Determining the CO_2 reactivity of petroleum coke

Easy-to-use high quality furnace

Calcinated petcoke is an essential ingredient in the production of aluminium. Its quality needs to be monitored continuously throughout the production process to ensure a high quality metal grade. As part of its range of coke testing furnaces, Carbolite has designed a special model for determining the CO_2 reactivity of petroleum coke in accordance with ISO 12981-1. The furnace has a single, vertical, tubular heating zone which is integrated into the unit, giving a neat and compact design overall.

Compact design – Carbolite's CO_2 furnace

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Aluminium is the most abundant of all metals on Earth – but it is also expensive due to the high cost involved in the extraction process. However, the production of aluminium is becoming more and more important for the future due to its low weight, which reduces the energy costs of the products manufactured over their lifetime. Global demand for aluminium is therefore increasing.

Calcinated petroleum coke is used to make anodes for the aluminium smelting industry. Petroleum coke (also known as petcoke) is a rock-like residual which is created during the oil refining process and becomes calcinated when it is roasted below melting point. As calcinated petcoke is an essential ingredient in the production of the aluminium, its quality needs to be monitored to ensure a consistently high metal grade. High quality coke is also essential in the steel industry or the production of titanium dioxide.

ISO 12981-1 describes a method for determining the reactivity of calcinated petroleum coke – which is used to make anodes for the production of aluminium – to carbon dioxide by the loss-in-mass method. The loss in mass is measured when a coke sample is exposed to carbon dioxide for 100 minutes at 1000 °C by comparing the weight before and after the test. The test is carried out using a CO_2 reactivity test furnace in accordance with ISO 12981–1.

Special features of the CO_2 furnace

As part of its range of coke testing furnaces, Carbolite has designed a special model for determining the CO_2 reactivity of petroleum coke in accordance with ISO 12981-1. The furnace has a single, vertical, tubular heating zone which is integrated into the unit, giving a neat and compact design overall. This single-zone tube furnace ensures a good vertical temperature distribution, being heated up to 1000 °C in well under an hour and maintained at this temperature with an accuracy of ±1 °C. It has two quartz tubes with a cap and cut glass seams to meet the ISO 383 standard. An external tube with a gas inlet allows the gas to flow down to the bottom and be preheated before flowing up through the coke bed. An inner reaction tube with a fritted disc is fitted inside the external tube, so that the base of the coke bed lies in the middle of the furnace.

The system is controlled by a high quality digital PID controller with a setpoint that causes the tube reactor thermocouple to indicate 1000 °C. A separate overtemperature protection controller prevents the system from overheating. The temperature inside the quartz tube is continuously monitored by a thermocouple with an accuracy better than ±0.375 %. An audible alarm sounds when the temperature is stable and the device is ready to measure.

The built-in CO_2 gas control system allows the supply pressure to be adjusted by an integrated pressure regulator while the gas flow rate is adjusted by a manual mass flow controller with a digital display. The CO_2 gas flow is maintained in the tube at a constant rate of 50 l/h for the duration of the analysis; the gas is automatically switched by digital outputs in the temperature controller. At a temperature of 1000 °C, the CO_2 gas reacts with the coke to form carbon monoxide. This results in a weight loss of the sample which is used to determine the petcoke quality by comparing the weight before and after the reaction.

Easy to install and to operate

The furnace has an easy-to-use operating system and is started by pressing the „heat on“ button. This causes it to be heated to a preset temperature of 1000 °C. When this temperature is reached, it is maintained for ten minutes, after which an audible alarm tells the user that the furnace is ready for the sample to be placed in the sample holder by opening a lid

at the top of the glass tube. When the „sample in" button is pressed, an automatic valve opens the CO_2 gas flow, which is precisely controlled by the digital mass flowmeter.
Heating stops after 100 minutes but the gas flow continues for another 30 minutes, after which the gas valve closes and another audible alarm indicates that the test is complete. When the sample is weighed again, the difference between the before and after weights indicates the amount of loss.
A series of tests carried out in the Carbolite laboratory yielded accurate, reproducible results. The sample weight for each test was 5 g ±0.01 g. The results of four tests performed over three days showed an average weight loss of 0.4313 g – the smallest loss being 0.4110 g and the biggest 0.4460 g.
The CO_2 furnace is fully compliant with ISO 12981-1 specifications and offers all the benefits of a modern furnace with high quality, high grade insulation, an integrated holder for hot glass – making it safer to use – and a competitive price. When designing and developing the furnace, Carbolite attached particular importance to the very latest technology and maximum product safety. This is why, for example, a digital mass flowmeter was chosen instead of a normal flowmeter with a needle valve; in addition, the furnace and the electronic components are housed in a compact case to ensure only minimum bench space is taken up while the furnace body itself is enclosed in a double skin to keep the outer surface cool. An electrical isolator switch is incorporated to isolate the power supply. Installation and commissioning are easy and can be performed by the user.
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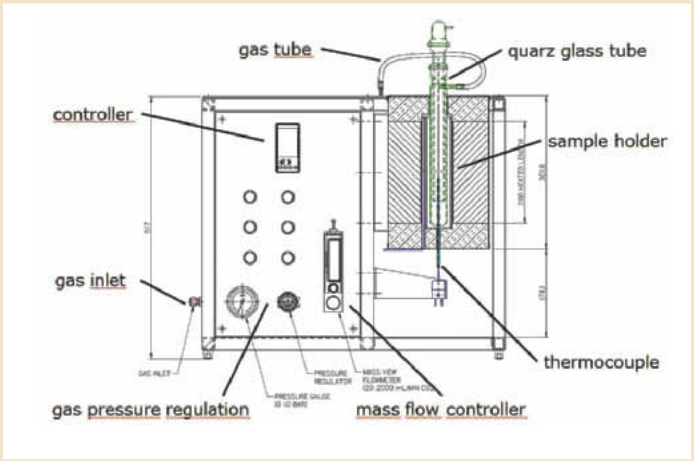

Schematic diagramm of the furnace