AN ANALYTICAL DESIGN MODEL FOR THE BRL HEATED DRIVER GAS SUPPLY SYSTEM

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A time dependent driver gas filling model was developed under sponsorship of the U. S. Army Armament, Munitions and Chemical Command's Ballistic Research Laboratory. Driver gas filling strategies were prepared utilizing the capabilities of the BRL pebble-bed heater, liquid nitrogen cryogenic pump, and driver purge valve in combination with the 3 foot diameter by 30 foot long driver.

Conservation equations for mass and enthalpy are solved for an open thermodynamic system to obtain the driver gas density and temperature. Driver gas pressure is determined from the perfect gas equation of state. Gas enters the driver at a specified mass flow rate and temperature and driver gas may leave the driver at a specified mass flow rate and average driver gas temperature. A key element of the thermodynamic model is an estimate of the loss of driver gas thermal energy to the driver walls via natural convection. Buoyancy forces establish a circulatory flowfield in the driver gas as the gas next to the driver wall is cooled; this process is governed by the nondimensional Grashoff number which is a ratio of buoyancy and Viscous forces. No experimental heat transfer data exist at the driver Grashoff numbers (up to 10**13) and geometry (horizontal cylinder) of interest However, gas temperature predictions based on a heat transfer correlation adopted for this model have been found to agree reasonably well with test data taken by Otis and Roessler in a short vertical cylinder and with the two dimensional numerical calculations of Markatos.

Test data acquired during the pebble bed heater shakedown will be used to calibrate the model and validate filling strategies in the late summer of 1990.