HEAT TRANSFER EXPERIMENTS USING GEOTHERMAL FLUIDS

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SUMMARY ONLY - Full text to be circulated

INTRODUCTION

Although most of the activity to date in use of geothermal resources has been related to electricity their direct use for process heating will assume more importance in future. This will involve the large-scale use of geothermal fluids in heat exchangers.

A joint MWD/DSIR project team has been set up to investigate the problems of heat transfer fran geothermal fluids in surface heat exchanges. Thermal and hydraulic design data is available for single-phase fluids. It was considered necessary to supplement this with experimental data particularly in three areas:

1. The use of two-phase geothermal fluids; determinationof heat transfer coefficients using various fluids in a clean tube. This involves the effects of gas as well as enthalpy.

2. The flow characteristics and pressure drop in a two-phase heat exchanger.

3. The rate of mineral deposition (principally silica) on surfaces and its effect on heat transfer.

This data is being obtained using a pilot size (350 kW) heat exchanger at Broadlands, in which separated steam and separated water fran the well BR22, and supplementary gas from another well, are combined as required and passed through a water-cooled tuba.

Concurrently with this experiment work, performance data is being obtained from existing industrial heat exchangers using bore fluid with a steam fraction of about 5% (Rotorua) and separated steam with about 3% gas (Kawerau).

DESIGN OF PILOT PLANT

Separated steam and water are metered using orifice plates and recombined before passing through eight tube sections in series. Each section is 3 m in length with an O.D. of 25.4 mm. Temperature and pressure profiles are thus obtained in eight steps. Corrosion-inhibited cooling water flows through an annular shell surrounding each tube. The cooling-water inlet conditions are held constant by automatic control. Since the cooling water must be pressurised, secondary exchangers are used to dissipate the heat.

EXPERIMENTAL PROGRAMME

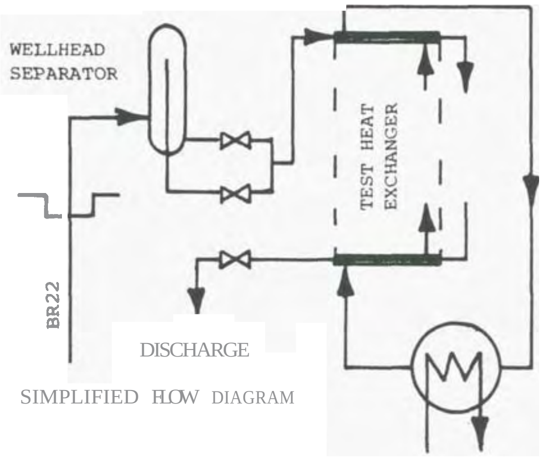
1. Short term work.

The objective of this work is to estimate the film coefficients, in clean tubes, which can be obtained under realistic industrial conditions. The main interest is in two-phase well fluid, but the whole range is being covered, including separated water and also steam with a varying gas content.

Since only the geothermal (tube side) coefficient is required, the other resistances to heat transfer must be predictable. This means that calibration work has been required to determine the cooling water (shell side) coefficient over a range of flows and temperatures. A large number of data points is required to fit this coefficient to a curve.

2.. Long term testing.

After the completion of the short term tests (December) the plant will be used for long term operation to determine the rate of fouling. Since the results must be extrapolated to one year for an industrial plant, the experiment must be run for at least three to four months at steady conditions.



SIMPLIFIED FLOW DIAGRAM