Indian MHD Programme - Status Review

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INDIAN MHD PROGRAMME -STATUS REVIEW

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INTRODUCTION

MHD technology development activities are carried out in 5MWt MHD pilot plant and auxiliary component test rigs. The airpreheater, hot air duct, FRP duct, main combustor, nozzle and downstream ducts have been successfully worked for about 2200 hours. Present direction of experimentation is to develope further the hot wall channel and demonstrate high enthalpy extraction. Initial experiments on MHD channel used water cooled copper electrodes filled with ceramics and was operated in cold mode. The current drain was low in this case and a new generator has been designed to operate at a thermal input of 8 MWt and a hot wall temperature around 1800 C. The status of recent experiments in MHD flow train and development of subsystems are discussed in this paper.

MHD PILOT PLANT ACTIVITIES

A new MHD generator designated as D22 has been designed and fabricated at MHD centre. It is a segmented Faraday type with 100 electrode pairs. The features of the design are hot electrode and insulation wall surfaces, increased ceramic area and special electrode materials based on ZrO2-CeO2 and Lanthanum chromite. The water leakage problems of gang cooled peg wall have been replaced by individual modules with external seal surfaces and cooling arrangements. The insulation modules had several materials such as Aluminium oxide, Magnesium oxide and Magnesium aluminate spinel in different zones for comparative evaluation. The channel was tested at 4.5 MWt though it was designed for 8 MWt due to the problem developed in one of the auxiliaries. The power generation parameters are given below:

Fuel	: LPG gas
oxygen enrichment	: 29 %
Mass flow rate g/sec	: 850
Thermal input	: 4.5 MWt
Plasma conductivity	: 8.5 mho/m
Magnetic field	: 1.98 tesla
Max. electrode wall temperature	: 1600 C
Max. insulation wall temperature	: 1620 C
Max.open circuit voltage	: 209 V
Max. short circuit current	: 2.7 amps
Power developed	: 4-5 KW
Insulation resistance at 1600 C	: 20 M ohms

The channel output was loaded to a bulb load array of 10 KW and 30 KW. A four electrode power consolidation was also tested and the consolidated power was inverted through a 2 KW inverter and fed to a separate AC loading panel to illuminate incandescent bulbs.

MHD RETROFIT

A detailed project report has been submitted to Government of India for retrofitting a 20 MWe coal fired MHD system to an existing 60 MWe thermal power plant at Ennore, Madras. Design, layout and cost evaluation of all the subsystems required for the above MHD retrofit have been worked out and described in the project report which is awaiting clearance from the government. Another proposal for 5MWe gas fired MHD demonstration plant is being worked out for government approval.

SLAGGING COAL COMBUSTOR

This section describes the details of the experimental runs conducted in the Slagging Coal Combustor (SCC) test rig with Lignite during the last one year. A change in tangential entry duct cross-section of the first stage of the combustor, increase in slag port dimension and introduction of vent system in the slag tank were done prior to the experiments. The highlights of the runs were attainment

of a very good, uniform and thin layer of slag in most parts of the first stage of the combustor. And approximatly 70% of slag was collected in the slag tank. The development of slagging coal combustor will be pursued in the same direction by conducting long duration experiments to achieve the main goal of continuous high slag rejection in the slag tank and reduce carry over slag. The modifications incorporated in the coal feeding system gave better performance. In both the runs, coal feeding was smooth without any problem. To arrive at optimum parameters, mathematical, cold flow, and vertical bench scale modelling studies are being conducted.

The cold flow model consists of a single tangential entry cyclone chamber of diameter 400 mm and length 1200 mm, glycerol injectors working on twin fluid atomization principle, glycerol pumping system, glycerol collection and re-circulation system and an exhaust duct system to let out the carry over glycerol. The effect of tangential entry velocity on collection efficiency was studied by varying the entry velocity. It was observed that the collection efficiency increases as the entry velocity decreases.

It is proposed to conduct a series of experiments on a bench scale vertical combustor of capacity 0.3 MWt to characterise the suitability of Indian coals. The vertical combustor system consists of a slagging stage which is designed as a double walled air cooled cylinder with two tangential air inlets and a gas fired vitiation heater which preheats the inlet air.

AIRPREHEATER FOR STEEL INDUSTRIES

The application of air preheaters for steel industries is also being pursued. Successful operation of airpreheaters for 2100 hours in the pilot plant has given sufficient data and experience to use these airpreheaters for steel plants. Recently major design calculations have been completed and cost estimation is in progress for preparing the feasibility report on demonstration of airpreheaters at Tisco steel plant.

MAGNET

Watercooled nonsuperconducting magnet for producing 4 Tesla field has been designed for evaluation of near electrode phenomena and study of plasma electro-dynamics. The clear bore of the magnet would be 250 mm x 250 mm with an active length of 300 mm. Field analysis and design aspects have been completed.

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