INVESTIGATION ON WATER-COOLED CALORIMETER MEASUREMENTS IN PLASMATRON FACILITY

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In the design of re-entry vehicles a particular attention must be paid to the requirements of the heat flux allowed at the stagnation point of the body and, because of the high expense of flight tests, laboratory tests must be performed and their results extrapolated to flight conditions.

For these reasons during my diploma course it was decided to have a better understanding of heat flux measurements.

A very deep analysis of the water-cooled calorimeter used was performed; in particular a numerical model of it was developed, validated and analysed. The model made is a second order model where nucleate boiling phenomenon and mixed convection heat transfer inside the cooling water are described and for these reasons the main property of this model is that the convective heat transfer coefficient can vary in time during the integration. Also side losses are described inside the model.
During the model analysis we tried to understand the physics of the model and to judge its coherence and in particular we:

- Tried to understand the effects of different parameter on the calorimeter response describing the physics of these effects.
- Demonstrate the presence of mixed convection inside cooling water during tests made.
- Tried to demonstrate the nucleate boiling phenomenon presence inside cooling water.

Also an experimental analysis of the calorimeter insulation efficiency was made.

As a result of this study made at the end a new design of the water-cooled calorimeter was proposed.

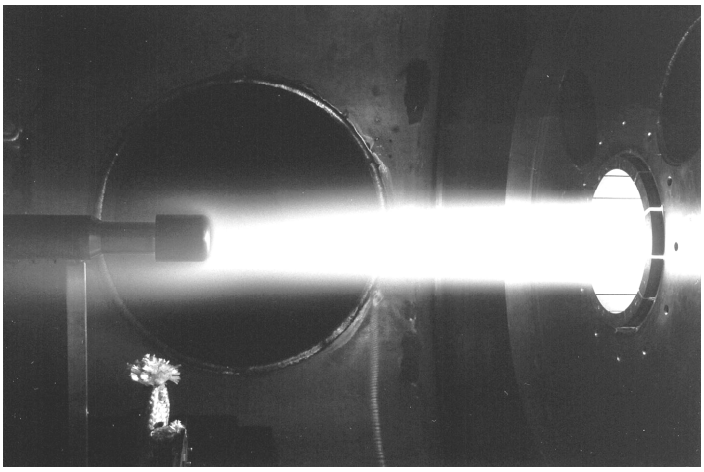

Figure 1: Heat flux measurements in Plasmatron facility