BDH
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Effects of stronger fluctuations in natural gas quality and hydrogen injections on Forced draught burners in the future

1 Introduction

This information sheet is intended to provide operators of a combustion plant with forced draught burners with information on the recommended handling of stronger fluctuations in gas quality and hydrogen (H_2) admixtures in the future.

2 Basics

The gas supply in Germany has been very stable in the past. Above all, natural gases could be obtained from the Netherlands (L-gas), Norway and Russia (H-gas), whose composition and combustion properties were subject to only minor fluctuations. This is expected to change in the future, among other things due to the increased use of LNG (= liquefied natural gas for transport by ship) and due to expected admixtures of hydrogen. As a result, there may be greater local fluctuations than before..

Standards, regulations and studies

a. Gas Appliance Regulation and DIN EN 676

Since April 2018, forced draught gas burners must have a valid certification in accordance with the Gas Appliance Regulation (EU) 2016/426 („GAR“) when they are placed on the market in the EU. If the burner meets the requirements of the GAR, it may be provided with the CE marking. As part of the certification according to the GAR, compliance with DIN EN 676 (last amended in March 2023) is also checked. However, the equipment of the burners required therein is only aligned towards a local fluctuation range of ± 2 % of the gas quality (see Annex R of DIN EN 676:2023-03). The characterization of the gas quality is carried out using the Wobbe index.

b. DVGW Worksheet G 260

The DVGW worksheet G 260 specifies the requirements for the quality of fuel gases in the public gas supply. The Wobbe index defined therein is the central parameter for the interchangeability of gases. For example, for natural gas H as a „methane-rich gas“ of the 2nd gas family, it is indicated:

- Nominal value Wobbe index: 15.0 kWh/m³ (based on 25 °C),
- Nominal bandwidth in the local distribution network: +0.7 kWh/m³ / -1.4 kWh/m³ (corresponds to a percentage deviation of +4.7% / -9.4%).

The DVGW worksheet G 260 (as of September 2021) does not contain any indication of a local fluctuation range due to a lack of sufficiently well-founded studies. However, work is currently underway as part of a DVGW project to be able to anchor local fluctuation ranges of the Wobbe index in the gas quality regulations in the future.

c. DIN EN 16726

The European standard DIN EN 16726 („Quality of gas – Group H“) specifies the quality characteristics and requirements for gases in networks for the transport of gas of group H. However, it does not contain any specification on questions of the overall width of the Wobbe index or its fluctuation range.

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d. Certification program ZP 3502.20

Since mid-2022, forced draught gas burners can be certified according to the GAR via a supplementary test in accordance with the DVGW ZP 3502.20 certification program for the combustion of gaseous fuels with a hydrogen content of up to 20% by volume.

e. DVGW-Hauptstudie

Several independent studies, including one by the DVGW, have found that many existing devices can only be operated efficiently, reliably and safely at the same time if the Wobbe index fluctuation range does not exceed ±2% or ±0.3 kWh/m³.

The following graph illustrates the fluctuation range of ±2 % within the natural gas H range as an example:

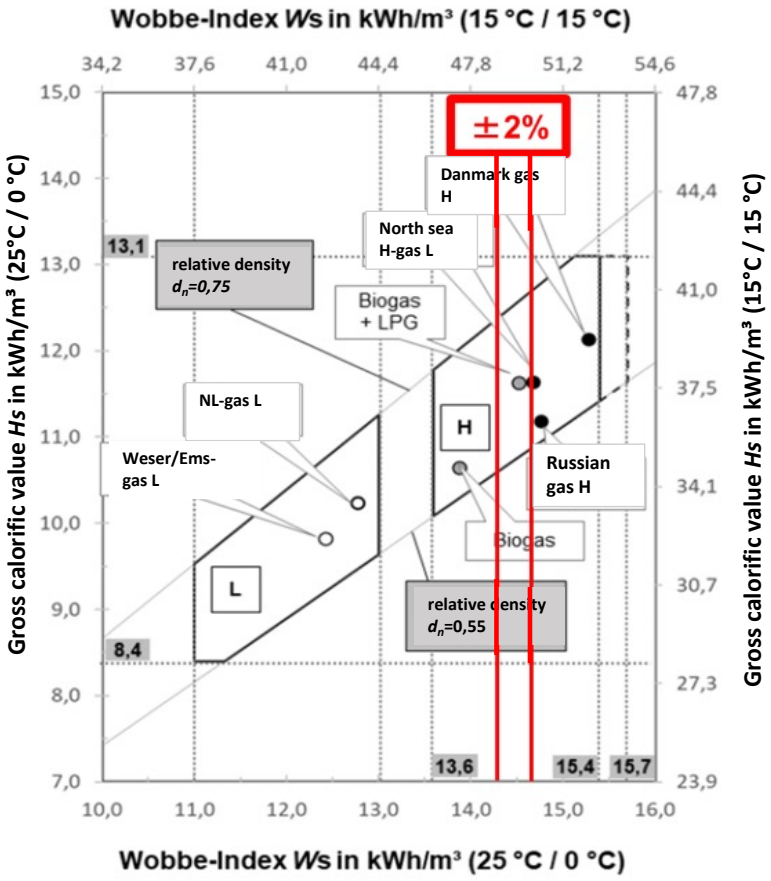

Figure 1: Fluctuation range of ±2 % within the natural gas H range (Source: Technical Rule – Worksheet DVGW G260(A), September 2021)

For the operation of a forced draught gas burner, knowledge of the gas quality and their local fluctuation range is therefore of substantial importance.

3 Possible effects of fluctuations in gas quality

Particularly in the case of existing plants, but also in new plants without appropriate combustion controls, major fluctuations in gas quality can have an impact on the combustion performance, the combustion quality, the emissions and also on the efficiency of the plant.

If the fluctuations are too large, the burner setting is not adjusted, wear, contamination or a chain of other boundary conditions that negatively affect combustion, incomplete and unstable combustion can occur with a high risk for the systems and the operating personnel.

a. Hydrogen admixture < 10% by volume

In addition to the diversification of gas supply sources, an increased supply of hydrogen into the natural gas grid is also expected in the future. Although no definitive political decision has yet been taken on this, the stakeholders are assuming that hydrogen will be injected into the public natural gas grid in the near future.

The certification according to the GAR currently covers a maximum hydrogen content in natural gas of 10% by volume, which corresponds to a Wobbe index fluctuation of approximately ±2%. Such a hydrogen admixture is therefore tolerated with adapted burner settings, compliance with maintenance intervals and intended operation. The impact on NOx emissions is small, although measurable.

In fact, the hydrogen content in natural gas has typically been < 2% by volume. The graph below shows the range of hydrogen injection related to the ±2% limit of the Wobbe index:

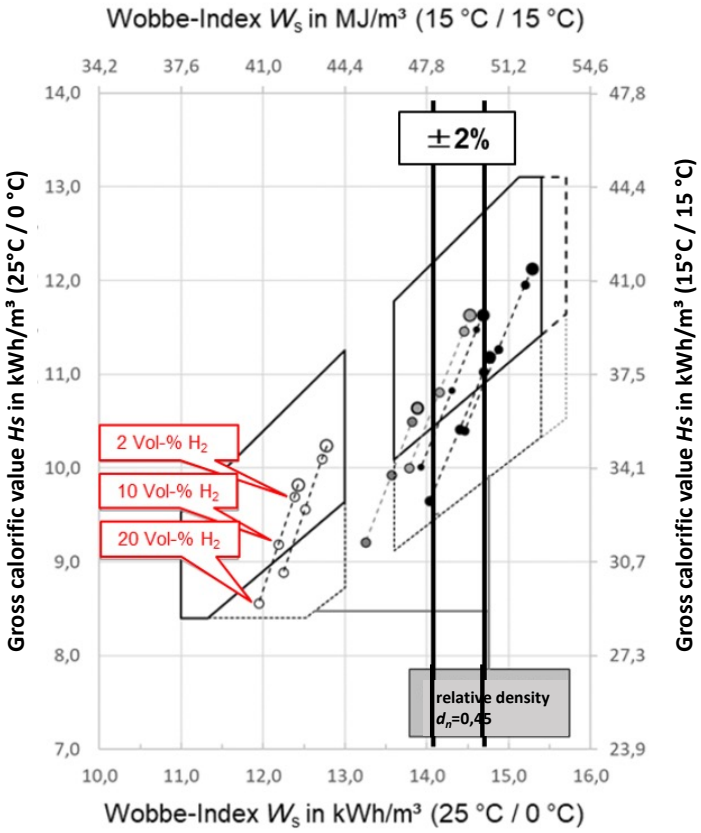

Figure 2: Range of hydrogen injection related to the limit of ±2% of the Wobbe index (Source: Technical Rule – Worksheet DVGW G260(A), September 2021)

b. Hydrogen admixture ≤ 20% by volume

Hydrogen concentrations of up to a maximum of 20% by volume can also be achieved for new plants with a limited fluctuation range if additional technical and organizational measures are taken.

For this purpose, in addition to the current certification according to the GAR, a test according to ZP 3502.20 (20 vol.-% H_2) is necessary. To deal with the large fluctuation range (0 – 20 vol.% H_2), manufacturers rely on organizational measures and / or additional measures (e.g. oxygen control). In addition, operators are advised to shorten maintenance intervals in the first two years of operation. The maintenance intervals should cover both winter and summer operation.

NO_x emissions increase with increasing H_2 content. They can be compensated by means of a modified burner setting, internal exhaust gas recirculation and, if necessary, external exhaust gas recirculation. The pressure losses in the gas ramps as well as combustion devices of the burners increase with a higher H_2 content.

4. Recommendations on how to deal with current and future fluctuations in gas quality

4.1. Basic recommendations for action

Compliance with the maintenance intervals recommended by the manufacturer, the performance of maintenance by qualified personnel, the use of original spare parts and the intended operation are suitable preventive measures to maintain the availability and safe operation of the combustion plant.

The designed lifetime of many burner safety components is set at 10 years or over a corresponding number of switching cycles. It is therefore strongly recommended to check / have checked when safety components on the combustion plant are due for renewal in accordance with the specifications of the component manufacturers (e.g. valves, flame monitors, combustion managers, etc.) and then replace them.

Furthermore, operators should regularly check with their gas suppliers about the current and foreseeable gas fluctuation range at their combustion plant and share this information with the specialist staff for burner maintenance. For all work on the combustion plant, knowledge of the current gas condition on site is important. On the basis of such information, trained service technicians can adjust the fuel-air ratio accordingly or recommend other measures.

4.2. Current status, fluctuations in the Wobbe-Index ≤ ±2%

Currently common fluctuations of the Wobbe index of about ±2% are tolerated by appropriate settings of the burner.

The oxygen trim system available today are considered to be recognized state of the art for compensating for parameters influencing combustion. These pursue the goal of increasing efficiency (e.g. through changes in the combustion air temperature or fluctuations in gas quality that have been common up to now). From today‘s point of view, it is therefore recommended to equip burners on shell boilers with commercially available oxygen trim systems.

4.3. Fluctuations in the Wobbe-Index > ±2%

For the automated handling of major gas quality fluctuations, the combustion optimization systems must be expanded in their mode of operation and control authority to maintain the safety level. You should therefore discuss with the manufacturer the possibilities and limitations of the setting.

It is expected that even more powerful combustion optimization systems will be available on the market in the future.

5. Summary

The challenges for operators, service companies and manufacturers of combustion plants with gaseous fuels will increase significantly in the future due to greater fluctuations in gas quality and hydrogen admixtures.

Depending on the local fluctuation range of the Wobbe index, operators should take individual measures in due time to ensure the safe, reliable and efficient operation of the combustion plant.

For more information, please visit:
www.bdh-industrie.de

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