A BOREHOLE SIMULATION AUTOCLAVE FOR LOGGING TOOL TESTING AT HDR ENVIRONMENT

Paul Hegemann rind Fritz Rummel

MeSy GEO-Meßsysteme GmbH, Meesmannstr. 49,44807 Bochum, Germany

Key words: boreholes, autoclave, logging tool testing, HDR

ABSTRACT

A high-pressure / high temperature autoclave system was developed to permit testing of newly designed logging tools under hostile HDR geothermal environmental conditions. The autoclave has the following specifications:

- inside diameter: 165 mm (6-1/2")
- inside length: 7800 mm (307")
- max. operating pressure: 150 MPa (21750 psi)
- max. temperature: 200 °C (392 °F)
- pressure medium: fluids

Pressure and temperature can be held constant within 1 per cent of their maximum values. The autoclave has an inside mounted 7-conductor cablehead and electrical feed-thrus, as well as hydraulic inlets / outlets at various positions to allow tool operation of almost any kind during testing.

1. INTRODUCTION

Deep boreholes are expansive probes into the earth crust. Exploration in such boreholes therefore requires most reliable and well-tested systems such as geophysical logging tools, fluid samplers or packer systems to withstand to the hostile downhole environment at great depth. Testing such downhole equipment under controlled laboratory conditions prior to running it downhole is particularly important for newly developed tools as experienced for testing in the 9 km deep German Deep Drilling project KTB or in the European HDR geothermal deep drilling projects Bad Urach or Soultz sous Forets. Since access to existing commercial, laboratory autoclave testing is limited in Europe, MeSy had the possibility to develop a new borehole simulation autoclave available to European researchers active in the development of new borehole testing or drilling systems.

2. THE MESY BOREHOLE SIMULATION AUTOCLAVE

The main components of the borehole simulation autoclave are shown in Fig. 1 and can be summarized as follows:

- The autoclave consists of an 8 m long heavy duty steel pipe with 280 mm O.D. and 165 mm I.D. for testing tools with a maximum length of 7800 mm.
- The steel pipe can be heated by an external furnace of 20 kW power which allows a heating-up rate between 2 °C/h and 25 °C/h.
- External insulation guarantees good heating efficiency and minimum thermal losses.
- Both, the top and bottom caps of the autoclave contain high pressure / high temperature seals, and hydraulic and electric feed-thrus which allow all kinds of testing. A 7-pin Gearhart Owens type cable head inside the autoclave allows connection to the testing tool. Adapters to other cable heads are available.
- The pumping and heating units allow to monitor and control pressure and temperature within 1 per cent of the maximum conditions of 150 MPa and 200 °C. These maximum conditions are in accordance with approval of the German Safety Authority (TÜV) which constantly inspects the autoclave system. Built-in safety units (burst disc valve and temperature limit) guarantee not to exceed maximum values. Maximum values can only be exceeded with approval by German Safely Authorities. German safety standards are in agreement with European safety standards.
- The autoclave is housed in a 10 m deep well of 1.5 m diameter which allows access to electrical and hydraulic inputs / outputs prior and after the tests. During testing the autoclave room is not accessible. Remote monitoring of pressure and temperature at various autoclave positions occurs digitally and analog on PC and strip-chart recorder.

3. RESULTS

So far, more than 100 new logging tools or tool components were tested. In some cases a simple O-ring in the tool housing was the reason to ruin a new development worth of some hundred thousand marks because of wrong design, if not tested prior to its final construction, MeSy's autoclave is offered to any scientific researcher or geotechnical customer in logging

tool development at effective costs with respect to public funding.

4. ACKNOWLEDGMENT

The development of the borehole autoclave system was supported by the German Ministry of Research and Technology (BMFT) under contract no. 0326690B and by the European Economic Community (EEC) under contract no. EN3G-0055D. The autoclave was developed by the MeSy engineers P. Hegemann, H. Vogt and R. Weckheuer. Advice from the German Safety Authority (TUV) is greatly appreciated.

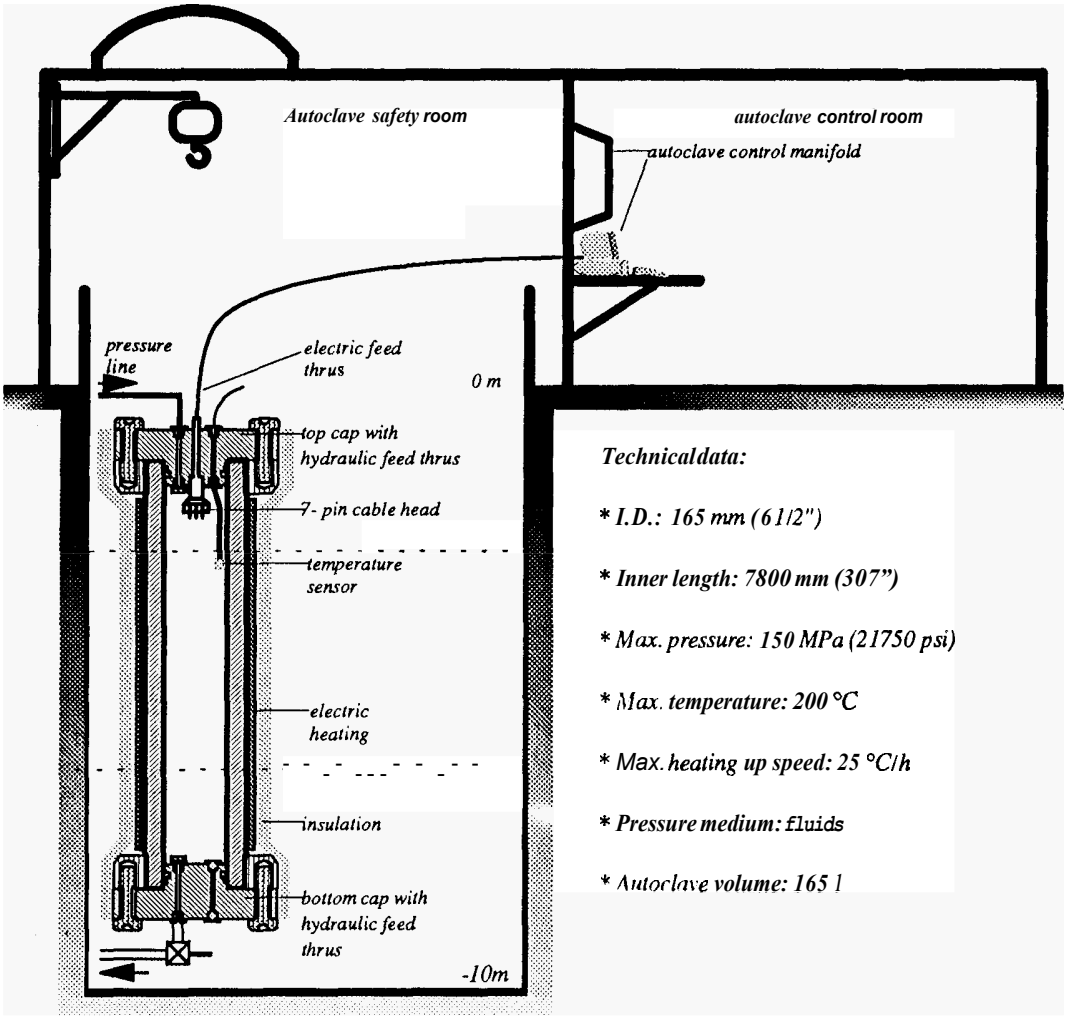

Figure 1: Schematic diagram of the borehole simulation autoclave system.