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Experimental studies on novel multi tubular reactor with shell having integrated buffer storage

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Abstract

This study concentrates on experimental analysis of a large scale metal hydride based hydrogen storage reactor having 50 kg $LaNi_5$. In order to cater the heat transfer limitations of hydrogen storage in large scale systems, the present design have been developed as multi tubular reactor with shell having integrated buffer storage configuration with 7 tubes supported by means of 4 baffles having total 50 kg $LaNi_5$ distributed equally among them and water as heat transfer fluid flows across the shell for heat transfer. The experimental study was performed for studying the absorption and desorption performance of the present hydrogen reactor wherein in case of absorption the parameters varied were HTF flow rate at 30 °C and supply pressure of hydrogen and in case of desorption which was carried out at atmospheric pressure, HTF flow rate and HTF temperature were varied. The metal hydride reactor reversibly stores 680 g of hydrogen amounting to 1.34 wt% of gravimetric capacity of metal hydride and equivalent energy storage of 10.4 MJ. In case of absorption, when the flow rate selected was 20 LPM the absorption time for 90% reaction completion was observed to be 1286 s (21.4 min) at 30 bar H_2 supply pressure. In case of desorption studies, it was observed that the varying flow rate from 15 to 25 LPM has negligible effect on hydrogen desorption