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BOOKLET

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

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Introduction

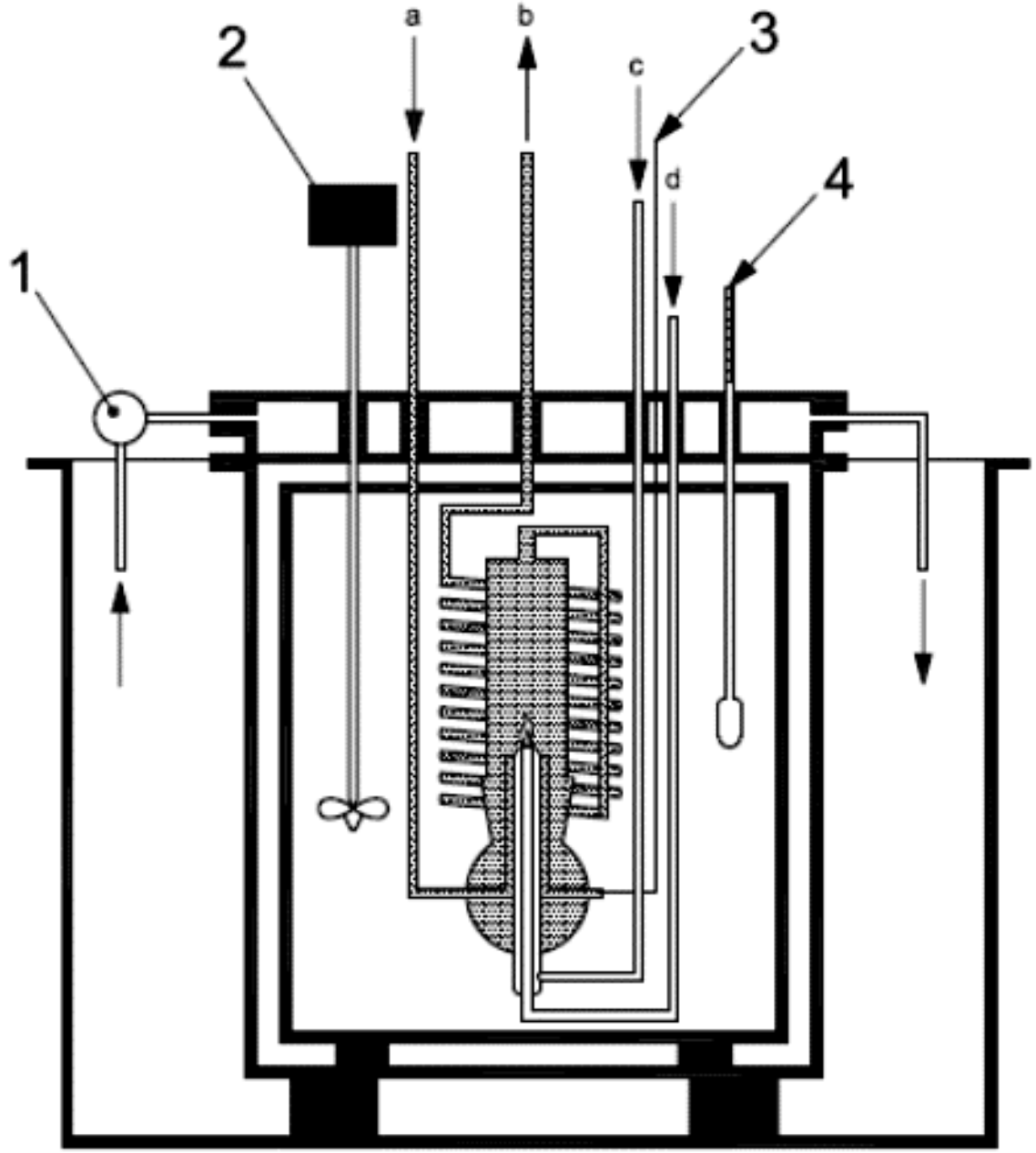
Today natural gas is the third model most widely used fuel in the world.

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 whit 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

$$CH_4 + 1.5O_2 \rightarrow CO + 2H_2O$$

$$CO + 0.5O_2 \rightarrow CO_2$$

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

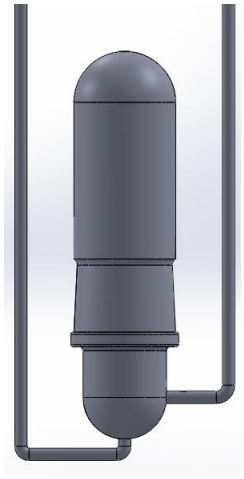
Solution Methods; PISO

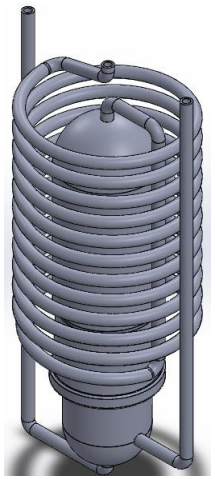
Convergence 1e-3 continuity and 1e-6 energy

time step size 0.01

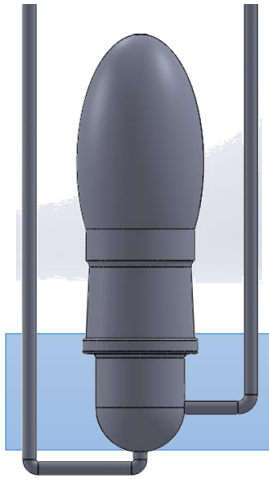
time steps 500

Methodology

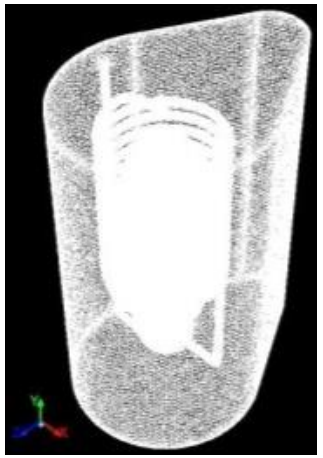




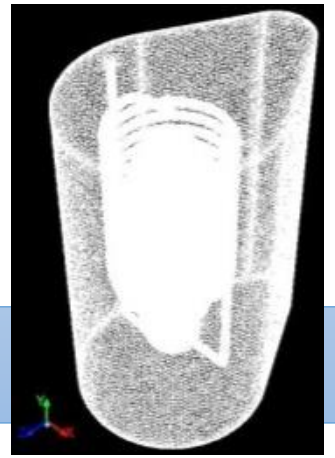
Diamter and height equal



ANSYS FLUENT



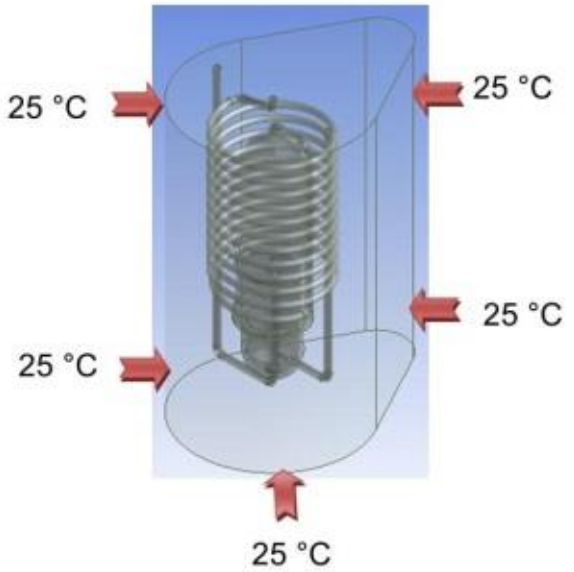
Aim: Increase heat exchanged



t= 0s

T_o=23.5 °C

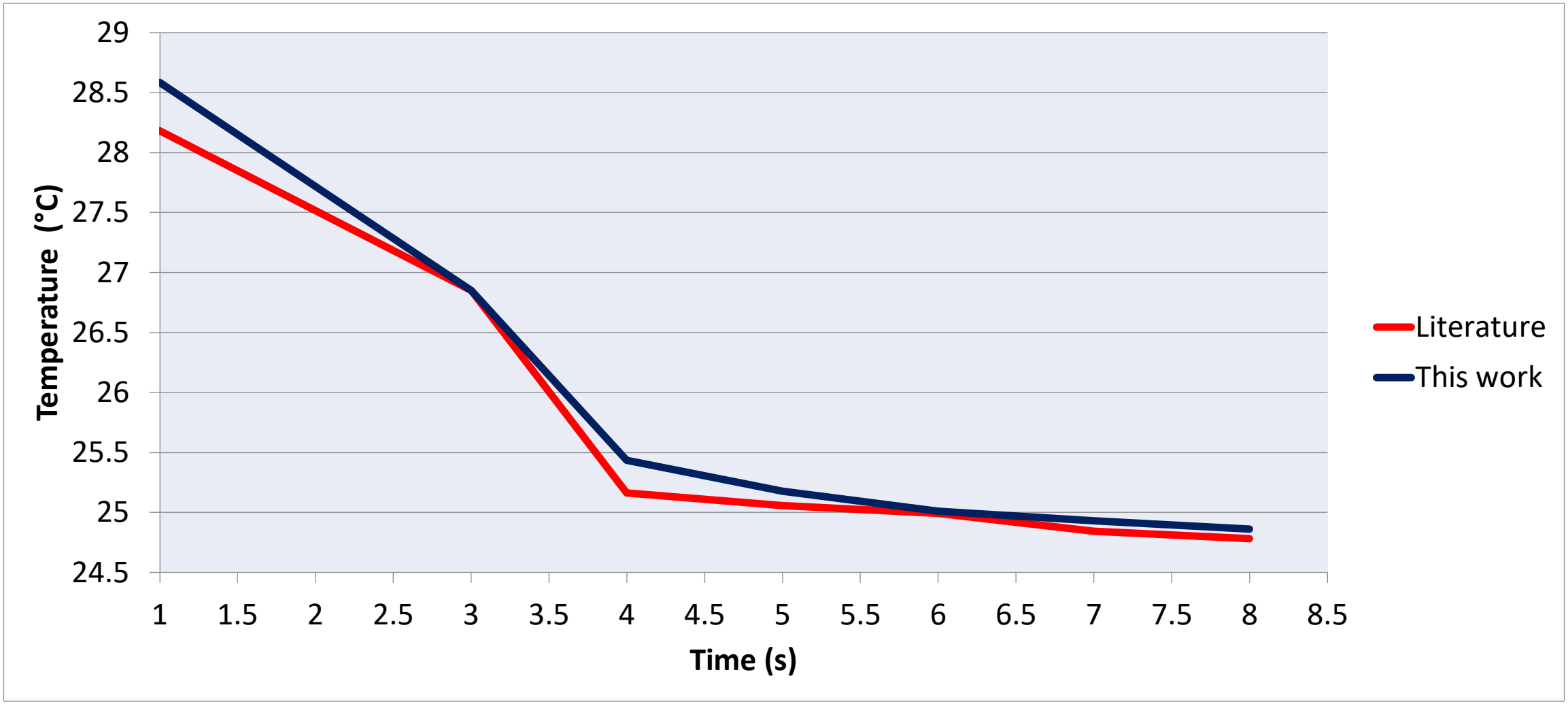
t > 0



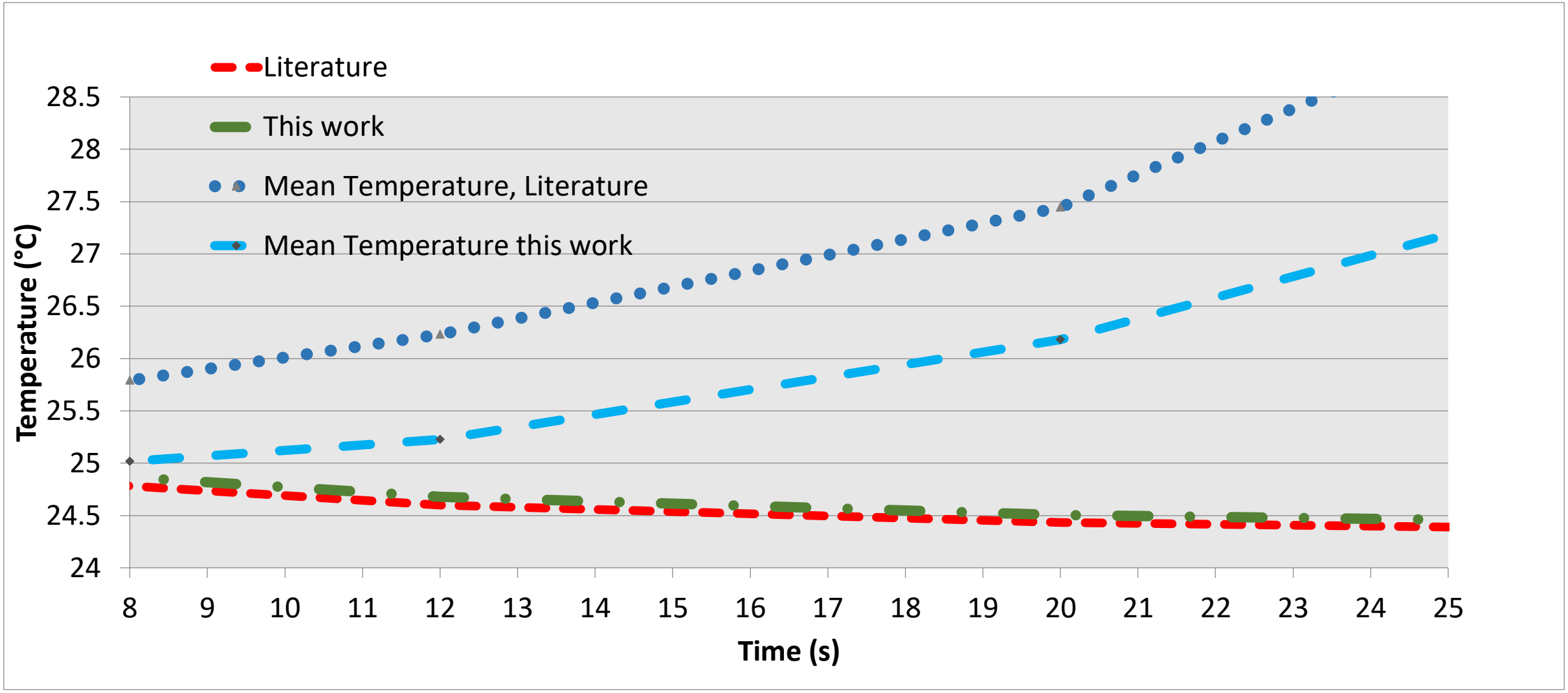
Criterium: The Lower temperature in exhaust gases

Results

First 8 seconds

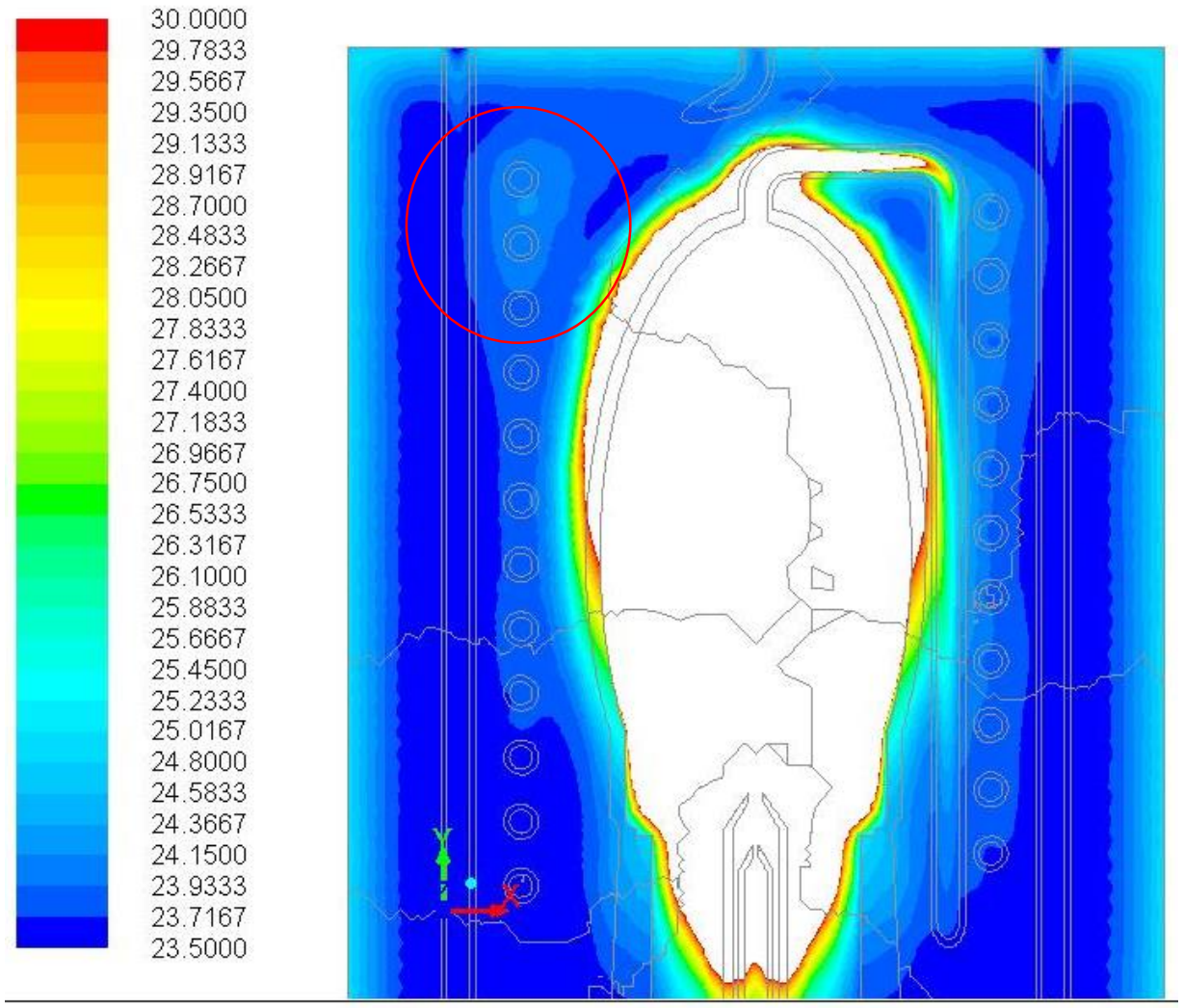


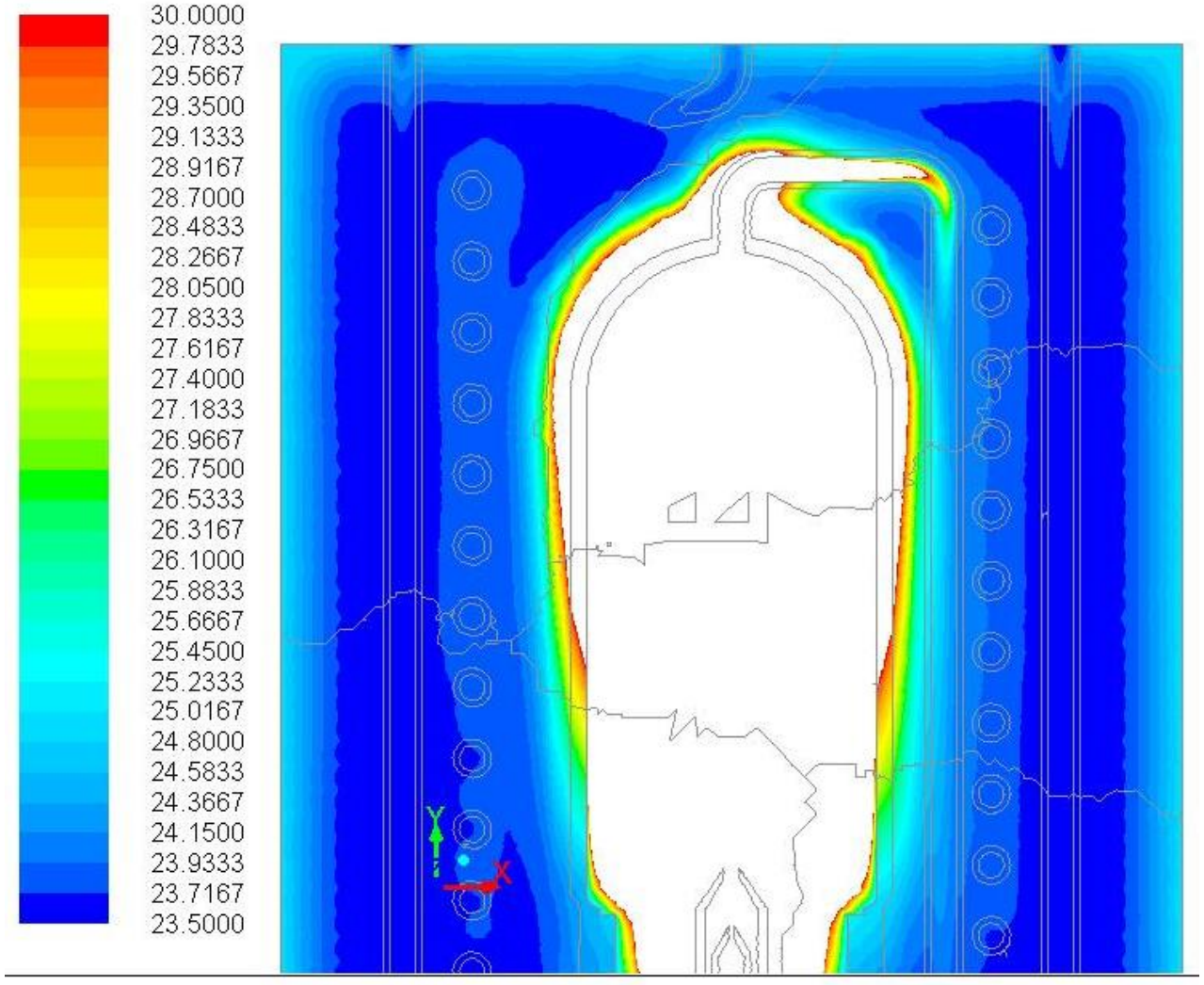
Results


Literature
This work
Mean Temperature, Literature
Mean Temperature this work
Temperature (°C)
28.5
28
27.5
27
26.5
26
25.5
25
24.5
24
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Time (s)

Results

100 seconds



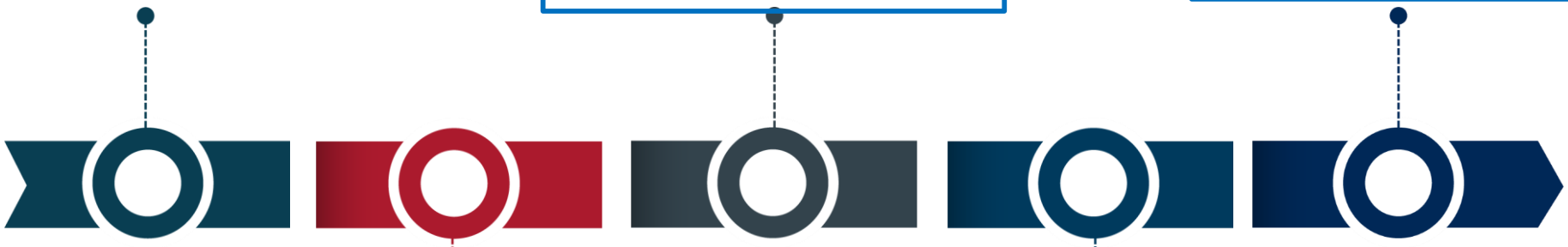


Conclusions

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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