

Practical example:

## Gas chromatograph for integral biogas injection measurement

Especially for the needs of biogas injection measurement, Elster-Instromet has now developed a gas chromatograph which addresses the requirements of the official gas quality analysis and the crucial product quality parameters pursuant to DVGW G 260 and G 262 in a single unit (Fig. 1). The measuring range also covers conditioning with LPG/air.

The unit comprises two components, the measuring unit and the process computer. The measuring unit is housed in a pressure-tight encapsulated, explosion-proof housing and is equipped with up to 5 process gas connections, which are fed forward via a double-block-and-bleed circuit. The process gas can be measured with a single unit using the integral stream switching system before and after conditioning to record the renewable and fossil energy contents separately. The device uses two micro gas chromatographic analysis modules, which determine the gas components  $H_2$ ,  $O_2$ ,  $N_2$ ,  $CH_4$ ,  $CO_2$ ,  $C_2$ ,  $C_3$ ,  $iC_4$  and  $nC_4$  using two different columns. An individual carrier gas, helium or argon, can be supplied to each module in order to achieve an optimum analytical performance. With small compromises in the signal-to-noise ratio, both modules can even be used with the carrier gas argon.

Fig. 1: Gas chromatograph for integrated gas quality analysis upon biogas injection

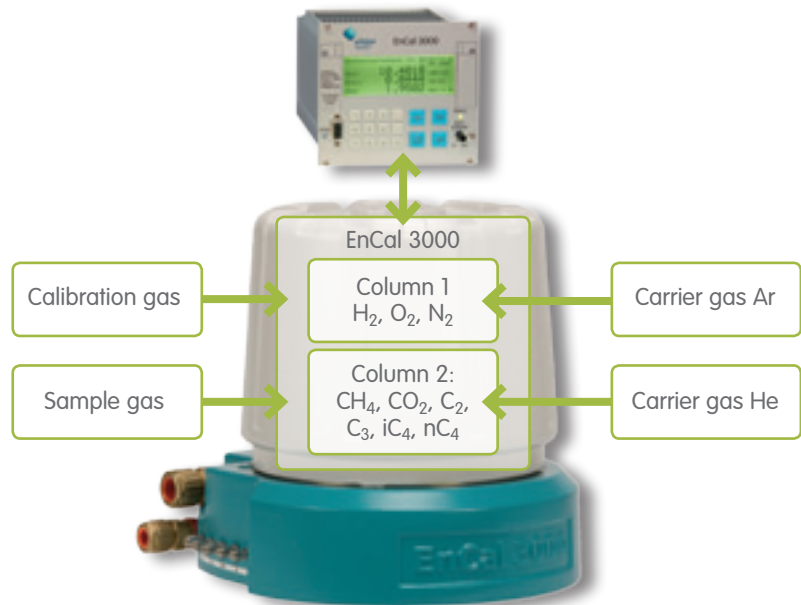
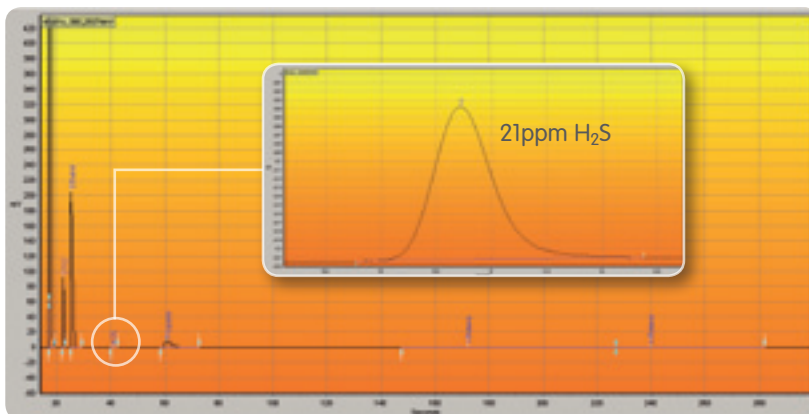


Fig. 2: Chromatogram of a test gas with a peak of 21 ppm  $H_2S$



Current developments deal with the integrated measurement of hydrogen sulphide  $H_2S$  in order to be able also to monitor this parameter of product quality upon injection. Figure 2 shows the chromatogram of a test gas with 21 ppm  $H_2S$ , the aim is to detect approx. 3 ppm corresponding to a limit value of 5 g/m<sup>3</sup>. Recent developments achieved a limit of detection of 2 ppm.

The measuring instrument described has been registered at the German National Metrological Institute (PTB) for a type approval. Once approval has been granted, custody applications can be implemented as follows: the calibrated energy measurement is taken using the standard variant

of the gas chromatograph EnCal 3000 for natural gas approved for biogas; a second device in the new variant for biogas described here works in parallel and monitors the specified limit values for the components hydrogen and oxygen. Once approval has been granted, the natural gas GC can be removed and the GC for biogas will be officially operated following calibration.

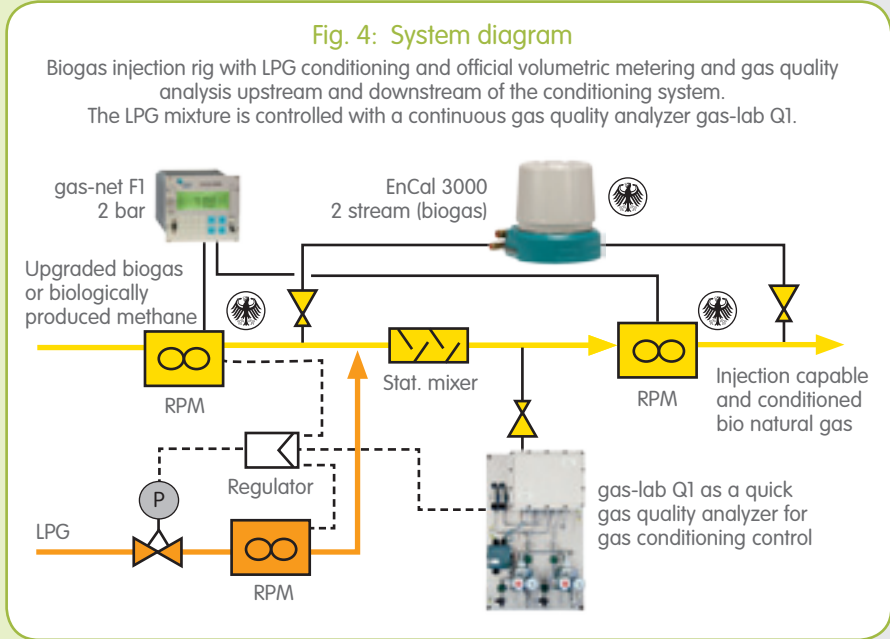
**Biogas injection rig at erdgas-schwaben in Altenstadt**

erdgas-schwaben gmbh operates a biogas upgrading plant in Altenstadt (Schongau district), which upgrades biogas from food leftovers to bio natural gas. Food leftovers have a huge energy density and are therefore well suited to the production of bio natural gas.

erdgas-schwaben gmbh found an ideal partner in Johann Emter, Ökopower. Ökopower produces biogas from leftovers which it receives partly from the canteens of municipal or public bodies (hospitals, administration offices, ...) and partly from food wholesalers in order to put spoiled food or food which has passed its use-by date, for example, to good use.

The bio natural gas plant in Altenstadt is the 6th project for biologically produced energy by erdgas-schwaben gmbh. 15,000 households can therefore be supplied with biologically produced fuel. The biogas upgrading plant delivers desulphurized, dry bio natural gas with a high percentage of biologically produced methane. The water scrubber technology is used for this.

Fig. 3: Container with the biogas injection conditioning, odorizing and official volumetric metering and gas quality analysis



For injecting bio natural gas, Elster GmbH has planned and set up a biogas injection rig together with Schwaben Netz GmbH, whose maximum injection rate amounts to approx. 800 Nm<sup>3</sup>/h (Fig. 3). The injection pressure is approx. 3 bar.

The schematic design of the injection and conditioning rig is illustrated in Fig. 6. The volume of biogas is measured using a rotary meter and is converted using a flow computer. The evaporated LPG (LPG with a high propane fraction) is likewise measured and converted and supplied to the bio natural gas via a static mixer (Fig. 5). The project supervisor at erdgas-schwaben is Tilo Degel.



Fig. 5: Volumetric metering system and LPG conditioning system

The calorific value of the conditioned bio natural gas is recorded with a quick calorific value measurement. In addition, the correlative gas quality analyzer gas-lab Q1 is used (Fig. 6), which also has PTB approval for the officially calibrated measurement of natural gases. It is best suited to this measuring task thanks to the continuous measurement and the short response time (T90 time < 10 s). The measured value is fed forward to the control loop as the actual value. The target calorific value is updated online by erdgas-schwaben gmbh at certain time intervals, and serves as the setpoint for gas conditioning.

The conditioned bio natural gas is also measured using a rotary meter and is converted using a flow computer. For this the same gas-net FI is used, which, thanks to its dual-stream design, also converts the pure bio natural gas prior to conditioning.



Fig. 6: Gas quality analysis system with test gas conditioning for 2 measured gas streams, gas-lab Q1 and EnCal 3000 for biogas (from left to right)

An EnCal 3000 for biogas is used for the officially calibrated measurement of the calorific value upstream and downstream of the conditioning system, as already described in the previous part of this publication. The dual-stream unit alternately measures the pure and the conditioned bio natural gas at regular 5 minute intervals.

### Summary

Biogas plants with upgrading and injection capacity place new requirements on gas measurement, particularly on gas quality analysis. In the case of injection, the product quality technical specifications must be complied with and therefore monitored using metrological technology. In addition, the official fiscal gas measurement requirements must be fulfilled. Existing measuring systems for natural gas may be used for these tasks, provided there is an expansion of the relevant approval, although they must be complemented with other measuring instruments in order to satisfy the overall requirements.

This article illustrates an integrated gas chromatographic solution of the operational and official measuring tasks as well as an application example in a compact modular injection rig with gas conditioning. The gas chromatograph for biogas presented has been registered at the German National Metrological Institute (PTB) for an official type approval.

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