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# PROPERTIES OF CARBON AND SIC FOAM AS THERMAL INSULATOR FOR SPACE THERMAL PROTECTION SYSTEMS.

**Abstract**

The development of reusable launch vehicle (RLV) and hypersonic vehicles must include a significant reduction of the payload transportation costs. One of the most expensive systems for any RLV is the thermal protection system (TPS), which protects the vehicle from the high thermal loads during re-entry. Thermal protection systems technology foreseen typically sandwich structures. Sandwich structures are required to be reusable, lightweight and thin. These characteristics are the driving requirements for the design and development of these challenging structures. One of the main components of the sandwich structure is the core. In this context core material shall withstand with high thermal loads and the main task is to put down the temperatures from the hundreds of degree of the upper surface (typically about 1000-1500C) in order to protect the inner volume of the spacecraft. In this frame, the foam core selection to the specific application is especially important. When failure of a sandwich panel occurs it is usually in the core, because plastic foams have low shear rigidity compared to the skins the most suitable materials are the carbon based one due to their high stability at high temperatures. Carbon foams properties can vary with the manufacturing method which determine the micro-structure. Their main featrues are thermal stability ( low CTE), lightweight, high insulating apacities, the weak aspect is the working temperature limit of about 1000C and mechanical properties. For these reasons SiC foams are also analyzed in this paper. SiC foams are Carbon foams coated with SiC typically by a chemical vapour deposition method. These foams enhance their mechanical properties and have a higher working temperature, but this lead to higher CTE and heavier weight. For these reasons a trade off shall be carefully carried out. In this paper foams thermal behavior is studied and Thermal Expansion Coefficient (CTE) is determined. By the use of the inverse method heat capacity and thermal conductivity are analysed. A robust numerical approach, such this inverse method, is one of the best for this problems as many parameters concur for the determination of properties. Such approach permits to perform the parametric and structural identification of the model. These procedures are presented including both experimental investigation

and methodical-numerical aspects. Special test equipment and the regularizing algorithm for solving the ill-posed inverse heat conduction problem are described.