

LAB-X5000



The LAB-X5000 benchtop analyzer offers many advantages:

- | **Compact and robust:** ideally suited in a plant's on-site lab
- | **Easy to use:** reliable results with minimum operator training
- | **Results in seconds:** fast testing of incoming biowaste for rapid decision-making, and product acceptance/rejection decision

LAB-X5000 for the rapid determination of sulfur in waste biomass used for the production of biogas

INTRODUCTION

The use of waste biomass for the production of energy offers many benefits: it decreases the reliance on coal and natural gas, reduces the amount of waste going to landfill, thus reducing the amount of methane released into the atmosphere. It is a clean, renewable source of energy that can be used in systems with low power demands, or to supplement other power sources.

Biogas is the result of the anaerobic digestion of organic matter such as food waste. The chemical process breaks down the material in an oxygen-free environment to produce biogas (mostly methane). The biogas is then captured and used to produce heat and electricity that can run engines, small turbines and fuel cells. What is left of the digested material can be used as fertilizer, soil enrichment and livestock bedding, so there is virtually no waste left.

The presence of sulfur in the organic waste can be problematic, as it can produce corrosive hydrogen sulfide (H_2S). Knowing the amount of sulfur in the waste informs the plant's process. For example, micro-aeration can reduce sulfur from > 3000 parts per million (ppm) down to 800 ppm during the digestion process, while using a biotrickling filter can reduce H_2S levels from about 1500 ppm down to 30 ppm. A simple and rapid way to determine sulfur content in waste before it is introduced in the digester is through the energy-dispersive X-ray fluorescence (EDXRF) analysis technique.

WASTE BIOMASS ANALYSIS MADE EASY

With the Hitachi High-Tech LAB-X5000 EDXRF benchtop analyzer, the analysis of waste organic matter oil couldn't be easier. Once the LAB-X is calibrated, routine analysis is carried out by pouring the waste into a sample cup (see Sample Preparation),

placing the cup in the instrument's analysis port and pressing a button to start the measurement. Preliminary results are displayed within seconds on the analyzer's large, industrial LCD touchscreen, showing the sulfur content. Pass/Fail messages can also be set up for fast incoming product testing and resulting process decisions.

The LAB-X5000 is calibrated by measuring a series of assayed samples or reference standards. Setting-up samples (drift correction monitors) are measured at the time of the calibration, and again in the unlikely event that the analyzer drifts, so there is no need to source calibration standards again or re-measure them, saving both time and money.

The combination of a high-resolution detector and optimized calibration parameters ensure that you get results you can trust. Built-in atmospheric compensation delivers reliable analysis without the need for helium, minimizing the cost per analysis while retaining optimum measurement stability.

Waste samples can be inhomogeneous, so for this application the LAB-X5000 is fitted with a sample spinner. With this, the sample is rotated during the measurement to deliver a result that is more representative of its entirety.

The analyzer includes several features that help protect against potential damage caused by sample spills or leaks, minimize downtime and prevent costly repairs: an easy-to-replace safety window is used under the sample cup to retain any accidental spill or leak, and the analyzer's turntable only places the sample above the X-ray tube and detector during the analysis, significantly reducing the risk of damage or contamination to critical components.

With up to 100,000 results stored on the analyzer itself, operators can view new and old results, print them on the optional integrated printer for a hard-copy record, download them on a USB memory device as a CSV file, and upload them to our ExTOPE Connect cloud service or a local server via Wi-Fi or ethernet for real-time access to the data anytime, anywhere.

SAMPLE PREPARATION

The sample preparation involves scooping or pouring the sample into a sample cup fitted with Poly-M film. If the sample is not homogeneous, tap it gently on a clean and flat surface to compact it and remove potential bubbles. Place the cup in a safety window (also fitted with Poly-M film) in the LAB-X5000's analysis port, and press the Start button. It is that simple!

PERFORMANCE AND RESULTS

Due to their inhomogeneous nature, there aren't biomass reference materials commercially available. For this application, the LAB-X5000 was calibrated by measuring a series of mineral oil samples with known sulfur content to establish the relationship between the sulfur concentration and the X-ray signal. A matrix correction was applied to increase the accuracy for a wide variety of waste samples.

Table 1 shows the typical calibration performance the LAB-X delivers for the determination of sulfur.

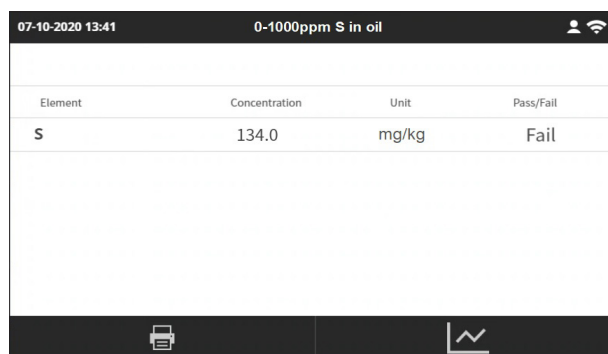
The limits of detection (LOD) were calculated from the results of 10 repeat measurements of a base mineral oil sample and the precision from 10 repeats of samples containing different levels of sulfur. The analysis time was set to 300 seconds.



Sample introduction



Starting the analysis



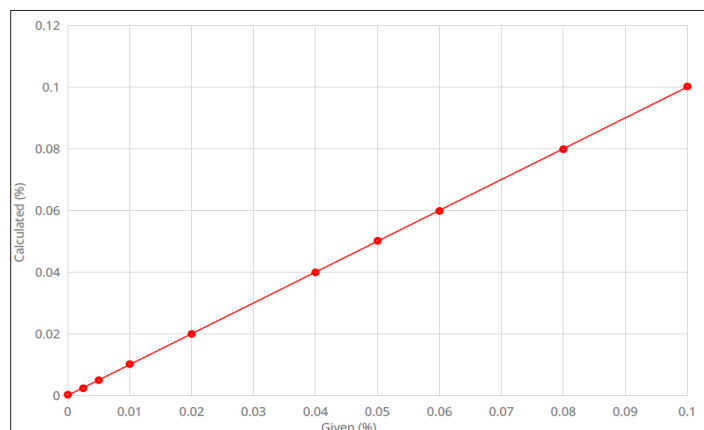
| Element | Concentration | Unit | Pass/Fail |
|---------|---------------|-------|-----------|
| S | 134.0 | mg/kg | Fail |

Results screen

Table 1: Typical calibration performance

| Analyte | Calibration range (ppm) | Standard error of calibration (ppm) | Guaranteed limit of detection (3σ) (ppm) | Limit of quantification (10σ) (ppm) | Precision (95% confidence) (ppm) |
|---------|-------------------------|-------------------------------------|---|--|----------------------------------|
| S | 0 – 1000 | 6 | 6 | 12 | 2.2 at 50 |
| | | | | | 2.9 at 100 |
| | | | | | 5.3 at 500 |
| | | | | | 7.2 at 1000 |

Graph 1: Calibration graph for Sulfur 0 - 1000 ppm (air path)



To suit your testing requirements, the LAB-X can be calibrated for different ranges of sulfur concentrations (from low ppms to high %s). Optimized calibration parameters are pre-loaded in the analyzer's software. All the operator has to do is follow the simple calibration instructions provided.

Factory calibrations (using mineral oil standards) are also available as options so your analyzer is ready to use straight out of the box.

SUMMARY

Once calibrated, Hitachi High-Tech's LAB-X5000 provides cost-effective and rapid determination of sulfur in waste biomass, enabling operators to make decisions fast on the use and treatment of incoming waste before it enters the digestion process. The analyzer's ease of use and ruggedness make it an ideal control tool close to the digester or in the biogas plant's laboratory, delivering results within minutes for maximum productivity.



ORDERING INFORMATION

The instrument configuration and accessories needed to produce the data in this application note are:

- LAB-X5000 "Sulfur in oils and fuels" package (P/No. 10010087 with integrated printer; P/No. 10027115 without the integrated printer); this includes the analyzer, sample cups, safety windows, sample film, pre-loaded calibration parameters, setting-up samples, calibration instructions etc.
- Sample spinner (P/No. 10009405)

Additional option:

- Factory calibrations (P/No. 10011710); include "0 - 1000 ppm S in oil" and "0.1 - 5% S in oil" calibrations; calibration standards are not included
- Factory calibrations (P/No. 10021504); as above; calibration standards are included

Visit www.hitachi-hightech.com/hha for more information.

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