

Hydrogen as an energy carrier: transport in methane mixtures

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The regulation activities in the hydrogen sector

- ✓ Updating of the Italian technical regulation with the introduction of hydrogen/methane mixtures, after exceeding the limit of 2% (vol.) of hydrogen which is currently permitted to be introduced into methane pipelines
 - ✓ Sharing of studies and experiments to ascertain the resilient capabilities of the materials to be used against the embrittlement of steel
 - ✓ Updating the safety distances and methods of execution of pipeline crossings with roads, rivers, etc.
 - ✓ Discussion of distribution and transport issues, up to the user meter
 - ✓ Verifying the alignment of the new content with national standards (i.e. EN, ISO, etc.)
 - ✓ Results of studies on domestic and industrial heating systems powered by hydrogen/methane blending

Compendium of regulations relating to transport and distribution

- ❖ Gas Transportation
- ❖ Gas Distribution
- ❖ Pipelines with maximum operating pressure greater than 5 bar
- ❖ Fire safety of loading and unloading operations of "tanker vehicles" transporting natural gas with a density not exceeding 0.8
- ❖ Crossings and parallels of pipelines and canals conveying liquids and gases with railways and other transport lines
- ❖ Chemical-physical characteristics and gas content

Proposal for a single regulatory text scheme

- Title I - Technical rule for the **design, construction, testing, operation and surveillance of natural gas transport works** and systems with density not exceeding 0.8
 - 1. General provisions. 2. Design criteria 3. Materials. 4. Construction on site. 5. Exercise. 6. Inspection and maintenance. 7. Installations inside industrial users.
- Title II - Technical rule for the **design, construction, testing, operation and surveillance of works and distribution systems** and direct natural gas lines with density not exceeding 0.8
 - 1. Distribution pipelines. 2. Pipelines serving industrial users. 3. Pressure reduction systems. 4. Technical appendices (Pipes with maximum operating pressure greater than 5 bar)
- Title III – **Loading and unloading operations** of "tank vehicles"
- Title IV - Technical standards for **crossings and parallelism of pipelines** and canals conveying liquids and gases **with railways and other transport lines**

The studies on the transportation of hydrogen by pipeline

- ❑ Collect the main **evidence presented in the literature** relating to the **transport and distribution of hydrogen** on pipelines, as a pure **substance** or in the form of a **mixture**
- ❑ Starting from a collection of **statistical data relating to hydrogen pipelines**, we address the main **evidence** relating to the **frequency of release events in hydrogen plants** and the **mechanisms** by which **hydrogen** can cause weakening **effects on steel**
 - *1. Events on hydrogen pipelines*
 - *1.1 Evidence relating to the frequency of release in hydrogen plants*
 - *1.2 Ignition probability of hydrogen and natural gas-hydrogen mixtures*
 - *2. Hydrogen-steel interaction*

Technical reference sources

- ❖ «Admissible hydrogen concentrations in natural gas systems», Klaus Altfeld and Dave Pinchbeck. Reprint: gas for energy 03 / 2013. ISSN 2192-158X. DIV Deutscher Industrieverlag GmbH
- ❖ “Gas infrastructure - Consequences of hydrogen in the gas infrastructure and identification of related standardization need in the scope of CEN/TC 234”. TECHNICAL REPORT. FINAL DRAFT FprCEN/TR 17797
- ❖ “Review of Release Behavior of Hydrogen & Natural Gas Blends from Pipelines”, Austin R. Baird, Austin M. Glover, Brian D. Ehrhart. SANDIA REPORT- SAND2021-9802. Printed August 2021

Hydrogen as an energy carrier for residential use

- In Italy, the **civil sector represents 41% of gas end uses**. The other uses are the thermoelectric sector 33%, industry 20.5%, transport 1.5%
- **Technology available** and certified
- **Various projects** carried out **abroad** that prove the **safety of using hydrogen** (equivalent to methane), considering the **entire supply chain**: production of **green H₂**, storage, transport, distribution, end uses
- It is desirable to be **able to carry out field tests** to acquire the **experience** necessary for **all operators**, **simplifying** the procedures for **starting experiments and defining test protocols** with mixtures of natural gas and hydrogen with **increasing percentages**

Hydrogen concentrations in natural gas: State-of-the-art

- **Technical standard** UNI EN 16276:2018 “*Gas infrastructure - Gas quality - Group H*”
 - ✓ Suitability **up to 10% vol.** hydrogen
 - ✓ The **safety parameters** (flammability limits, ignition energy, flame speed) are **marginally influenced**
- Experimental **campaigns** for the evaluation of the **effect of H2-NG mixtures on the transport infrastructure**
 - Use of **H2 at 5% vol.**, in some sections of a **pressure reduction plant** on the national NG network
 - Use of **H2 at 5% vol.**, in some sections of the **national NG network** (supply for the pressure reduction cabin and two utilities)

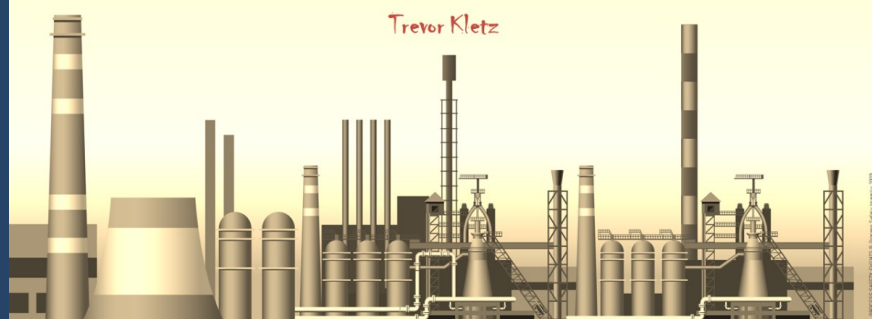


Further investigations

- Identification of **models for risk assessment** and analysis relating to **pipeline transportation of H₂-NG mixtures** (**probability** of release and triggering in case of **loss of containment**)
 - Uncertainties on the chemical-physical and **combustion properties**
 - Disagreement on **emerging risk scenarios** after a loss of containment
- Identification and design of **experimental tests** related to hydrogen transport
 - A maximum **hydrogen content of no more than 10% vol.** should not alter the risk scenarios defined for the transport of natural gas

Acknowledgment: Eros Mannino,
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If you think safety is expensive, try an accident



Questions ...???

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Thanks for the attention!

