The Use of Hydrogen in Gas Pressure Reducing Stations in the Existing Gas Distribution Grid

Introduction

The Dutch research program HyDelta on "hydrogen in the existing gas grid" was started in 2020 and involved a scala of work packages. This poster is about the work package "gas pressure reducing stations".

Objective

The main goals are to fill the gaps of knowledge if and how gas pressure reducing stations for natural gas can be used for hydrogen.

- Do existing gas stations work properly with hydrogen?
- How can maintenance work safely be done on gas stations with hydrogen?

Research questions within HyDelta "gas pressure reducing stations"

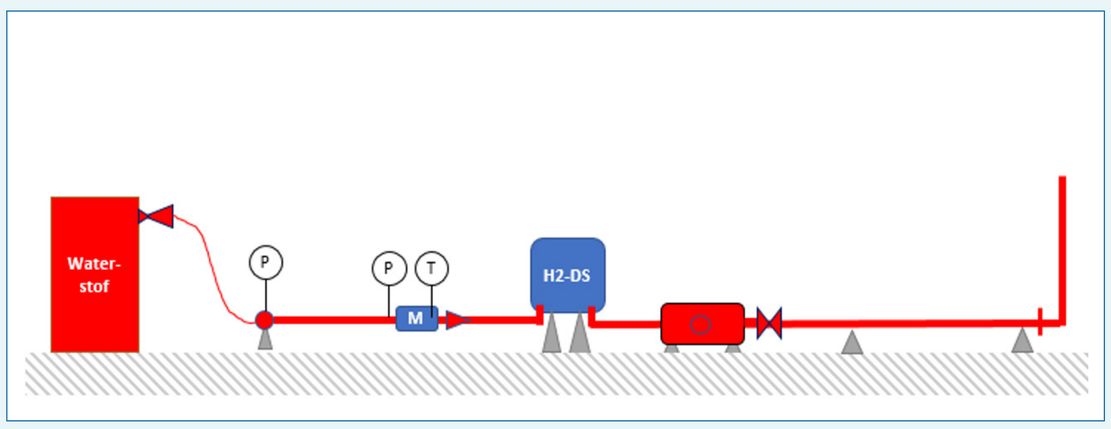
Research question 1; Operation of gas pressure reducing stations with spring loaded pressure regulators on hydrogen (testing)

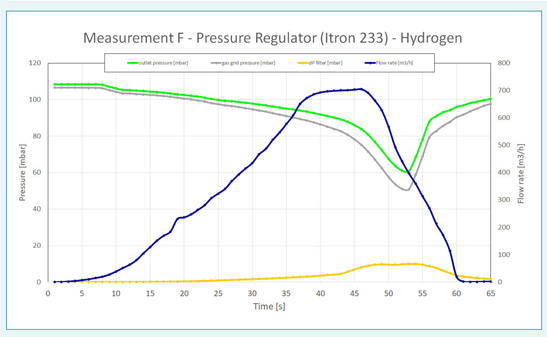
Research question 2; Safety during maintenance works for hydrogen gas pressure reducing stations (modeling)

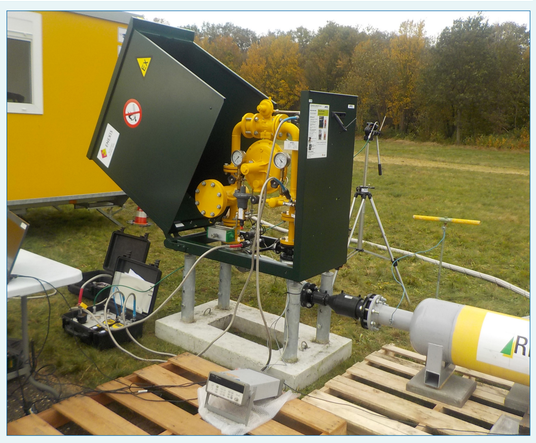
Research question 3; Ventilation of gas cabinets overhauling gas pressure reducing stations (testing)

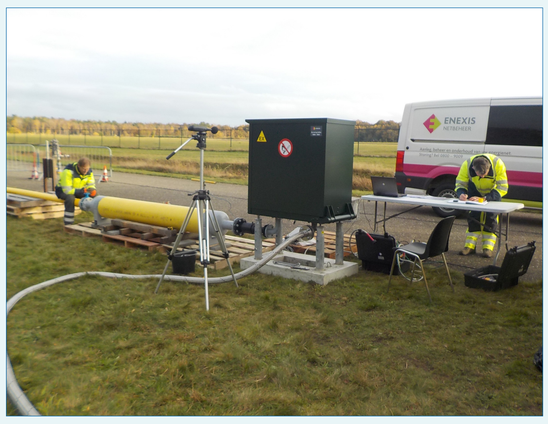
Research question 4; Dust transport in natural gas/ hydrogen (testing)

Research question 1









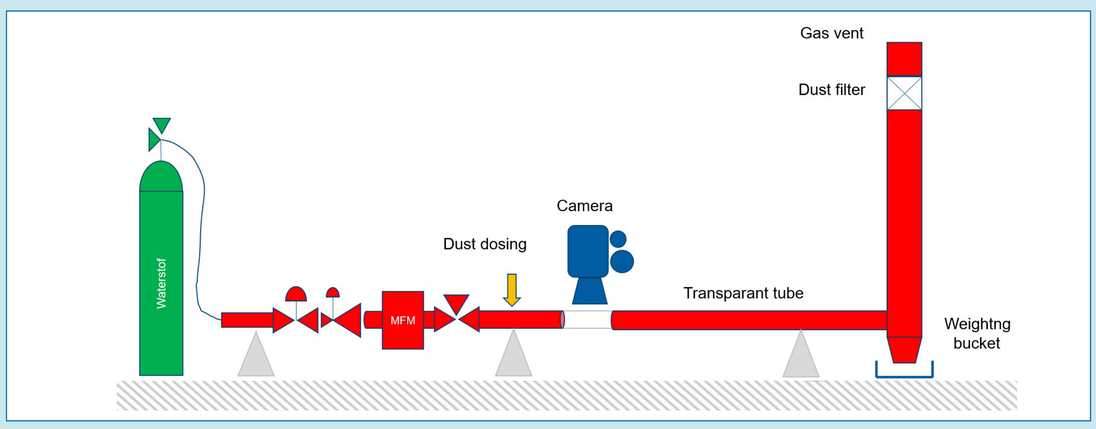
Method

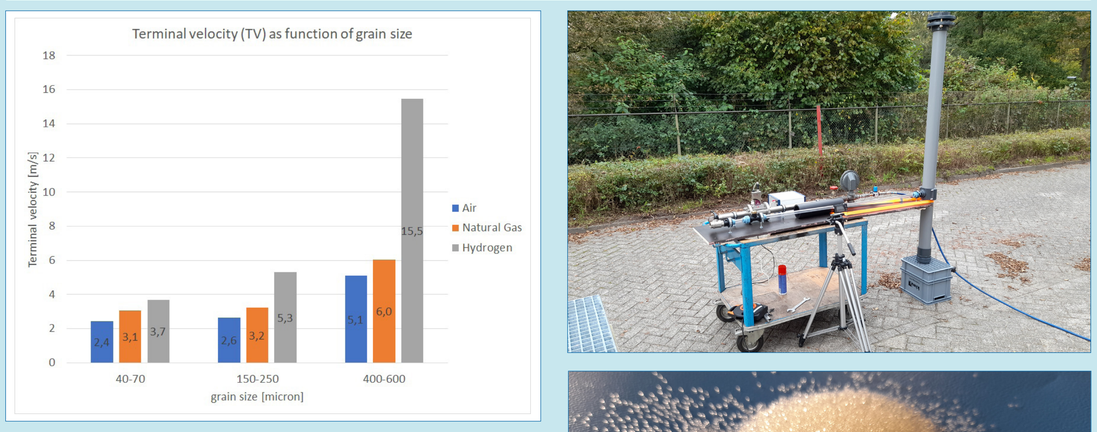
- An existing gas pressure reducing station was tested with different springloaded pressure regulators (PSV's and PRV's).
- Gas capacity for the regulators is ~ 200 m^3n/h natural gas and ~600 m^3n/h hydrogen.
- Test protocol with range of settings to map differences (6-8 monitoring tests per regulator) according to EN334/ EN14382.

Results/ conclusions

- The test program shows similar trends for natural gas and hydrogen.
- The capacity checks for the PRV's have been performed for a ratio of 3 between natural gas and hydrogen.
- The response pressures for the PSV's are the same order of magnitude for natural gas and hydrogen.
- The gas pressure reducing station, equipped with spring loaded safety valves and designed for natural gas, can be used to adequately, reliably and safely used to reduce the pressure for hydrogen.
- The results are in line with earlier research by Kiwa Technology for a gas pressure reducing station which was equipped with a gas actuated pressure regulator **[1]**.

Research question 4





Method

- The behavior of transporting dust was mapped to understand differences between natural gas and hydrogen.
- Fine, medium and coarse particle sizes were selected, based on literature search. Similarity with sand and rust in existing gas grid. Different batches were used to map the characteristics of each grain size batch.
- First set of tests were done to map the influence of different gases (air/ natural gas/ hydrogen), terminal velocity, time for a single test, available amount of dust and reproducibility.
- Second set of tests to map the influence of velocity exceeding the terminal velocity and mapping the influence of momentum (rho-v^2).

Results/ conclusions

- The terminal velocity for hydrogen is a factor 1,2 to 2,6 higher than for natural gas. To transport the same volumetric amount of energy, the required velocity will be a factor 3 higher **[2]**. It can be expected that more dust will initially be transported if a gas grid is switched from natural gas to hydrogen (dependent on the average grain size and dust density).
- Initial conditions after transfer from natural gas to hydrogen will result in more dust. Temporarily more fouling of gas filters so shorter maintenance intervals will be required.

References

[1] C. Lock, K. Pulles, Gasdrukregelstation voor waterstof, Kiwa Technology, rapport GT-200308, april 2021 (https://www.netbeheernederland.nl/_upload/Files/Waterstof_56_997f368b1e.pdf)

[2] Erik Polman, Theo Musselaers, Rene Hermkens, Sjoerd Jansma, Michiel van der Laan, Hans de Laat, Benjamin Pilzer, Kees Pulles, „Toekomstige gasdistributienettten," KIWA GT-170272, 2018 (https://www.netbeheernederland.nl/_upload/Files/Toekomstbestendige_gasdistributienetten_133.pdf)

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