Chapter 4
Hydrogen Transport and Distribution

Mathilde Weber and Jérôme Perrin

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List of abbreviations

ASTM American Society for Testing Materials
CUTE Clean Urban Transport for Europe
D nominal outside diameter of a pipe
FRP fibre-reinforced polymer
GH$_2$ gaseous H$_2$
H$_2$ Hydrogen
ISO International Organization for Standardization
LH$_2$ liquid H$_2$

Mathilde Weber
Air Liquide R&D Center, 1 chemin de la porte des Loges, Les Loges en Josas, BP126, 78354 Jouy en Josas Cedex, France, e-mail: mathilde.weber@airliquide.com

Jérôme Perrin
Renault Technocentre, Department of Research, Advanced Studies, and Material (DREAM), Guyancourt, France, e-mail: jerome.perrin@renault.com

4.1 Introduction

The successful development of the future hydrogen transmission and distribution infrastructure is critical to a widespread use of hydrogen as an energy carrier.

Hydrogen delivery infrastructure is related to the hydrogen production site (centralised or not) and its transportation to the end-use station. At present, mature pathways include the transport of compressed gaseous hydrogen in cylinders and cryogenic trucking of liquid hydrogen. The components needed for the transmission and distribution are pipelines, compressed gas tube trailers and cylinders, or cryogenic trucks, railcars, and ships. Depending on the degree of hydrogen penetration in the market, a certain capital cost of pipelines will be necessary to build the estimated million km of distribution pipelines and thousand km of high- and medium-pressure transmission pipelines.

As a result of its lower molecular weight and viscosity, hydrogen flows more than two times faster than natural gas in a pipeline under the same conditions of pipe diameter and pressure drop. Due to the lower heating value, however, such a hydrogen pipeline carries about 30% less energy than its natural gas counterpart. As a consequence, hydrogen pipelines need to operate at higher pressures to achieve comparable energy transport capacities or they have to be of large diameter. A special issue to be taken into account with hydrogen is its fast diffusion through most materials and seals, which in turn may cause severe degradation of steels, etc.

Any large-scale hydrogen distribution system also is associated with the problem of bulk storage to provide a buffer between production facilities and fluctuation in demand. The most widely studied options are underground caverns and depleted underground natural gas formation.

The following sections will focus on the hydrogen distribution infrastructure from pipeline distribution for large industrial needs to local distribution via truck transport with or without on-site hydrogen production. Then, underground bulk storage as well as hydrogen refuelling stations for vehicles will be described.

4.2 Hydrogen Distribution by Gas Pipelines

To meet the increasing hydrogen demand by industrial customers, the capacities of hydrogen production are increasing, existing networks are expanding, and new networks are being developed. Praxair, as an example, doubled its capacity in 2002