HyQ - Publishable summary

HyQ consists of pre-normative studies to provide a strong support to Regulation Codes and Standards organisations in order to normalize an acceptable fuel quality for PEMFC. HyQ is focused on automotive application which requires high hydrogen quality for high power delivery. Nevertheless, HyQ also deals with the stationary application.

Faced to the increased global energy demand and to environmental concerns, the concept of using hydrogen as fuel has shown a real potential. Proton Exchange Membrane Fuel Cells (PEMFC) appear to be the best hydrogen-based energy conversion devices for a wide range of applications from portable to vehicles. The performances and durability of such a device are affected by the quality of the reactive gases. Depending on the way to produce and purify hydrogen, it can contain different kind of pollutants which impact the performances and the durability of PEMFC. Standardization of the H_2 quality is a pre-requisite for the hydrogen based energy technology enabling the industry to move towards a mass market.
The technical aspects of this project can be divided in three main parts. One part focuses on the impact of the impurities on the PEMFC depending on the end-users specification. The purpose of this part is to find out the maximum level of contaminants in H2 to stay in an acceptable range of PEMFC performances. The second part focuses on the analysis of H2 and the quantification of each contaminant in the fuel. The main objective of this task is to figure out the cheapest and most accurate method to assure the gas quality and the concentration of each impurity in H2. The third part consists on a cost benefit analysis based in the one hand on the hydrogen fuel production, purification and quality insurance cost depending on the quality required and in the second hand on the investment needs and the maintenance cost of a PEMFC according to the end user specifications. The goal of this cost benefit analysis is clearly to find out the optimum level of quality of H2; it means the level of quality which response to a consensus between gas producers (production/purification cost) and OEMs (PEMFC cost).

Thanks to the work plan define in the first period and after the choice of most relevant impurities to be tested made by the consortium, the final period of the project was focussed on PEMFC testing campaign.
Partners showed that on/off cycles are benefit to mitigate the impact of impurities and especially the ones which have a reversible impact. Indeed, after stopping and restarting the fuel cell and when feeding it with CO containing H2, a recovery of cell performances is observed. Furthermore, In that condition, the release of adsorbed pollutant from the catalyst has been observed by coupling a gas chromatograph analyser to the fuel cell.

Furthermore, the analytical tools developed by the consortium now allow quantifying the most relevant and challenging impurities in H2 (total sulphur compound and formaldehyde). The limit of quantification for total sulphur compound has reached 3.3 ppb (ISO standard highest acceptable level: 4 ppb). The limit of detection for formaldehyde has reached 5 ppb for formaldehyde and 10 ppb for formic acid which is, for formic acid, at least 20 times less than the highest acceptable level required by ISO.

The conclusions of the first period have been transmitted to the ISO. The consortium made recommendation thanks to the ISO mirror committee in which HyQ partners are members.

They expressed their recommendation during the ballot of the document ISO TC 197, WG14 DIS 14687-3.