PRESLHY

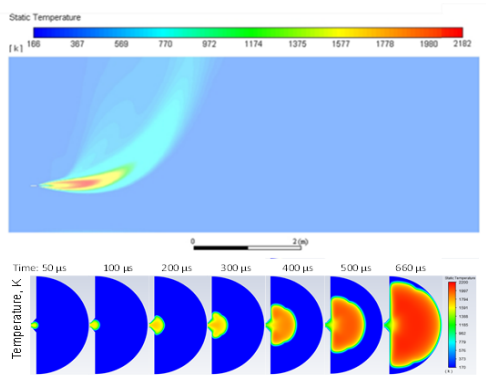
Newsletter

ISSUE 5 MAY 2021

Top stories in this newsletter

PRESLHY
Dissemination conference

Project key outputs



Conclusions from experimental, analytical and computational studies

PRESLHY dissemination conference

PRESLHY dissemination conference on pre-normative research for safe use of liquid hydrogen was held on the **5-6 May 2021** as a virtual event. The conference recorded about 340 registrations from 25 different countries and approximately 250 attendees to the event. Speakers from PRESLHY consortium presented the results of the outstanding research performed on the major phenomena associated to the release and dispersion of liquid and cryo-compressed hydrogen, the ignition of cryogenic hydrogen-air mixtures and their combustion. The conference addressed the potential impact of the project outputs on the international community working on hydrogen and fuel cell technologies. Presentations by invited international speakers enriched the conference program, providing a throughout overview of the state of the art and worldwide research on safety of liquid hydrogen. If you missed the event or could not attend all sessions, you can find the conference presentations and videorecordings on PRESLHY website.

Find out more about PRESLHY project key outputs

The pre-normative research outcomes and advancement of knowledge beyond the state-of-the-art were implemented into publicly available documents underpinning the inherently safer deployment of hydrogen and fuel cell technologies using LH_2 and cryo-compressed hydrogen:

⇒ Chapter on LH_2 safety for the Handbook on Hydrogen Safety

⇒ White paper

⇒ Novel engineering correlations and tools for LH_2 safety

⇒ Guidelines for safe design and operation of LH_2 infrastructure

⇒ Recommendations for RCS

The documents address several aspects inherent to LH_2 and cryo-compressed hydrogen safety, spanning from LH_2 safety science, role and potential benefits of LH_2 systems, to practical guidelines and recommendations for Regulations, Codes and Standards (RCS). Documents are available on PRESLHY website.

Conclusions from experimental, analytical and computational studies: closed knowledge gaps and models for hydrogen safety engineering

The extensive experimental campaigns enhanced the current understanding of the phenomena associated to LH_2 safety:

⇒ Multi-phase accumulations with explosion potential:
- Repeated spill in gravel bed might generate dangerous condensed phase mixtures; not for other substrates;
- Water sprays on LH_2 and LH_2 spill on a small water pool seem to be non critical.

⇒ Combustion properties of cold gas clouds, especially in congested area:
- Higher expansion ratios come with higher critical expansion ratios;
- Uncongested mixtures behave less critical;
- Density effects might promote strong pressure effects in particular for congested areas.

⇒ Knowledge and experience related to releases involving large quantities:
- Large discharges do not generate static electricity or promote spontaneous ignition under normal weather conditions.

The performed analytical and numerical studies provided validated models for the determination of consequences and hazards from incidents involving LH_2 systems and infrastructure:

- Modelling of steady state and transient cryogenic releases accounting for heat transfer effect or a discharge line friction and extra resistances.
- Characterisation of concentration decay in momentum cryogenic hydrogen jets.
- Definition of the final state resulting from mixing LH_2 and moist air, and assess potential for O_2 condensation.
- Prediction of the extent of LH_2 pools and characterization of evaporation processes on different ground substrates.
- Determination of Ignition Energy for hydrogen-air mixtures.
- Assessment of electrostatic field-up generated during hydrogen releases.
- Evolution of laminar burning velocity and expansion ratios for cryogenic hydrogen-air mixtures.
- Determination of hydrogen jet fire flame length and thermal load.
- Determination of the maximum pressure load from delayed ignition of turbulent hydrogen jets.
- Characterisation of Pressure Peaking Phenomena for cryogenic hydrogen releases in an enclosure.
- Critical conditions for flame acceleration and detonation transition for cryogenic hydrogen-air mixtures.
- Estimation of the overpressure generated by a BLEVE and a fireball size after LH_2 spill combustion.

Future work, open issues and priorities

The performed pre-normative research highlighted some areas where further research may be needed:

⇒ Fundamental/Modelling: clarify material issues with cryogenic hydrogen; improve thermodynamic modelling in multiphase, non-equilibrium, reaction kinetics (< 200K); determine induction times and detonation cell sizes (< 200K).

⇒ Dispersion phenomena: ventilation of closed rooms and interaction with other mitigation concepts; multiphase effects on large scale dispersion with obstruction and/or (partial) confinement.

⇒ Combustion phenomena: broader assessment of FA and DDT for varying congestion and confinement at larger scale; evaluation of detonation potential of solid O_2 in LH_2 pools; potential for spontaneous ignition of cryogenic hydrogen releases; further experimental and numerical research on BLEVEs.

⇒ Risk assessment and mitigation strategies: proper design and approval of safety valves; integral (applied) tests (dispersion and combustion in closed rooms) for mitigation strategies, including sensor placement and performance; crash test for vehicle tank systems.

In December 2020, the ISO TC 197 committee has established the working group **WG29 subtask 2** for the update of ISO TR 15916 with regards to LH_2 applications. Activities of WG29 will be kicked-off in June 2021.

Forthcoming events

Please note that future events may be affected by current restrictions associated to Covid-19 pandemic.

⇒ International Conference on Hydrogen Safety, 21-24 September 2021, Edinburgh, UK.

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 779613.

To find more information about our research activities, please visit: www.preslhy.eu