Massflow control of a solar thermo-chemical energy storage system using ammonia

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Abstract.
A solar thermo-chemical energy storage system using ammonia and powered by a concentrator dish is investigated at the Australian National University (ANU). Dissociation and synthesis of ammonia provides energy storage, which is capable of providing electricity on a 24-hour basis without the need for any fossil fuel back up.
In the heat recovery part of the closed loop system a needle valve produces pressure difference for regulating the massflow and a piston pump circulates the gas-mixture through the synthesis reactor. The pump speed varies the massflow and a buffer vessel limits the pressure pulses. To govern the massflow a proportional-integral-derivative-controller is used. The goal is to achieve a continuous and steady flow of reactants through the synthesis reactor. This was obtained by using empirical methods such as the closed loop cycling technique and the process reaction curve (system step response).
The main components of the solar dissociation part are an air pressure driven ammonia piston pump, which is controlled by varying the pressure of the air supply valve and the endothermic reactor. Further there is another needle valve for a pressure difference. For maximum solar dissociation the temperature during solar transients has to be kept close to constant.
This paper presents the sensitivity analysis of the controller parameters as a function of massflow and system pressure. Also latest results on controlling the solar dissociation temperature via the massflow will be depicted.