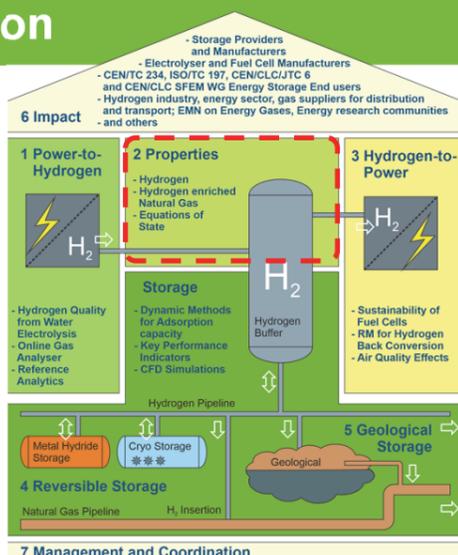


Thermophysical Properties of H₂ and H₂-enriched natural gas (WP2)

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MefHySto Introduction

- Duration 2020–2023
- EU Funding 2.3 M€
- Coordinator BAM
- 14 Partners



- Ambitious new EU energy target of using 32 % of renewable energy by 2030
- Cannot be reached without advanced energy storage solutions, e.g., H₂ storage
- Measurement science is critical for realisation of this commitment
- Financial concerns of amount of hydrogen generated – stored – back-converted

Work Package 2 Introduction

- Thermophysical Properties of H₂ and H₂ enriched natural gas
- Equations of State

Tasks

- Develop and test lab techniques to provide reference mixtures of humid H₂/H₂-enriched natural gas
- Influence of H₂ content on the saturation curve of H₂-enriched natural gas mixtures
- Develop reference equations of state (EOS) for H₂-enriched natural gas mixtures and H₂ under geological storage conditions



	Helium	Hydrogen sulfide	Water	Carbon monoxide	Hydrogen	Oxygen	Argon	n-Decane	n-Nonane	n-Octane	n-Heptane	n-Hexane	n-Pentane	Isobutane	n-Butane	Propane	Ethane	Carbon dioxide	Nitrogen	Methane
Methane																				
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Argon																				
Oxygen																				
Hydrogen																				
Carbon monoxide																				
Water																				
Hydrogen sulfide																				

Figure 1: GERG-2008 Reference Equation of State Compound Matrix [1]

Gravimetric Preparation of Gas Mixtures

Preparation of gas mixtures that qualify as reference materials (according to ISO 6142-1)

- Pre-treatment of cylinders > filling station direct filling, small cylinder, liquid injection > use of pre-mixtures > fine weighing (Fig. 2)
- Mixture Validation by Process-GC (Fig. 3)
- Bracketing method according to ISO 12963



Figure 2: mechanical balance Voland HCE 25: 25 kg ± 15 mg



Figure 3: Multichannel process GC (12 TC detectors, one single isothermal method (t = const. = 60 °C), 40 min run)

Density measurements

Density measurements over a large p, T-region using a single-sinker densimeter with magnetic suspension coupling (Fig. 4)

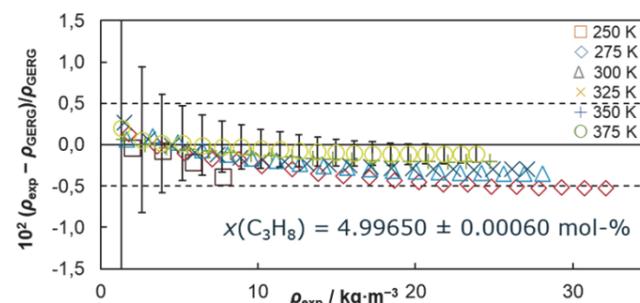


Figure 4: Magnetic suspension coupling allows the measurement of the apparent sinker mass without any contact between the balance and the sinker. This ensures high accuracy

Comparison of Density to GERG 2008

E.g., density of binary Mixture (0.05 Propane + 0.95 Hydrogen) → Maximum relative deviation: 0.67 %

Figure 5: Comparison of the results with established equation-of-state models, such as GERG-2008 and AGA-8-DC92



References

[1] O. Kunz; W. Wagner; J. Chem. Eng. Data 57, 3032–3091, 2012. DOI: 10.1021/jc300655b - © 2012 Am. Chem. Soc.

