

# FLUID-SOLID-HEAT COUPLING SIMULATION FOR FURNACE

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KEYWORDS -  
ANSA, CFD, Furnace

## ABSTRACT -

In this work, a temperature distribution was analysed with a fluid-solid-heat coupling simulation for furnace. The Meshed model that was used in this analysis was generated with the CFD meshing function of ANSA. The P-1 radiation model and the k-ε turbulence model were adopted. The results show the temperature of steel liquid layer at about 1400°C and temperature at output of water cooling system at 27°C. The analysis provides a great insight into the thermal transmission pattern in the structure and acts as a starting point for further optimization.

## 1. INTRODUCTION

There are a number of different phenomena that place in a DC Electric Arc Furnace. Such phenomena are those of, conduction, convection, radiation, electromagnetism and chemical reaction. The Thermal analysis of the Furnace in this paper centers on the efficiency of water cooling system and temperature distribution of molten iron layer.

## 2. PHYSICAL MODEL

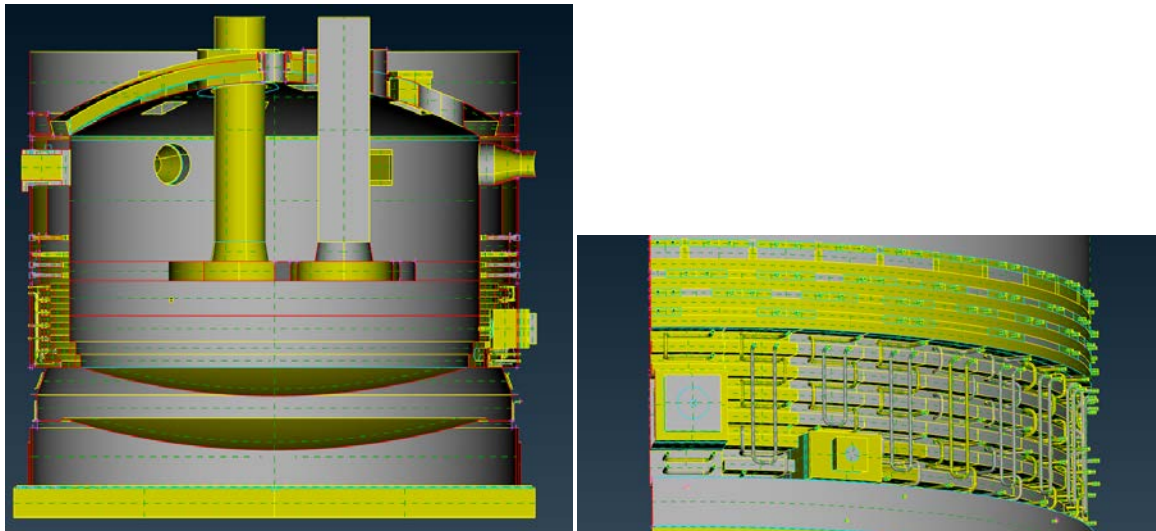


Figure 1 – Geometry model

The water cooling system contains more than 200 pipes at the side of the Furnace. The geometry model is shown in figure-1. The picture on the right in the figure 1 is the part of water cooling system.

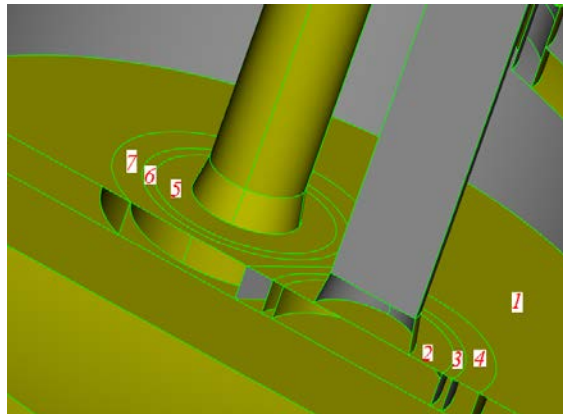


Figure 2 – Heat source

2,5	10% of total
3,6	25% of total
4,7	15% of total

Table1 – Heat distribution

Heat generated from graphite electrode was simplified as heat source which is shown in figure-2. The heat was generated by graphite electrode and was distributed from zone-2 to zone-7. The distribution of heat source is shown in table-1.

### 3. MESH GENERATION

The mesh generation for this simulation had to result in less than ten millions elements due to a limit in the available computing power. The skewness of the grids was set as less than 0.97. The mesh was generated using CFD meshing function of ANSA.

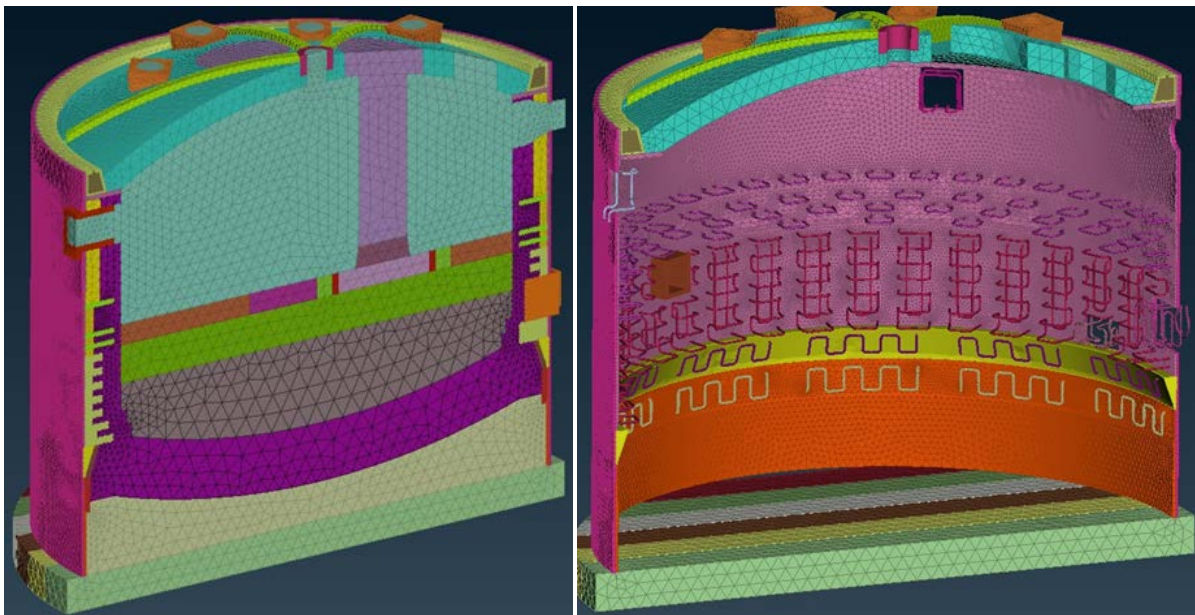


Figure 3 – Mesh generation

tetras	6777798
pentas	148280
pyramids	2461
toatal	6928539

Table 2 – Number of grid

The Grid of the sides and the water pipes of the cooling system are shown in right picture of Figure-3. The type and the number of mesh generation are shown in table-2.

4. RESULTS

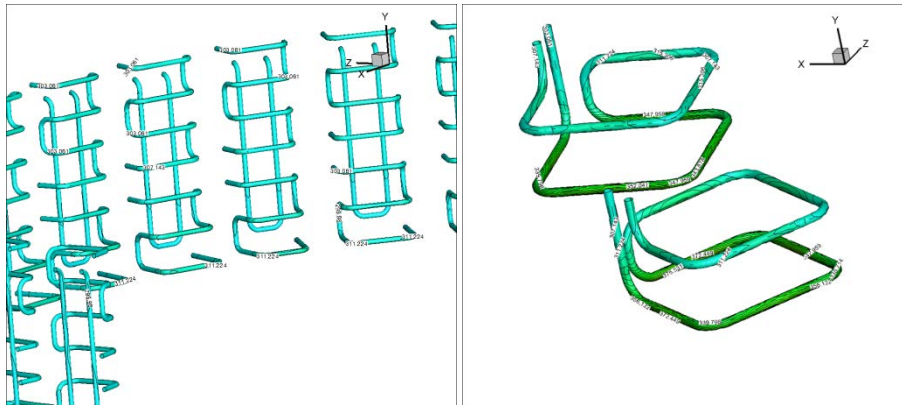


Figure 4 – Temperature distribution at pipes

The initial temperature of the water at the inlet of cooling pipes was 25°C. After the simulation, the temperature at the output of the water cooling pipes was 26°C which is similar to the results in the actual experiment.

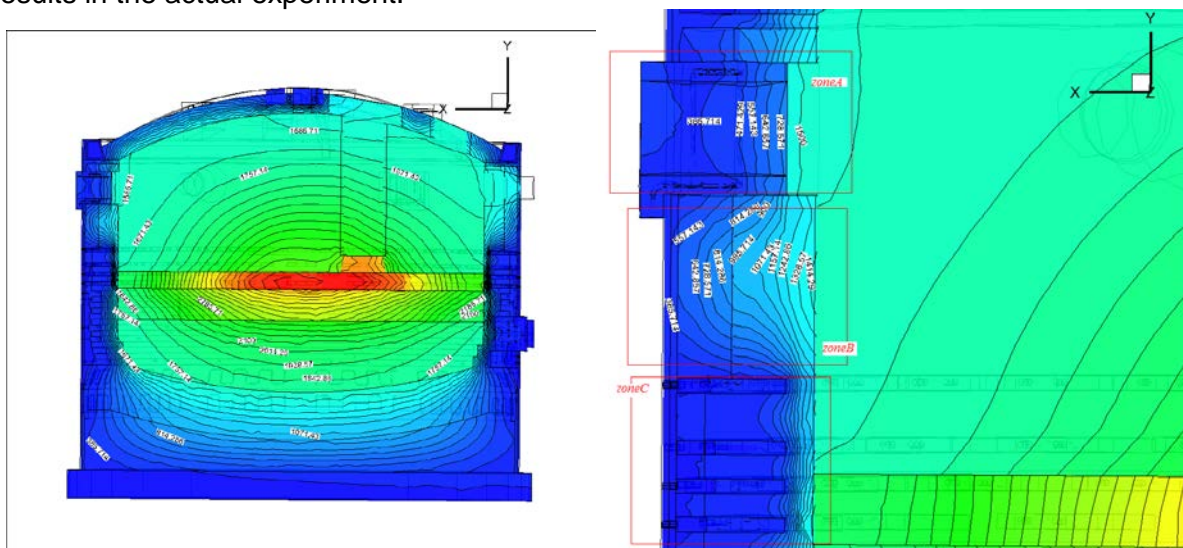


Figure 5 – Temperature distribution of furnace

The Global temperature distribution is shown on the left of figure-5. The temperature distribution of the molten iron layer is about 1400°C which is also, similar to experiment's results. The picture at right of the figure is the temperature of heat insulation beside the water cooling system.

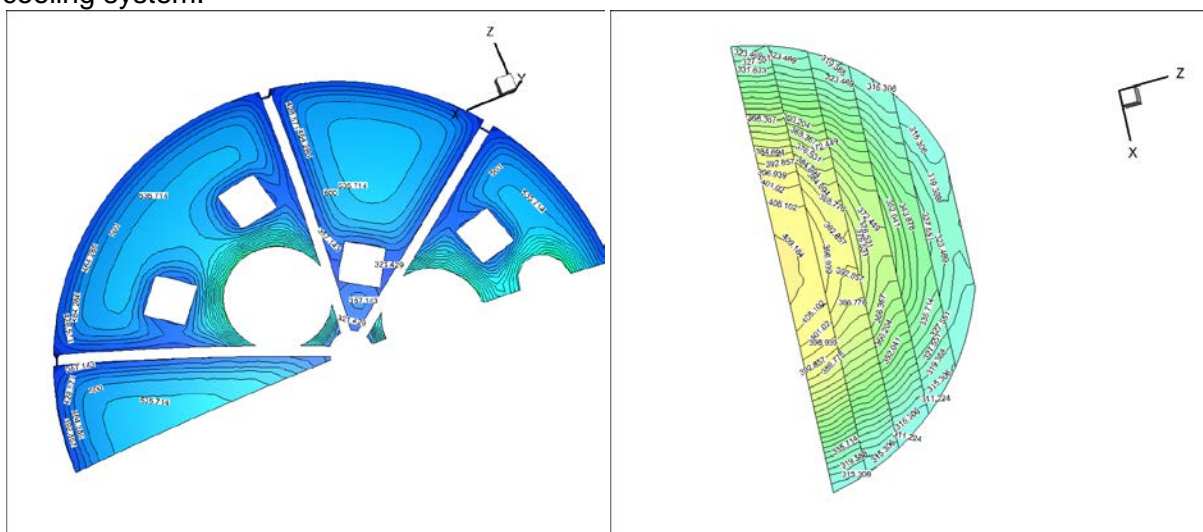


Figure 6 – Temperature distribution of top and bottom

The picture at the left of figure-6 is the temperature distribution at the top. It is less than the max temperature of the criterion. The picture on the right of figure-6 is the temperature distribution of bottom.

## 5. CONCLUSION

- 1) ANSA is a high-powered software for CFD mesh generation.
- 2) Temperature at the output of water cooling pips is 26°C.
- 3) Temperature distribution of molten iron layer is about 1400°C.

## REFERENCES

- (1) ANSA version 13.2.1 User's Guide, BETA CAE Systems S.A., December 2011.
- (2) "Numerical calculation of velocity field and temperature field of electrical arc in DC electric arc furnace", Guo Hong-zhi, Journal of iron and steel research, Feb. 2003.