

## Hydrogen Storage Optimisation: Development of Advanced Tools for Improved Permeability Modelling in Materials

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**Abstract :** This study addresses a critical challenge in transitioning to a hydrogen-based economy by introducing and validating a one-dimensional (1D) tool for modelling hydrogen permeability through hybrid materials, focusing on tank applications. The model developed integrates rigorous experimental validation, published data, and advanced computational modelling using the PanDiffusion framework, significantly enhancing its validity and applicability. By elucidating complex interactions between material properties, storage system configurations, and operational parameters, the tool demonstrates its capability to optimize design and operational parameters in real-world scenarios, as illustrated through a case study of hydrogen leakage. This comprehensive approach to assessing hydrogen permeability contributes significantly to overcoming key barriers in hydrogen infrastructure development, potentially accelerating the widespread adoption of hydrogen technology across various industrial sectors and marking a crucial step towards a more sustainable energy future.

**Keywords :** hydrogen storage, composite tank, permeability modelling, PanDiffusion, energy carrier, transportation technology

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