# An optimised spouted bed reactor for hydrogen production

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The growing need for sustainable energy solutions has driven increased interest in producing hydrogen from renewable resources. Among these, agricultural and textile waste—readily available yet frequently underexploited—emerges as a promising feedstock for thermochemical conversion into hydrogen and other valuable compounds. Spouted bed reactors are particularly advantageous for this application, thanks to their superior mixing and heat transfer capabilities, which are essential for optimizing reaction performance [1, 2]. The research conducted by the Process and Engineering Research Team (PERT) group aims to experimentally optimize a pilot-scale spouted bed reactor to enhance hydrogen production and overall process efficiency, supporting the advancement of circular and low-carbon energy systems.

The research activities involve testing a spouted bed pilot reactor (20 kWth) located at Filidea facilities (Biella, Italy) and the experiments focus on adjusting the operational parameters such as equivalence ratio (ER), biomass feed rate and initial height of the inert bed, to enhance hydrogen yield and process efficiency.

Experimental trials are carried out under various ERs, including combustion and gasification conditions, to assess temperature profiles and gas composition, including $H_2$, $CO_2$, $O_2$, $CH_4$, and CO. Initial bed heights are also assessed to ascertain the influence of the fluid dynamics on the final product streams. Hydrogen concentrations reached up to 15% vol under optimized conditions.

The insights gained from these experiments contribute to the development of efficient, scalable solutions for clean hydrogen production, advancing the sustainable conversion of waste materials into valuable energy sources.

**Keywords**: *spouted bed reactors, hydrogen, gasification, biomass*

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[2] Energies 2024, 17, 5, 1046; doi: 10.3390/en17051046