Metals and chemical industry
Magnos28 oxygen monitoring in the production of technical metal powders

Optimizing oxidation process to ensure metal powder quality.
Ensuring process safety by inert gas monitoring.

Measurement made easy

Introduction
Metal powders of defined size and pureness are an important intermediate for further use in the production of minerals based industrial products such as paints, pyrotechnics, silicon nitride ceramics or semiconductor wafers. In general these powders are produced from raw materials in a crushing or grinding process in ball mills or classifier mills under controlled inert gas or oxygen concentrations.

Two important examples for technical metal powders are:
• Aluminum flakes
• Silicon powder

For both, the accurate measurement of oxygen for many hours is of great importance for the production process.
Metals and chemical industry

Magnos28 oxygen monitoring in the production of technical metal powders

**Production of aluminum flakes**
Aluminum flakes have a typical diameter from 20 to 100 μm and are used as feedstock in different industries and applications. In the minerals industry, aluminum flakes act as pore former and propellant during the production of aerated concrete. They serve for the thermal insulating properties of aerated concrete.
The paint industry uses Aluminum pigments in many applications either fulfilling functional tasks or enhancing the end products optically (metallic effect).
Finally, Aluminum flakes act as a source of energy in many pyrotechnical products.

**Measuring task – Process control of oxidation process**
Starting material for the production of metal pigments is aluminum powder with a grain size of several μm. To enlarge the surface, the powder is crushed in a ball mill, process duration being several hours. The specific surface area, the grain distribution and the surface coverage of the particles essentially determine the reaction behavior of the products in later application processes. For example aluminum flakes with improved wetting in water are required for aerated concrete blocks. In order to obtain the resulting flakes in a stable form and chemically inert and optimized for the later production of the end product, a defined oxidation process is required, which is controlled in the mill during crushing at O₂ concentrations of 6 to 14 %.
Typical requirement for processes that run for several hours are stable gas analyzers with low drift. Analyzer adjustments are performed typically only every few weeks.

**Production of pure silicon powder**
Pure silicon powder is the raw product for the semiconductor industry. It is also used in the ceramics industry in the production of reaction-bound silicon nitride powder (and other materials. Silicon Nitride for example is needed for the production of photovoltaic modules.

**Measuring task – Inert gas monitoring**
The grinding chamber of a classifier mill is filled with inert shield gas N₂ or Ar in order to prevent oxidation or explosive reactions that could occur with ambient air inside the mill.
The process conditions are dry O₂ in N₂ and the typical process lasts for more than 24 hours during which a threshold of max. 4 % O₂ is monitored.
Several subsequent process runs are performed during a typical production period, during which no calibration of the instrument is possible. Therefore, drift stability is a key requirement for the O₂ measurement. Adjustments are only made typically once a month.
Diagram 01 shows a typical process run for silicon powder production. In certain phases of the process, for instance when the O₂ concentration in the mill approaches the threshold value, inert gas, regulated by the compressor, “reconditions” the atmosphere in the mill. To avoid overpressure a valve to environmental atmosphere opens, which explains the short periods of elevated O₂ concentrations.

---

01 Inert gas monitoring in the silicon powder process

---

Diagram 01 shows a typical process run for silicon powder production. In certain phases of the process, for instance when the O₂ concentration in the mill approaches the threshold value, inert gas, regulated by the compressor, “reconditions” the atmosphere in the mill. To avoid overpressure a valve to environmental atmosphere opens, which explains the short periods of elevated O₂ concentrations.
ABB solution: Magnos28

The Magnos28 represents the future of paramagnetic oxygen measurement, leveraging ABB’s pioneering technology leadership and over 75 years of innovation in the field of continuous gas analysis. This exciting product completely rethinks paramagnetic oxygen analysis, replacing the glass dumbbell with a revolutionary new silicon sensor, the microwing, and automating historically manual manufacturing processes leading to levels of quality and reproducibility beyond anything that is currently available on the market.

Revolutionary new microwing technology

The Magnos28 introduces a fundamental revision of the sensor design. The patent-pending microwing replaces the glass dumbbell with its circuit path, mirror, mounting and taring weights as an all-in-one device without any additional attachments. Applying the latest semiconductor based production technologies, multiple sensors are manufactured on a wafer slice – a completely new approach to magnetomechanical oxygen measurement. Absolutely reproducible silicon sensor elements, the microwing, are the basis for a product which promises greatly improved repeatability and precision. The microwing sensor reacts very accurately to oxygen concentration changes due to its very low mass, high width-to-thickness ratio and optimized magnetic field distribution in the measurement position.

Refined for challenging applications

Magnos28 is best suited for these measurements. Special coatings protect sensitive internal sensor parts like the pole shoes. No adhesives are used in the sensor production, which could interact with the sample gas and influence the measurement. As a result, Magnos28 offers the required qualities for long term stability of span and low zero drifts.

Fast results when every second counts

Compared to its predecessor the internal chamber volume is reduced by a factor of three. Completely redesigned gas paths and optimized drillings result in a rapid gas exchange. With its optimized design the new Magnos28 facilitates more than 15% improvement in response time. This feature makes Magnos28 a perfect fit for threshold monitoring, when process conditions rapidly change.