

DESIGN, FABRICATION AND TESTING OF A PEBBLE-BED LIQUID NITROGEN EVAPORATOR/SUPERHEATER FOR THE LARGE BLAST/THERMAL SIMULATOR!

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The paper documents the work performed for the U.S. Army Corps of Engineering through subcontracts with the Ralph M. Parsons Company during the period September, 1989 through August, 1990. The program objective was to design a pebble-bed heat exchanger intended for rapidly evaporating pressurized cryogenic liquid nitrogen (LN2) and controllably heating the resulting gaseous nitrogen to supply high temperature, high pressure driver gas for the LB/TS. Driver gas pressures ranged to 2,250 psig (15 Mpa) at temperatures as high as 750 F (672K).

The Pebble-bed Evaporator/Superheater (PHB) consists of an outer pressure shell, stainless steel liner surrounded by Zircon insulation, eight vertically stacked pebble-beds filled with 3/8 inch diameter nickel balls and 64 electric resistance heater rods encased in stainless steel tubes. A multiple spray injector array uniformly introduces cryogenic LN2 into the uppermost bed where it is converted to gaseous nitrogen. Perforated baffle plates between the series of beds assure uniform axial gas flow to efficiently utilize the stored heat. Before operation, the PHB is preheated to 1,850 F over a period of 4 hours. During driver fill, pressurized LN2 is pumped through the PHB at a constant rate of 1,057 gpm(54kg/sec) using positive displacement cryogenic pumps.