Thermal and Fluid Dynamics Studies Applied to Steel Industry

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Introduction: The energy pay back is one of the most interesting field especially in the steel industry where this contribution is strictly connected to steams and emissions inside and outside the plant. Perhaps, this application is sometimes disturbed by a strong variation of emissions ("off gas"). One solution is represented by the use of special elements named "Phase Changing Material" (PCM), capable to absorb and release energy in form of latent heat.

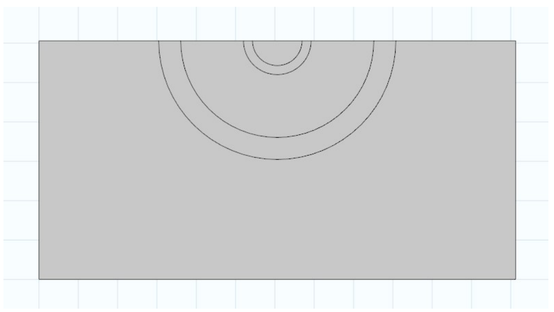

Figure 1. PCM – first model

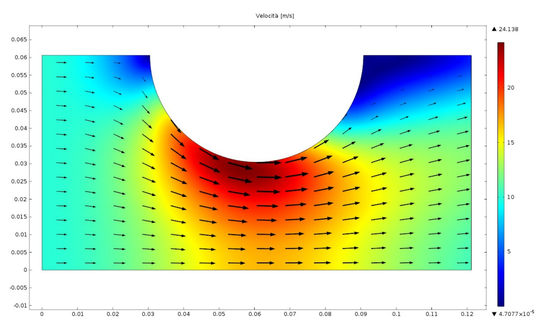

Figure 2. PCM – off gas

Computational Methods: The primary objective is the determination of the temperature fields within the system and consequently the position of the interface of solidification and the values of heat exchange.

Therefore we will use the non-isothermal flow physics.

to determine the position of the interface will use a dummy variable B function of temperature, the main physical properties of the materials will then be guided by the variable B.

we consider two different geometries:

A) PCM sectioned along a plane normal to the axis and immersed in the off-gas stream

B) PCM sectioned along a vertical plane containing the axis.

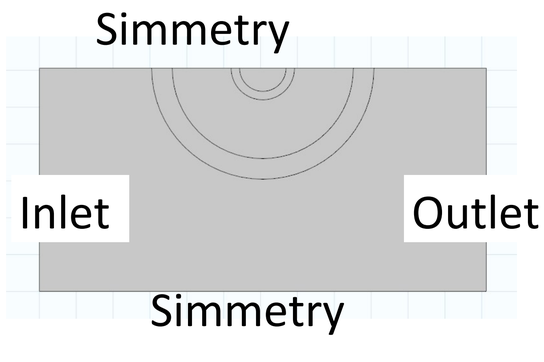

Figure 3. Model A

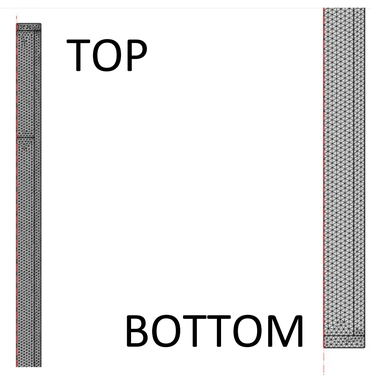

Figure 4. Model B

Results: Solving the problem has made it possible to assess the position of the melting front and seize the criticality of the geometry adopted; it was then possible to observe the effect of absorption of latent heat and its release in respect of flue gas temperatures

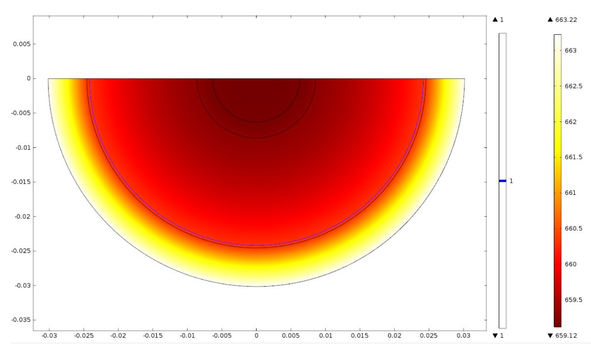

Figure 5. Temperature

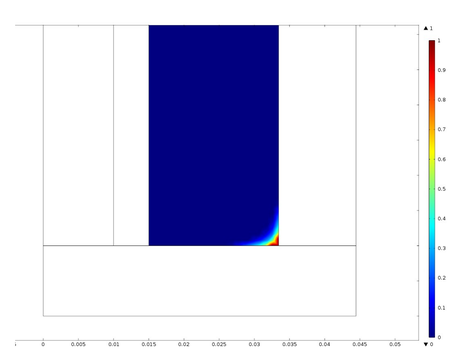

Figure 6. Fusion: Starting point

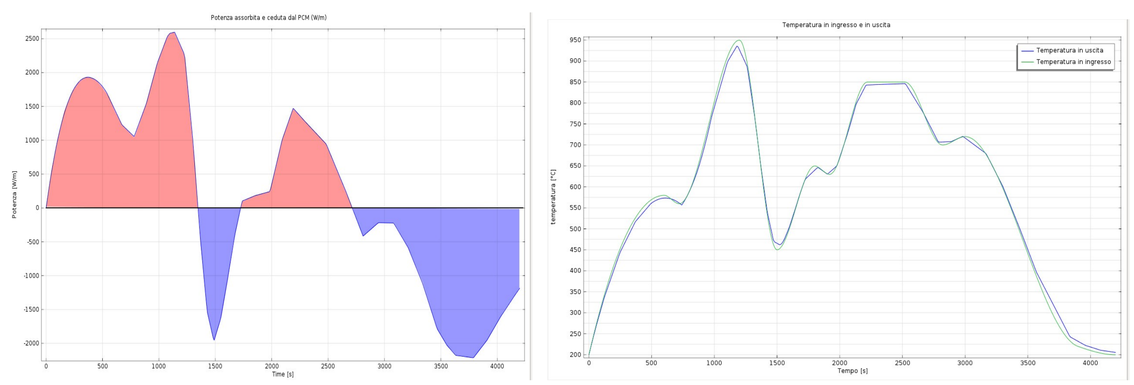

Figure 7. Latent heat adsorbed/released – fluid temperatures

Conclusions: Using the multiphysics simulation allowed the evaluation of the various aspects related to the use of PCM and the relationships between them, it was then possible to determine the geometry of the PCM themselves and to assess their effectiveness in stabilizing the gas temperature.

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