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Technical Information

to the

MRS-1

measuring system for determining of
coal expansion pressure

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General

The expansion pressure is one of the most important phenomena occurring in coke ovens during the coking process. The coal charge softens during the carbonization process and its volume increases, resulting in generation of pressure directed towards the heating walls of the chamber.

Different types of coal used for coking are characterized by different intensity of this phenomenon. Although high expansion pressure has a positive effect regarding the coke quality, the risk of damaging the walls of the coke oven chamber or even destroying it must be taken into consideration.

When planning the coking process, it is therefore essential to be aware of the value of the coal charge expansion pressure, where a high value indicates the possibility to produce high-quality blast furnace coke. However, the safety of the ceramic lining of coking chambers may be endangered by this production and, in extreme conditions, there is a risk for its full destruction.

Several methods of measuring and predicting the value of expansion pressure are known which use direct and indirect measurements. Unlike determining other parameters, no internationally accepted ASTM and ISO standards exist at present for the measurement of expansion pressure.

The MRS-1 system for measuring expansion pressure consists of the following parts:

1. Test furnace with an air cooled mechanical holder for the sample. The furnace pocket is automatically air cooled for shortening of time periods between successive tests. The test furnace is electrically heated by resistance bars while heating power is controlled by an intelligent solid state controller. Temperature in the furnace is controlled with an accuracy of $\pm 1^\circ\text{C}$. A temperature gradient up to $15^\circ\text{C}/\text{min}$ can be set with an accuracy of $\pm 0.5^\circ\text{C}$ and the maximal furnace temperature is of about 600°C .

The furnace is equipped with temperature measurements in several important locations, and in particular by measuring the pressure of coal that has been packed in the prescribed way in the measuring crucible. The furnace has a cooling of the sample holders as well as cooling the heating space to reduce the time lag between successive tests.

2. Apparatus for measuring of expansion pressure that provides measurement of the force (expansion pressure) acting on the piston. Measurement of expansion pressure can be completed with a subsystem for measurement of contraction.

3. Multi-purpose electronic control system with a powerful industrial computer on PC platform for controlling the measuring process and for database functions. If changing software and modifying or updating the interface, the computer can be also used for other tasks.

4. To a special order, the expansion pressure measuring system can be also be supplied with a subsystem for measuring coal contraction.

Technical parameters of the MRS-1 system

1. Electric testing furnace

for 600 °C maximum temperature,
including automatic control of temperature gradient and controlled cooling.

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|--|--------------------|
| - heating | by resistance rods |
| - maximal temperature | 600 °C |
| - programmed control of heating | |
| - accuracy of temperature control | ± 1 °C |
| - temperature gradient | 0.5 to 15 °C /min |
| - accuracy of temperature gradient | ± 0.5 °C /min |
| - automatic control of furnace cooling prior to the successive test. | |

2. Apparatus for measuring of expansion pressure

The apparatus consists of:

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| a) Force transducer with strain gauge beam sensor Hottinger Z6H2 | |
| - nominal load | |
| - maximal error | 0.02 % |
| b) Measuring amplifier | |
| - linearity | 0.03 % |
| - measuring range | 0.1- 2 mV/V |
| - sensitivity change | 0.05 % / 10 °C |
| - temperature range | - 20 to + 60 °C |

3. Electronic control system

for automatic control of furnace temperature with selectable temperature gradient.

The main part of the system are as follows:

- MiPC 70 CT/5860 main unit with CPU Pentium 200 MHz, 8MB SIMM, flat LCD TFT Colour display 10.4"
- Keyboard
- HDD 1.6 GB
- FDD 3,5"
- A/D interface card with digital I/O
- Network interface for the ETHERNET
- Interface for any standard VGA display

4. Functions of the control system

4.1 Automatic evaluation and recording

of all important parameters during the test (according to customer's requirements) and long-term archiving on magnetic media:

- floppy disk
- hard disk

4.2 Data transfer out of the system

via network (ETHERNET)

4.3 Printing of test protocols and plotting of graphs

- printing protocols and graphs on a HP DeskJet color printer

5. System diagnostics

- automatic during the whole test
- registration of faults and errors in form of files
- registration of test operation in form of files
- registration of commands of operating personnel

6. System software

- MS DOS 6.22
- real-time control software for performing the test
- software for visualization, archiving and printing of data

7. Dimensions

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|---------------------|--------------------|
| - test furnace | 700 x 500 x 700 mm |
| - control computer | 430 x 250 x 500 mm |
| - color ink printer | 450 x 420 x 220 mm |

8. Power supply

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|------------------|--------------------------|
| - power input | max. 2000 VA |
| - supply voltage | 220 V, 50 Hz, $\pm 10\%$ |