HyCoRA – Hydrogen Contaminant Risk Assessment Grant agreement no: 621223

Analysis and necessary review of work plan

Authors: VTT: Jari Ihonen

Confidentiality: Public
Submission date: 16.11.2015
Revision: -

Report's title Deliverable 6.9 Analysis and necessary review of work plan	
Customer, contact person, address Alberto Garcia, FCH JU	**Order reference** Grant agreement no: 621223
Project name Hydrogen Contaminant Risk Assessment	**Project number/Short name** HyCoRA
Author(s) VTT: Jari Ihonen	**Pages** 5/5

Summary

This deliverable summarises the feedback from the 1st and 2nd OEM workshops and analyses the feedback for the planning and reviewing of the WP1-WP4 work in HyCoRA project.

Confidentiality	Public

Contents

1. Introduction

In HyCoRA project the planning of the experimental work and risk model has been done taking into account the feedback from automotive OEM and hydrogen suppliers from the 1st OEM workshop (30.9.2014).

After 18 months work a second OEM workshop was organised (9.10.2015) and the guidance from that workshop is reported here. Also the guidance from the first OEM workshop is briefly summarised.

The information is used for the planning of the work for M19-M36 in HyCoRA project.

2. OEM Guidance

2.1 Guidance from the 1st OEM workshop (30.9.2014)

The risk model approach of HyCoRA project principally correct and supply chain specific QA requirements were supported; however, it was advised to keep the model simple, as quantitative data for the model may be difficult to achieve.

Hydrogen quality is currently monitored by monitoring PSA process parameters. A failure in process parameter monitoring will cause quality problems. The only possibility for H2 contamination in retail hydrogen is a failure in quality control of central production at the same time, when PSA purification is failing

Consequently, risk mitigation can be done by improving process monitoring so that measurement sensors with no common failure mode are used. It indicates adding a second quality monitoring instrument could be efficient risk mitigations, assuming that there are no common failure modes. The continuous monitoring of canary species was considered as one way to have inexpensive risk mitigation methods. It was also considered possible that continuous monitoring may not have the same requirements as when doing full analysis for ISO 14687:2-2012 species.

Particulates were considered as a major issue, since large (over 0.005 mm) particles can be detrimental for the high pressure components of on-board hydrogen storage in FCEV. Also, halogenates contamination due to supply chain were considered difficult to measure but should be quantified. When hydrogen is by-product from industry, a real risk of chloride additions exists; otherwise, the risk is rather small from the production (PSA purification, water electrolysis).

In the current standard (ISO 14687:2-2012) formic acid and formaldehyde were considered very problematic to measure with the levels in the standard. As these are also the most probably contaminants having too low limits, it was advised that formic acid and formaldehyde should be further studied for providing data for a possible revision of ISO 14687:2-2012.

Finally, it was advised to keep the risk model simple and to include formic acid and formaldehyde as reversible contaminants, as these are complicated for the analysis and the experimental effort for the revision of the limits in ISO 14687-2:2012 could be reasonable.

2.2 Guidance from the 2nd OEM workshop (9.10.2015) and from OEM participant e-mails after the workshop.

The second OEM workshop was organised by JRC in Brussels 9th of October 2015. The agenda of the workshop and participants are in the tables below.

09 October 2015		Speaker
09:00	*Arrival*	
09:00-09:10	Welcome & opening remarks	*Georgios Tsotridis, JRC-IET*
09:10-09:20	Tour de table & workshop expectation discussion	*All*
09:20-09:50	HyCoRA project objectives, scope and brief summary of results	*Jari Ihonen, VTT*
09:50-10:40	DOE/LANL Hydrogen Fuel Quality Overview	*Tommy Rockward, LANL*
10:40-11:00	Discussion	*OEM*
11:00-11:15	Break	
11:15-11:45	Sampling and Analysis of hydrogen fuel from HRS in Europe	*Thor Aarhaug, SINTEF*
11:45-12:15	Discussion	HRS producer/operator
12:15-12:45	Recent development on hydrogen purity analysis	*Thomas Bacquart, NPL*
12:45-13:45	Lunch (60 minutes needed)	
13:45-14:05	Hydrogen fuel impurity testing - results	*Sylvie Escribano, CEA*
14:05-14:25	Hydrogen purity analysis development in HyCoRA project	*Thor Aarhaug, SINTEF*
14:25-14:45	Risk assessment of hydrogen quality assurance - results	*Jari Ihonen VTT*
14:45-15:15	Discussion	*All*
15:15-15:35	Break	
15:35-16:10	OEM feedback & recommendations for 2nd project half of HyCoRa	*All*
16:10-16.15	Closing remarks	*Georgios Tsotridis, JRC-IET*
16:15	End of workshop	

Participant name	Participant organisation
Gerhard Gissibl	BMW
Gabor Toth	Daimler
Norbert Klein	Hyundai Europe
Julien Roussel	Toyota
Martine Carre	Air Liquide
Alice Elliot	Shell
Shabbir Ahmed	ANL
Tommy Rockward	LANL
Arul Murugan	NPL
Thomas Bacquart	NPL
Thor Aarhaug	SINTEF
Jari Ihonen	VTT
Sylvie Escribano	CEA
Georgios Tsotridis	JRC

In the workshop, the results of both HyCoRA project and results gained by other organisations (NPL, LANL) were presented. OEM feedback was mostly collected by e-mails after the workshop.

Concerning the qualitative and quantitative risk model in WP4, there were no objections against the model based on CO coverage level.

The original work plans of the WP2 and WP3 were also considered to be still relevant. The WP3 work during the 2nd sampling campaign will focus on more diverse set of hydrogen refuelling station manufacturers, while in the 1st campaign the focus was on diverse set of hydrogen production methods and feedstocks.

Concerning the work of WP1 there were different opinions from hydrogen suppliers and automotive OEMs. While the effect of halogenates was considered important by all respondents, the formic acid and formaldehyde received different level of attention. The results of the query are summarised in Table below. Concerning the effect of halogenates, the long term effects were considered more important than short term effects.

Position	The issue to be studied
1	The effect of halogenates (Cl-).
2	Steady-state and drive cycle CO contamination studies using ultra-low anodes (≤0.05 mg/cm^2).
3-4	Further studies with formic acid and formaldehyde providing evidence to revise limits in ISO 14687-2:2012.
3-4	The recovery of the stack from sulphur contamination (sulphur desorption).
5	The CO cleaning effect of start and stop (CO oxidation during shut-down). The work will be done both experimentally and with simulations.
6	The CO cleaning effect due to internal air bleed during operation (CO oxidation).

3. Analysis and necessary review of the work plan

Based on the feedback from OEMs and the results gained so far, the following conclusions and recommendations can be made for the further planning of the WP1 work in HyCoRA project.

1) There should be more focus on halogenates in WP1 (and possibly in WP2).
2) Ultra-low loading anodes (≤0.05 mg/cm^2) should be used in further CO contamination studies.
3) The recovery of the stack from sulphur contamination as well as further studies with formic acid and formaldehyde can be included in the work plan.
4) The CO cleaning effect of start and stop is difficult to study so that the experiments would provide quantitative information about S/S effects in real automotive systems. Therefore, this will not have a high priority in experimental work.
5) The CO cleaning effect due to internal air bleed is difficult to study and requires lot of resources. Therefore, it is studied only in combination with steady-state and drive cycle CO contamination measurements, whenever possible.