Validated analytical techniques for ensuring H_2 quality in full compliance with ISO 14687

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Abstract

Hydrogen produced from different processes (steam reformation of hydrocarbons at high temperature, electrolysis of water, chloroalkali membrane electrolysis process, biomass transformations) can make an important contribution to the transition to a carbon-free energy model, particularly in the transport and energy storage sectors. In the transport sector, hydrogen is a solution already available to support the development of electromobility. Even following a suitable purification steps (such as inorganic, metallic or ceramic membranes, cryogenic separation, pressure swing adsorption method), impurities may still remain in the hydrogen which could affect the performance of fuel cells even at trace levels.

The ISO 14687-2:2012 standard *"Hydrogen fuel – product specification – Part 2: Proton exchange membrane (PEM) fuel cell applications for road vehicles"* lists maximum concentrations for 13 gaseous impurities that should not be exceeded in hydrogen supplied to fuel cells. This ISO standard suggests, in its informative annex B, analytical techniques to assess the molar amount fraction levels of impurities in hydrogen produced by different methods. It should be noted, however, that these methods were identified at the date of publication in 2012 and therefore does not include any analytical methods developed after this time. These techniques present determination (or quantification) limits that are often barely lower than the ISO specifications or even higher as for formaldehyde or total halogenated compounds.

ISO 14687 is currently under revision and a new version is expected in 2019. This standard will include relaxed threshold levels for some impurities based on new research data which became available. Annex B has also been removed and is now part of ISO 21087 to be published in 2019 "*Gas analysis — Analytical methods for hydrogen fuel — Proton exchange membrane (PEM) fuel cell applications for road vehicles"* which specifies validated analytical methods and procedures for ensuring hydrogen quality at hydrogen distribution facilities. This is an important ISO standard as it provides guidance on how to comply with the hydrogen quality specifications required by ISO 14687 for proton exchange membrane (PEM) fuel cells for road vehicles.

The objective of this study is to review and assess the existing offline validated analytical techniques that currently exist for measuring impurity amount fraction levels in hydrogen in accordance with ISO 14687 by assessing the measurement criteria established in ISO 21087. Special attention is payed to techniques allowing the simultaneous analysis of several of the 13 gaseous compounds for reducing costs and time taken for analysis purposes.

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