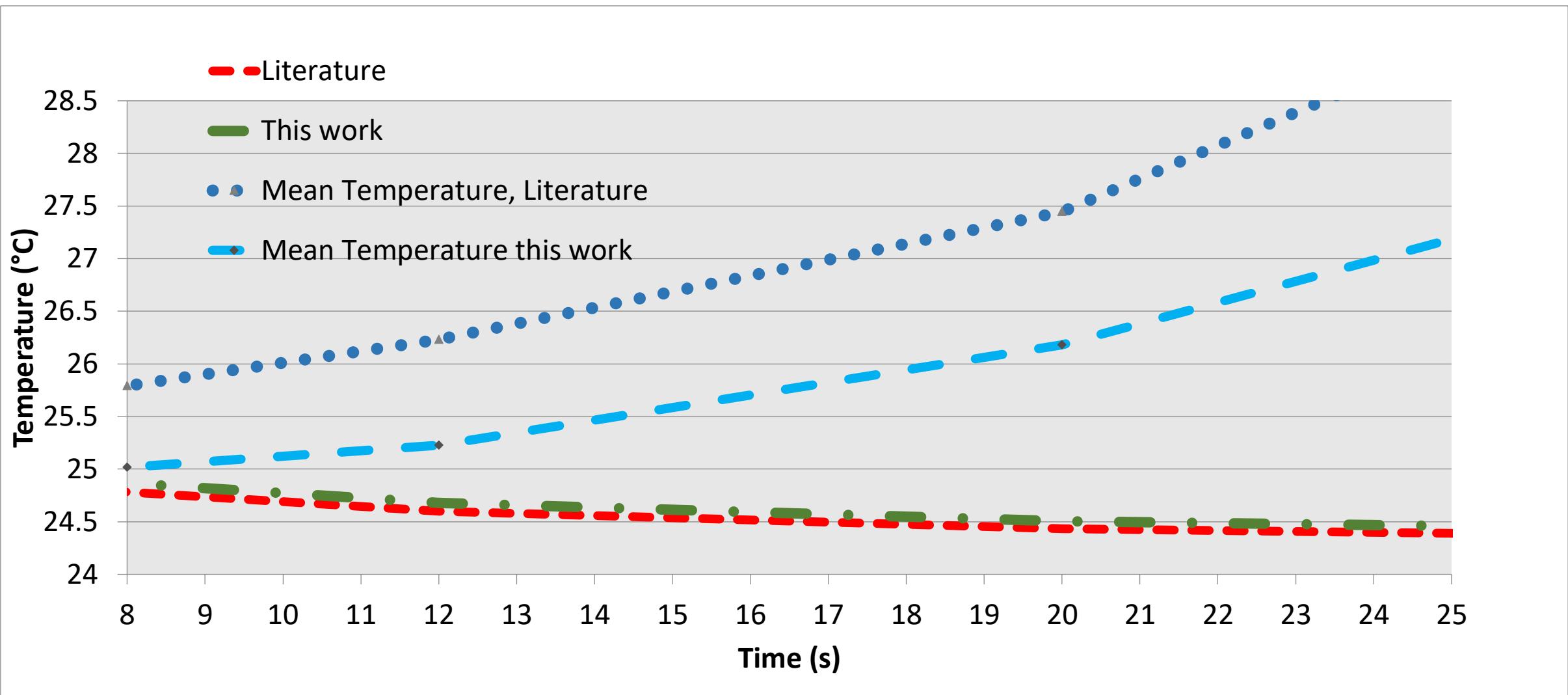


Results

First 8 seconds

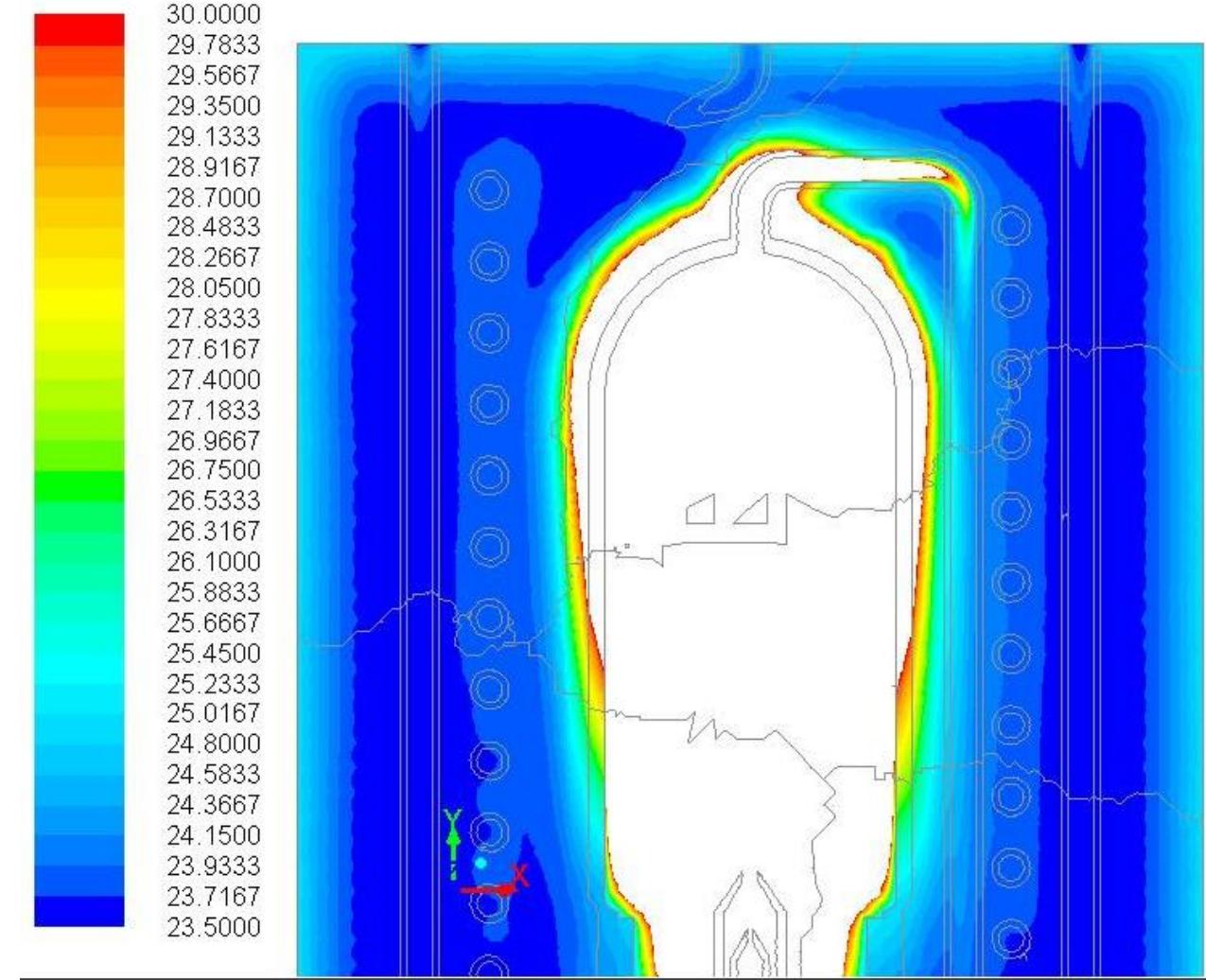
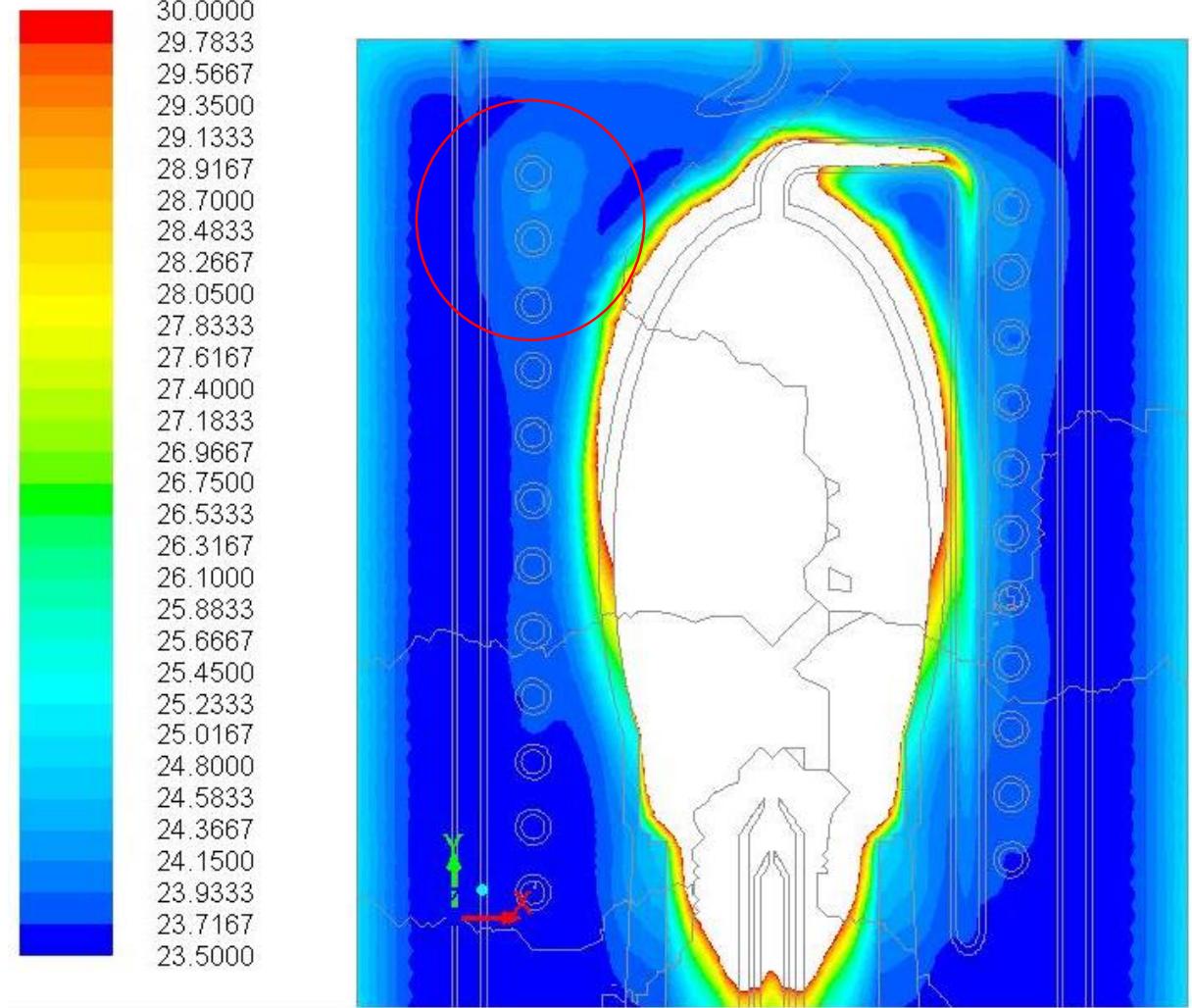


Results



Results

100 seconds

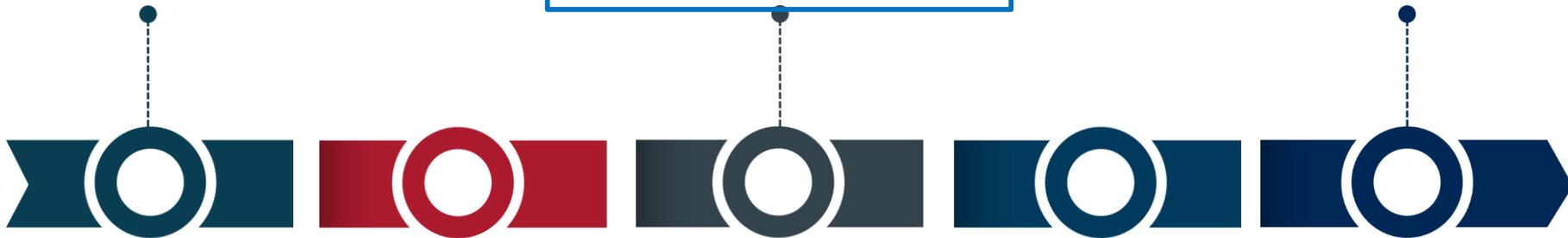


Conclusions

Was shown two numerical simulations in a transient state of two combustion chambers for the reference calorimeter to measure SCV of natural gas.

maximum difference of 0.40°C in the first second

We chose a chamber with a cylindrical body and hemispherical lid



The best performance was to literature chamber

We need to increase the area where the gases are accumulated

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