



Testing Hydrogen admixture for Gas Applications

Final workshop of the 24th of March 2023

Questions / Answers

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The THyGA final workshop took place on March 24th, 2023. The replay and slides of the presentation are available on the project website: <https://thyga-project.eu/thyga-final-workshop/>

Some questions were asked in the chat during the workshop, the THyGA experts gave some answers below. Please contact us if they are not clear or if you have other points to discuss: contact_thyga@engie.com

What type of control devices are considered in the fittings standards?

[THyGA Answer]: All possible control and safety devices used in gas appliances. Burner controls (incl. auto-adaptive), gas valves, sensors, etc.

Should the amount of hydrogen blended be limited to the incoming gas quality?

[THyGA Answer]: Depends on the approach taken. Existing appliances are certified for proper and safe functioning over a certain Wobbe index range. If the injection of hydrogen widens this range to which an appliance possibly is exposed then there certainly are issues of technical or even legal nature (e.g. product liability). Another option is indeed to make sure the Wobbe index limits (in the case of H2 injection, it is the lower Wobbe index limit that may be exceeded) are always respected. By consequence then the max. amount of hydrogen that can be injected will depend on the Wobbe index of the natural gas in which it is injected.

Sheet reads H-gas only allows 7% injection? but the lower limit of G20 is at 40% H2? (further remark: "My question was about the orange line in the graph of sheet 23") (Hans Driessen – Kiwa)

[THyGA Answer]: if the supplied natural gas has a Wobbe index that varies between 46,44 and 54,00 MJ/m³ (cf. EASEE-gas Common Business Practice 2005-001/02 on Harmonisation of Natural Gas Quality) than the max. H2 concentration to respect the H-group Wobbe index limits is 7%. Another option would be to continuously check the Wobbe index of the natural gas the H2 is injected in and adapt the max. H2 concentration accordingly. G20 is a reference gas with a constant Wobbe index of

50,72 MJ/m³) which allows indeed $\pm 40\%$ H₂ before reaching the lower Wobbe index limit of the H-group. Natural gas on the other hand has a Wobbe index varying within a certain range.

TC58 follows all components from EN13611 (sensors, valves, electronic controls etc). (Hans Driessen – Kiwa)

[THyGA Answer]: This is not a question, but Hans' answer to the 1st question above.

In prTS15502-3-1 for fully premix appliances we have defined a Low Wobbe reference gas (including 20% H₂) and a High Wobbe Reference Gas (without H₂) (Michel Oldenhof)

On sheet 30: for fully premix burners, a flash-back will cause an explosion in the fan (because it contains a flammable mixture - venturi is positioned at air inlet of the fan) (Hans Driessen – Kiwa)

[THyGA Answer]: some proposals from the THyGA project are given in report D4.3

Miklos Fazakas: I do not agree that gas appliances marked with the symbol of 2H are not at all suitable for operation with a hydrogen-methane mixture with a certain limited hydrogen content.

- because most of the gas appliances in operation were put into operation under the scope of the GAD and the GAD did not include such a reference to the quality of gas supplied in the member states.
- the protocols for the testing of gas appliances have not been changed in this regard since the switch from the GAD to the GAR. The tests of the gas appliances are still based on the EN 437 standard, as was the EN 437 under the GAD, which does not take into account the specificities of the gas supply of the member states.
- gas appliances are not marked as suitable for burning natural gas, but are marked with the symbol of the 2H gas group, which means that the gas appliance is capable of burning gases belonging to the 2H group. The 2H gas group is defined by the gas quality area delimited by the limit gases of the gas group determined in EN 437.
- In the EN 437 standard, there is no difference between the legal status of hydrogen, nitrogen, or propane components added as components of the methane gas when mixing limit gases for testing the gas appliances. All of the gas appliances marked with the symbol of the gas group 2H have been tested to ensure that the appliance operates safely with a hydrogen content of 23 V/V %.

[THyGA Answer]: We discuss the topic of gas groups and categories in deliverable D4.3, hoping it provides complementary views on your points.

On the ID card for the burner it is stated "premix" does that mean fully premixed or partially premixed or both?" (Mindert Van Rij)

[THyGA Answer]: it means fully premix. It is more clearly stated in the reports (especially D3.8).

Sheet 52 top line in the table shows critical aspects for appliances using CH₄. I would agree, like instant water heaters and other type A appliances :-) (Hans Driessen – Kiwa)

[THyGA Answer]: The way we have presented the result in the table states which what gas MIXED with H₂ a problem was observed. So, it is not for CH₄ alone, but CH₄ + H₂ and the % of H₂ can also be read in the table. We agree that was not very clear and it was improved in the report.

Is there any solution for setting appliances in the field with varying gas quality if we don't know the incoming gas quality? (Steven Sutton)

[THyGA Answer]: It is impossible to set appliances correctly without any information on the gas in the grid during this operation. It is better to leave appliance untouched, presumably keeping a CH₄ adjustment which would not be that bad.

Therefore, the importance of developing portable Wobbe meters for having a possibility to do adjustments properly.

Is it possible to know which type or models of domestic gas cookers or hobs used for these test? Thanks. (Enrico Gatti)

[THyGA Answer]: for confidentiality reason, unfortunately, we cannot provide all information regarding the tested appliances. However, in our reports, you will find essential information such as power, ThyGA segment, appliance category... For any particular question, we can try to arrange an exchange with the appliance manufacturer.

Most installers are using in the field CO₂-analyzer which have a O₂ sensor (and CO₂ is calculated based on Air excess) Where there tests done with these types of test equipment to see the effect for the adjustment topic? (Michel Oldenhof)

Most installers use electrochemical flue analysers that measure O₂ and calculate a CO₂ value. So adjustment is done based on O₂. (Mindert Van Rij)

[THyGA Answer]: In these analysers, O₂ to CO₂ conversion is done through a formula that depends on the %CO₂ at stoichiometry. This value differs from CH₄ to CH₄+x%H₂ and leads to adjustment that are richer than expected..

For the correct interpretation of THyGA WP3 results one should know that the tests for THyGA WP3 were done with lab analysers which so measuring separately O₂ and CO₂ and not recalculating the one value from the other

Why are the pollutant measured in ppm and not in mg/kW ? (are there corrected 0%O₂?) (Clement GUYONNET)

This CO relevance you will have on site with all forced draught burners and installations, when during setting we do not know the composition of the delivered gas (W_o). Further very many installed installations have been altered in the setting in the past. (Ulrich Dreizler)

[THyGA Answer]: all figures of THyGA WP3 are recalculated for stoichiometry so yes, with 0 % O₂.

The emission in mg/m³ H₂ is low but in ppm on volume is much higher as H₂ is much lighter than CO. Doesn't using mg.m³ give the wrong impression?

[THyGA Answer]: The flue gas composition and volumes from the combustion of gas containing H₂ is different from CH₄ and therefore ppm or m³/m³ introduces a distortion. It would be probably better to use mg/kWh. But as CO limits for safety are in ppm we have kept this unit. This should probably best be addressed by CEN standard dealing with CO emission (and NO_x emissions) from natural gas/hydrogen blends.

With the increase in flame temperature there are possible problems of increase in NO_x. From the two graphs seen now (Q_{max} and Q_{min}), however, the opposite is true. Maybe I'm missing something? (Antonio Cucciniello)

[THyGA Answer]: In principle, H₂ injection on uncontrolled premix boilers will result in higher air excess and therefore lower flame temperature resulting in lower NO for the vast majority of the tested appliances (decrease of measured emissions).

In practical terms if there is a project to mix up to 20% H₂, in a NG distribution network with thousands of domestic users with various gas appliances, where there could be variations from 0% to 20% H₂ and with Biomethane blending, does it seem to you that there is a great risk if the equipment is not inspected or adjusted? Please explain.

[THyGA Answer]: D2.3 listed potential problems that could appear when H₂ is mixed to natural gas. D3.8 on test results shows that, for most appliances, no problem occurs between 0 and 20% H₂. In the 0-20% H₂ range, most problems occurred during adjustment tests for boilers (CO emissions above 1000ppm). At 23%H₂, flashback issues were observed for some cookers. It should also be noted that most equipment tested during the THyGA project were new, so the impact of ageing (with natural gas) is still not clear. In D5.3 on safety check, we suggest establishing a list of gas appliances that could operate up to 20%H₂ with the help of manufacturers and to perform a safety check or an appliance change for the other ones.

Can you explain plug flow?

Mindert Van Rij: Perhaps "step change" in gas quality is a better word than "plugflow"

[THyGA Answer]: Plug flow is another name for 'step change' or ROC ('Rate of change' of the percentage of H₂, increasing or decreasing rate). ROC test is performed by changing rapidly the gas composition flowing to the tested appliance. This test is described more in details in D3.8.

For appliances with no adjustment such as cookers does this mean that with the 20% blend and varying gas quality, the results show that there no issues in the field? (Steven Sutton)

[THyGA Answer]: Our results, with their limitations (limited number of tests, not all appliances on the market are tested..), show that there is no safety or operational issue below 20%H₂. However, recent tests showed issues with delayed ignition whose design makes them sensitive to this phenomena. Mostly, some boilers, water heaters and fires without fan are concerned. These results are described more in details in D3.8.

The percentages of H₂ referred on WP3 results are in percentages in volume or in mass ? (Mario Ribeiro)

[THyGA Answer]: the percentages of H₂ are systematically given in percentages in volume.

Pressure drop and non rotating of the flow meter are rather extreme conditions. Are you planning to consider fugitive emissions?

[THyGA Answer]: The question is not very clear to us. We have tested pressure drop impact on appliances using H₂ NG blends, this can happen for appliances/installations without pressure regulators. Non rotating flowmeter is not a tested situation and are not in the scope of THYGA.

Where to find the reports of the project and the slides of this workshop?

[THyGA Answer]:

All deliverables are available on the project website: <https://thyga-project.eu/category/publications/>.

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