

DEVELOPMENT OF A PEBBLE-BED LIQUID NITROGEN EVAPORATOR AND SUPERHEATER FOR THE SCALED LARGE BLAST/THERMAL SIMULATOR (LB/TS) FACILITY

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The paper documents the work performed for BRL during the period September, 1986 through May, 1988 under a research and development program. The objective was to design, fabricate and test a scale model of a pebble-bed type heat exchanger intended for rapidly evaporating and heating cryogenic liquid nitrogen (LN₂) to supply high temperature, high pressure gas for use in the proposed LB/TS test facility. BRL has specified driver gas pressures ranging to 2,200 psig (15 Mpa) at temperatures as high as 700 degree F (644 degree K). The development and successful tests of the scale LN₂ Pebble-bed Evaporator/superheater are described. Relatively incompressible dense LN₂ was used as the source for hot compressed driver gas to avoid the use of slow but expensive large air compressors. Evaporation of the LN₂ and heating of the driver gas was successfully performed in a single pass in the in-line pebble-bed heater with full temperature control of the driver gas.

SPARTA has demonstrated that relatively small LN₂ pumping systems can provide nitrogen gas at the required maximum driver pressure and temperature in minutes depending primarily on the capacity of the LN₂ pebble-bed evaporator/superheater eliminated moisture condensation in the test section.

The tests showed that:

The LN₂ pebble-bed evaporator/superheater concept is a practical means of quickly and simultaneously pressurizing and heating gas for the LB/TS drivers; outlet gas temperature can be regulated to a substantially constant temperature which is lower than the pebble-bed temperature; and internal pressure and pressure drop through the LN₂ pebble-bed was negligible.