Integrated design for demonstration of efficient liquefaction of hydrogen (IDEALHY)

Fuel Cells and Hydrogen Joint Undertaking (FCH JU)

Grant Agreement Number 278177

Title:	A Review of Available Information on the Hazards of Liquid Hydrogen Production, Storage and Road Transportation *(Publishable Summary)*
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Work Package	Whole Chain Assessment
Deliverable Number:	3.9
Date:	28 October 2012
Report Classification:	Restricted (here: *Publishable Summary*)

New Energy World JU
fuel cells & hydrogen for sustainability

Approvals	
WP Leader	✓
Coordinator	✓
FCH JU	**pending**

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Publishable summary

Hydrogen is seen as an important energy carrier for the future which offers carbon free emissions at the point of use. In particular, hydrogen could be used to power vehicles using hydrogen fuel cell technology and thereby replace the use of petrol and diesel. In the absence of a hydrogen pipeline supply network, which would be costly and take considerable time to build, hydrogen could be supplied using road tankers. However, transporting hydrogen by road as a compressed gas is very inefficient and supplying liquefied hydrogen (LH_2) by road tanker is seen as the most effective way forward in the medium term. This will require large quantities of LH_2 to be produced, stored and transported for re-fuelling vehicles.

The IDEALHY project receives funding from the European Commission's 7th framework programme (FP7/2007-2013) for the Fuel Cells and Hydrogen Joint Technology Initiative. The project has the aim of developing a new hydrogen liquefaction process which will enable LH_2 production to be undertaken at increased scale (50-200 tonnes per day) and with significantly increased efficiency. The production of large quantities of LH_2 and the subsequent road transportation and storage at vehicle re-fuelling stations (often in urban areas) present new challenges in terms of ensuring the safety of the public. For these reasons, as part of the IDEALHY project, the safety of the proposed production and supply system is to be considered.

This report is a review of available information of relevance to the hazards presented by the release of LH_2. Depending on how LH_2 is released, different hazardous scenarios may result, including: the formation of a pool which evaporates and disperses; a pool fire in the case of ignition; a flashing liquid jet fire; accumulation of gaseous hydrogen in confined and congested areas and the subsequent explosion hazard.

The focus of the review was on identifying experimental data which can provide parameters critical to the development of mathematical models. Overall, there was a dearth of experimental data on the hazards posed by LH_2, especially at large scale. Limited information was available on the evaporation from LH_2 spills and the subsequent dispersion. Only one small scale study of LH_2 pool fires was identified and none for flashing liquid jet fires. Gas accumulation and explosion hazards were perhaps the most studied, including experimental studies at full scale in re-fuelling station geometries. However, none specifically related to gas accumulation and explosions arising from a spill of LH_2 in a confined or congested region were identified. Other areas of uncertainty are the potential for a Boiling Liquid Expanding Vapour Explosion (BLEVE) of a LH_2 storage tank (or road tanker) and whether or not a Rapid Phase Transition (RPT) event could occur in the event of spillage onto water.

It is concluded that further experimental work is needed, preferably at large scale, focussed on the hazards arising from LH_2 releases.

Key words

Liquid hydrogen, hazards, spills, dispersion, fire, explosion, BLEVE, RPT

Abbreviations

LH_2	Liquefied Hydrogen
LNG	Liquefied Natural Gas
NG	Natural Gas
NTP	Normal temperature and pressure
tpd	tonnes per day
WP	Work Package
RPT	Rapid Phase Transition
BLEVE	Boiling Liquid Expanding Vapour Explosion

Table of Contents