

UT-3000: The Ideal Tool for Mercury Monitoring in Natural Gas



© Wintershall Q4-C platform, North Sea



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FIGURES: OFFSHORE AND ONSHORE NATURAL GAS PRODUCTION PLANTS. A SPECIAL UT-3000 SETUP ALLOWS TO MEASURE HG ON-LINE CONTINUOUSLY OR MANUALLY.

Preface

Mercury is a frequent constituent of natural gas. It can be found in concentrations from a few $\mu\text{g}/\text{m}^3$ up to $>10000 \mu\text{g}/\text{m}^3$. In gas samples from Northern Germany concentrations between $700 \mu\text{g}/\text{m}^3$ and $4400 \mu\text{g}/\text{m}^3$ have been reported. The limit for sales gas in Germany is $28 \mu\text{g}/\text{m}^3$. Besides its toxicity mercury causes damage by corrosion to gaskets, turbine vanes and other components of gas plants. For this reasons it is important to monitor the mercury concentrations in natural gas production.



UT-3000 ANALYZER WITH AUTOMATIC CALIBRATION UNIT

A special version of the UT-3000 analyser is dedicated for measurement of mercury in natural gas. Both a manual system using the Tedlar® Bag Technique as well as an automatic system for on-line installations are available. For this applications special precautions have to be made to prevent explosion. ATEX certified versions of the UT-3000 system are available for installation in hazardous areas.



Sampling System for on-line Mercury Determination in Natural Gas

For sampling of natural gas from a pipeline a specially designed sampling system has to be used in order to reduce pressure and to guide the sample from the sampling point to the analyzer. The most important requirement for such a sampling system is that it has to retain the mercury concentration of the sample gas unchanged. Of course it must also be suitable for use in hazardous zone.

Mercury Instruments has met this challenge and developed the Natural Gas Sampling System which really works. The surface of the system is electrically heated thus avoiding condensation caused by the Joule Thompson Effect. This prevents from loss of mercury. Condensate mist is effectively removed by a coalescing filter which is specially for analytical applications. Surfaces of tubing and filters are automatically and permanently conditioned with a primary and a secondary bypass. The design of the system allows a maximum input pressure of 3480 psig (240 bar), the output pressure is adjustable from 1 psig to 25 psig (0.07 bar to 1.72 bar). Standard connectors to interface with the plant is ¼” NPT, others are optionally available.



FIGURE: SAMPLING PROBE FOR NATURAL GAS AND LIQUIFIED NATURAL GAS (LNG)

Setup for continuous measurement of Hg in natural gas

For automatic continuous mercury monitoring a special set-up has been engineered. The analyser system is installed in a pressurized enclosure which has been approved for installation in hazardous zones (ATEX). The sample is extracted from the gas pipeline with the heated sampling system. The sample is then guided to the analyser through a heated stainless steel capillary. A built in gas sensor shuts the system down and stops the sample gas flow when a leakage is detected.



FIGURE: ON-LINE TEST MEASUREMENTS AT THE BENCHAMAS PLATFORM (THAILAND)

Calibration of the Analyzer System

The UT-3000 system does not require frequent calibration. For quality assurance a calibration check is recommended every 3 months. Calibration can be performed either manually using the **Manual Calibration Set** or automatically with the **Automatic Calibration Unit**. Both

calibration devices are using the principle of static calibration with mercury saturated air. These are maintenance free and unlike permeation devices they do not require re-weighing. This calibration method is according to ISO/DIS 6978-3, ASTM D 5954 and VDI 2267 PART 8 Standard Methods.



The calibration gas is generated in a specially designed mercury chamber surrounded by an aluminium jacket that is cooled by a thermoelectric cooler. The temperature of the mercury vessel is exactly measured with a high-precision temperature sensor. The mercury chamber contains elemental mercury of high purity. The signal from the electronic temperature sensor is transmitted to the UT-3000 ULTRATRACER where the mercury concentration of the calibration gas is calculated. A small volume of air is extracted from the mercury chamber with a syringe and injected into the calibration port of the analyzer.



The **Automatic Calibration Unit** will be fixed installed in the analyzer system cabinet. It performs the extraction and injection of the calibration gas by means of an Hamilton® high precision syringe module automatically. Up to 12 calibration points can be programmed. The repeat frequency for the automatic calibration can be set at any time interval or to a fixed daily time.

FIGURE : CALBRATION OF THE UT-3000 WITH THE MANUAL CALIBRATION SET

MMS Multiplexer Valve Unit

For the automatic measurement of multiple sampling points a Multiplexer Valve Unit is available as an option. This module is microprocessor controlled and mounted into the analyzer cabinet. All sample lines are continuously purged with sample and thereby constantly preconditioned.



FIGURE: MMS MERCURY MONITORING SYSTEM WITH SAMPLE POINT MULTIPLEXER AND UT-3000

Setup for Manual Sampling of Hg in Natural Gas Applying the Tedlar® Bag Technique

The bag sampling technique offers a simple, cost-effective and yet precise method to determine the mercury concentration in natural gas (or other gas samples).

A Tedlar® sample bag (for repeated use available as an accessory) is filled with the natural gas sample. The valve of the bag is closed and is carried to the UT-3000 analyzer which has been set up in the laboratory or another safe place.



FIGURE: CONNECTING A TEDLAR® BAG FILLED WITH A SAMPLE TO THE UT-3000 BENCHTOP MODEL



FIGURE: ATTACHING THE CONNECTION TUBING TO THE TEDLAR® BAG NOZZLE

It is a precondition that the instrument has been properly calibrated. An easy to use calibration device is available as an accessory.

The sample volume is set to a value between 0.1 and 1 liter, depending on the expected concentration. For higher concentrations the sample volume has to be set smaller, for lower concentrations the sample volume should be higher.

The built-in flow meter is calibrated automatically according to the composition of the sample gas before each measurement in order to achieve the correct sample volume.

Measuring the sample from the bag

After the instrument has been switched on the user is asked to enter the sample name. A message on the display tells the operator to connect the sample bag and to open the sample bag valve. After the **F1** key has been pressed the instrument will draw the preset volume of sample from the bag. The end of sampling is indicated by a beeping sound and a message appears: **Close sample bag valve (clockwise); Remove Sample Bag.**

Now analysis is started by pressing the **F1** key. After one minute (depending on sample volume) the result will be displayed on the screen.