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Innovative reactor prototype for Hydrogen production in a stationary application using sodium borohydride

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Abstract

Hydrogen storage has proved to be the greatest obstacle preventing hydrogen from replacing fossil fuels. Hence, a safe, efficient and economical method of storing hydrogen must be available to turn viable a hydrogen economy based on renewable resources [1]. Hydrogen can be stored in chemical hydrides such as sodium borohydride ($NaBH_4$), with large theoretical H_2 content of 10,9 wt%. With the aid of catalysts, and at room temperatures, the alkaline hydrolysis of $NaBH_4$ can be enhanced [2].
In this work, a 100 L innovative reactor for hydrogen production was designed, based on the optimized layout of a laboratorial scale reactor [3], as part of a project financed by the Portuguese financial support program NSRF. The developed system has the capability to feed a 5 kW PEM fuel cell with a maximum hydrogen consumption of 75 slpm.
The $NaBH_4$ solution is stored in a 50 L reservoir from where seven consecutive 7,0 L injections to the reactor are possible. The Ni-Ru based catalyst applied can be re-used several times without losing its performance [1] and because of this capacity its replacement will be done, manually, every seven $NaBH_4$ solution injections (simultaneously with the residual solution removal and the reactor cleaning). The catalyst should then be recovered for further utilization. Additionally to the reactor, a 400 to 500 L reservoir was also designed to be used as the system buffer since the reactor works in batch mode and it is desired that the PEMFC operates continuously. The system was conceived for stationary applications and eventually to be installed in remote areas, reason why the system´s monitoring and control are fully automatized. Its hydropneumatic circuit layout is characterized by four parts: injection system, reactor, valves bloc and buffer. It is assumed that the designed system can operate continuously throughout 15 hours with a medium hydrogen consumption of 10 slpm, which can supply a daily household energy power demand.

References

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