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future's
in the making

On-line gas analysis in scientific investigations

Express Multi-Component Gas Analyzer
GAOS MS-20-8

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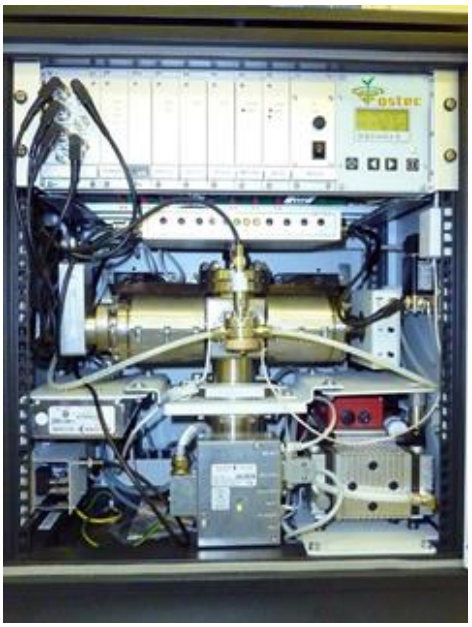
future's in the making

Process Mass Spectrometry

The MS process mass-spectrometer provide real-time, fast, accurate, comprehensive gas analysis.

OPERATIONAL CHARACTERISTICS

- Modular configuration, fast replacement of blocks for maintenance service and repair;
- IP54 protective execution;
- Continuous working 24 hours during 6 – 12 months without of servicing of vacuum system;
- Automatic algorithm of working with the functions of diagnostics, adjustment, calibration and operative control of measurements accuracy.



Mass-spectrometer GAOS MS-20-8

H_2, D_2, T_2, He, CH_4, H_2O, Ne, N_2, CO, O_2, Ar, CO_2, SO_2, Kr, Xe — *200 ns*

Industrial Sample Conditioning Block

C_2H_6, C_3H_8, C_4H_{10}, C_5H_{12}, C_6H_{14}, C_6H_6, C_7H_8

Depending on the analytical applications, the process mass spectrometers MS are equipped with various modifications of Sample Conditioning System.

SAMPLE CONDITIONING SYSTEM SPECIFICATIONS

- Continuous of gas probe sampling under conditions:
  Temperature up to 1200 ºC;
  Dust content up to 30 g/m^3;
  Pressure (10^{-3}÷3) bar;
  Presence of a condensate, aggressive gases;
- Step by step cleaning of gas probe, dust, condensate removal, cooling;
- Switching from various points of sampling and gas probe transportation on the mass spectrometer input;
- Automatic control of the operating parameters (temperature, pressure, volume flow) and self-diagnostics of the Sample Conditioning System.

Analytical Applications

METALLURGY
- Basic Oxygen Steel process (converter);
- Blast Furnace Optimization;
- Steel Vacuum Processing (VOD, RH);
- Air separation (analysis of blowing oxygen purity);
- Emissions Monitoring and Pilot Plant Gas Analysis for non- ferrous metallurgy.

GEOLOGY
- Mud Gas Logging;
- Isotope Analysis;
- Gas Measuring;
- Fluid Inclusions Gas Analysis (geochemistry investigations).

OIL AND GAS INDUSTRY
- LNG production;
- Natural gas processing;
- Hydro-cracking process;
- High-temperature cracking furnace optimization;
- Process of the catalyst regeneration;
- The chemical analysis of technological gases: recycle hydrogen, fuel, inert.

ATOMIC ENERGY
- Chemical and isotope analysis of H_2-He-T_2 fuel gas mixtures (International project "ITER" - experimental thermonuclear reactor);
- Chemical and isotope analysis of gas phase of the fuel elements cover;
- Monitoring of hydrogen and other gases migration during the atomic reactor stress testing.

HIGH-PURITY GAS PRODUCTION
- He, Ne, Ar, Kr, Xe, H_2, N_2, O_2

ALTERNATIVE ENERGY
- Plasma gasification of the solid waste with reception of synthesis-gas for power and chemical industry;
- Optimize of hydrogen reformer and catalyst efficiency for fuel cells development and testing.

INVESTIGATIVE ANALYSIS
- Monitoring of the gas phase for thermal, termogravimetric analysis;
- The elemental analysis (C, N, O), quantity determination of the dissolved gases in metals;
- Pilot plant gas analysis of the metallurgical processes.

Process Mass Spectrometry in Scientific Investigations

Thermogravimetric Analysis

Thermal analysis methods are widely used to characterize the thermophysical properties, structure and stability of various substances and materials. Thermogravimetric analysis is particularly widely used, in which the weight loss of a sample is recorded continuously during programmed heating.

Thermogravimetric analysis is a recognized test method for the production of polymeric materials in the chemical industry, in the pharmaceutical industry, and is also used to study the properties of ceramic materials, minerals and metals, food products, adhesives, varnishes and paints.

The most powerful analytical tool for scientific research in thermogravimetry are TG-DTA/DSC synchronous analysis systems in combination with a mass spectrometer for monitoring the composition of the gas phase.

Gas analysis by the GAOS MS-20-8 mass-spectrometer at the thermogravimetric analysis. The installation of TG-DTA/DSC analysis «Setsys Evolution», SETARAM, France.Institute «Gipronickel», Saint-Petersburg, «MMC «Norilsky nickel».

Process Mass Spectrometry in Scientific Investigations

In synchronous analysis of TG-DTA/DSC, the change in heat flux and sample mass is measured simultaneously depending on temperature and time in a controlled atmosphere. This method of thermogravimetric analysis not only increases the performance of measurements, but also simplifies the interpretation of results, due to the ability to separate processes with different thermal effects (positive or negative) that are not accompanied by a change in weight (for example, phase transitions) from which a change in weight occurs (for example, desorption degradation).

Analysis of gases by the method of mass spectrometry (MS) allows to obtain more detailed information on the composition and thermophysical properties of the samples under study and to reliably interpret the measurement results.

The sample during thermogravimetric analysis (TGA) is in a given as controlled conditions, and the environment (heating rate, gas atmosphere, volumetric flow rate, etc.). The TGA method in combination with a mass spectrometry system for gas analysis is used, for example, to quantify the composition of a polymer composition or any mixtures. Weight loss in an inert gas atmosphere, for example, may result from the release of chemically or physically bound water (drying behavior). The selection of solvents and plasticizers or decomposition of polymers are divided in time depending on its thermal stability. After switching the atmosphere of an inert gas to an oxidizing atmosphere (air, oxygen), the added soot, for example, burns to carbon dioxide. Inorganic additives, such as talc or fiberglass, in the temperature range up to 1000 ºC form a residue in the form of ash.

Studies in synchronous analysis of TG-DTA / DSC in combination with MS:

Decomposition

- allocation of water
- stability
- residual solvent
- pyrolysis

Composite materials analysis

- composition of polymers
- technical analysis
- burning out of the binding
- destruction of paraffin
- definition of the ashes rest

Heterogeneous reactions solid – gas

- combustion
- oxidation
- corrosion
- adsorption
- desorption

Identification

- composition of gas mixtures
- under the mass spectrum form ("A fingerprint" method)
- partial pressure
- fragments
- reactions gas-solid phase

Process Mass Spectrometry in Scientific Investigations

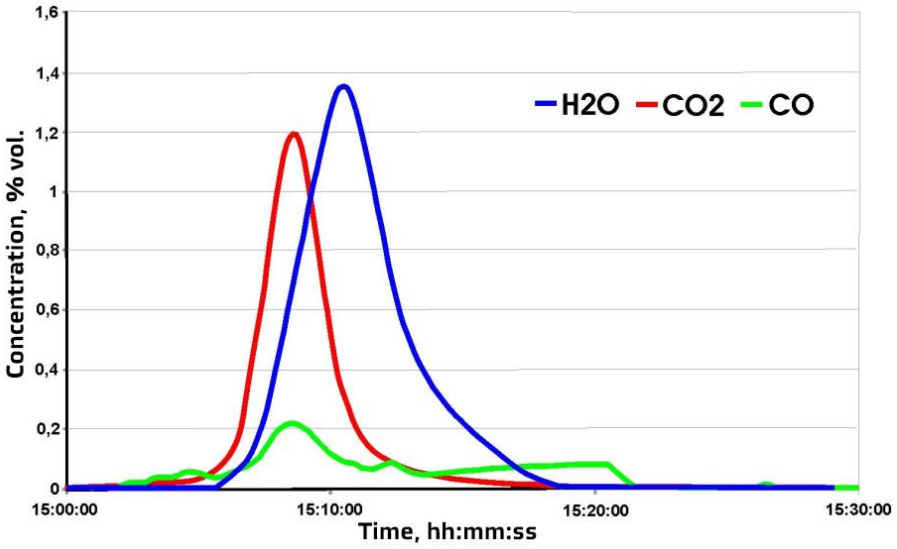
Specialized mass spectrometer GAOS MS-20-8 for scientific research in the installation of thermogravimetric analysis has a high-temperature (up to 450 ºC) sample gas input, automatic tuning of the mass spectrum and the choice of analytical spectral lines: 16 analytical lines in analog and 16 in the counting modes work registration system.

The components are determined by a mass spectrometer for research on the development of new technologies, optimization of the parameters of technological processes of copper-nickel production at the "MMC "Norilsk Nickel":

H_2, N_2, O_2, CO, Ar, SO_2, H_2S, CH_4, NH_3, COS, CS_2

Range of measured concentration: 0,0001÷100 % vol.,
minimum reached detection limit – 0,01 ppm.

Before scientific studies, the TG-DTA / DSC system and mass spectrometric gas analysis are tested using standard samples with known chemical composition and thermal physical properties. The obtained gas analysis data are compared with reference values using the balance method.



The time diagram of the gas analysis of reference sample of the copper-nickel concentrate. The GAOS MS-20-8 mass spectrometer.