



LABORATORY COKING STATION



## THE NEW KARBOtest

KARBOtest is a tool for determining the quality of coals and coal blends which significantly helps in blending coal charge. It allows to assess its suitability for industrial coking process, under conditions similar with those existing in industrial coke ovens.

A single charge (4-5 kg) is sufficient to obtain coke in a quantity enabling reliable assessment of its properties, which is of fundamental importance for predicting the quality of industrial coke.

**Tests can be performed at low cost, in a quick and safe manner.**

## DIFFERENCES BETWEEN VERSIONS

	Version 2000	Version 2015
oven	separate heating unit with a manual crane for moving the retort, separate table for gas cleaning system	separate unit in compact structure that includes: heating unit, gas cooler, retort cooler, charging / discharge unit with automatic moving system for the retort
gas water cooler	free-standing on the table	integral part of main unit
retort cooler	none	integral part of main unit
retort transfer system	crane with manual control	automatic conveyor / mechanical emptying of retort
electrostatic precipitator with high voltage power supply	free-standing, manual control	installed in separate movable connectable cart for gas treatment equipped with power supply control integrated with system control
retort transfer trolley	free-standing bin	trolley, docked in the system structure

The first version of the experimental Karbotest system was developed in the 1990s.

Over time it was improved and modified to meet users' expectations.



The version presented here was created in 2015. Changes made in the design of the system are of great importance for the users with regard to:

- **operating speed,**
- **safety,**
- **ease of use,**
- **ergonomics.**

## MODULAR DESIGN

The system has a modular structure. This enables it to be configured to meet customer requirements on expected results. There are three equipment options adapted to the required scope of operations.

To suit the purpose of using the system, the following versions are available:

	MINI	MIDI	MAXI
<b>MINI</b>	<b>basic</b> – coke production, separation of the heaviest tar fraction, preliminary treatment of coke oven gas (when burning the gas, smoke arises due to combustion of un-separated tarry material present in the gas)		
<b>MIDI</b>	<b>expanded</b> – coke production, tar separation, coke oven gas is deprived of tarry material (smokeless combustion)		
<b>MAXI</b>	<b>full</b> – coke production, separation of benzol, hydrogen sulphide, ammonia, cleaned coke oven gas (material balance of the coking process can be drawn up)		
<b>result of system operation</b>			
coke produced	•	•	•
separated heavy tar section	•	•	•
partly cleaned gas burned (high smoke emission due to presence of tarry substances)	•	•	•
gas cleaning		•	•
tar yield determination		•	•
separation of H <sub>2</sub> S, NH <sub>3</sub> , benzol from gas			•
gas yield determination			•
drawing up of material balance of the coking process			•
<b>system components</b>			
oven unit	•	•	•
gas water cooler	•	•	•
retort cooler	•	•	•
automatic retort moving system	•	•	•
gas burner	•	•	•
movable cart with electrostatic precipitator and high voltage power supply for elimination of tar mist from gas		•	•
gas meter (on a cart)			•
absorbers for removing hydrogen sulphide, ammonia, benzol (on a cart)			•

**!** Choosing the basic version does not preclude upgrading the system in the future, as it can be easily upgraded to the expanded or full version at any time.

## OPERATION AND USE

The new system is controlled remotely from a stationary or laptop computer which communicates with the unit by means of wi-fi or wired connection. The use of a control touch panel installed within the structure of the system enables process control without the need to communicate with a computer.

The software installed in the computer enables real-time monitoring of the coking process, while the information can be displayed even on another independent monitoring computer.

The display system is clear and very intuitive. Implemented sensors and the options in control system to confirm subsequent process steps prevent unintended instructions to be carried out whereas the personnel health or system damage is at stake (e.g. transfer of hot retort from the oven to the cooler, while there is still a retort in the cooler is impossible to be conducted).

Most of the tasks have been automated to significantly simplify and shorten system operation.



# MODERN DESIGN OF THE 2015 VERSION

The system includes components that have been improved in relation to the earlier version.

## Major modifications:

### automatic retort insertion and retrieval and coke sample unloading system

The automatic retort transfer system significantly facilitates manipulation of the retort. Together with the heating head and the charge/coke weighs 60 kilograms. It is of particular importance when the hot (~900 °C) retort is moved from the oven to the cooler. An automatic retort turning system has been introduced. The system facilitates coke discharging from the retort and eliminates manual operation. Retort turning also facilitates access and cleaning of the retort interior.

### integrated retort cooling unit

The current version of the system includes an integrated unit for cooling the retort after completing the coking process. In the previous version the retort was required to remain in the oven until next day to allow cooling to a temperature enabling coke discharge. In the new version the retort is automatically transferred to a cooling chamber where it is cooled within about 2 hours. This significantly shortens time to obtain coke for further analysis. With the earlier version it was impossible to make more than one cooking test during one day, whereas now it is possible to carry out up to 4 tests a day. Thanks to that it allows to send produced coke for detailed analytical testing on the same day.

### retort transfer trolley

The trolley facilitates charging the retort and ramming the charge. The trolley can be parked anywhere, even outside the room where the system is located. Upon docking the trolley inside the main unit, the drive system automatically picks up the retort from the trolley and transports it to the oven. In addition, the mobility of the trolley simplifies the cleaning of both: the retort itself, as well as of the heating head. Both of them can, by means of an automated conveyor, be placed in the trolley alternately.

### computer system with control, process display and data storage software

The control software enables real time observation of all installed temperature sensors, i.e. thermocouples in the three independent heating sections, on the heating head and optionally in the charge. In the case of the full system version, the software also displays the volume and flow rate of the evolving gas. This enables monitoring and analysing the process status and comparison with archived data in order to spot differences, if any. The new control software is much more intuitive and user-friendly than the one used in the 2000 version.

### coal sample rammer

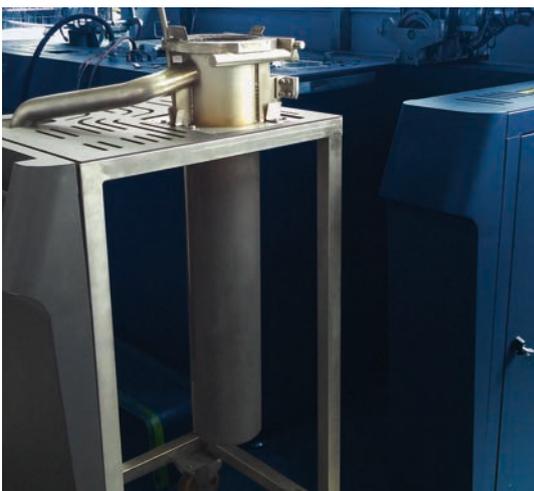
New design of the rammer facilitates charge ramming and making an opening for the temperature sensor. The ram is provided with a scale that enables immediate determination of the density of the charge while it is being prepared for the test.

### electrostatic precipitator (MIDI version)

In contrast to the software version 2000, the electrostatic precipitator is controlled by the system control software, rather than with the power supply modul. The values of the voltage and current supplied to the electrostatic precipitator are being displayed by the control software. This way all important process parameters are displayed in one location (control software) rather than being scattered over the separate system components. This makes monitoring of the entire proces easy and user-friendly.

### NH<sub>3</sub>, H<sub>2</sub>S, benzol absorbers, gas meter (MAXI version)

In contrast to the earlier versions of the KARBOtest, the absorption and gas metering system is located in a separate mobile module - gas cart. The latter is connected by means of a gas conduit with the oven module. This effectively saves space for arranging all components of the gas system. The gas meter provides information on the amount of evolving gas, enabling thereby to obtain data regarding the gas output efficiency of the coking process. Data on the gas flow are digitally transferred to control system.



## MODERN MEANS SIMPLE AND ERGONOMIC

Modern technological solutions applied in the new version of KARBOtest make the system simple to operate, much more efficient in operation, ergonomic, with easily accessible components. More importantly they enable making measurements in an economic, fast, reliable and safe manner.

Most of procedures have been automated what substantially simplify and shorten time of test.

Institute for Chemical Processing of Coal

Director

**Aleksander Sobolewski Ph.D.**



**INSTITUTE FOR CHEMICAL  
PROCESSING OF COAL**

## ...BEYOND STANDARDS!

It is commonly known that the process of development and implementation of new technologies is crucial for successive and sustainable growth of our civilization. What we know is that present and future competences and competitiveness results of our past and our experiences.

The effective participation of the Institute in the innovation chain accompanied with its elongation is our greatest honor and challenge.



### REFERENCES

**2005**

Cokeplant Dneprodzerzhinsk  
– Dneprodzerzhinsk (Ukraine)

**2008\***

ArcelorMittal Steelworks  
– Krivoy Rih (Ukraine)

**2010\***

Steelworks Yenakievo  
– Yenakievo (Ukraine)

**2012\***

EVRAZ Nizhny Tagil Metallurgical Plant  
– Nizhny Tagil (Russia)

**2013\***

Cokeplant Altai-Koks Zarinsk  
– Zarinsk (Russia)

**2015**

Institute for Chemical Processing of Coal  
– Zabrze (Poland)

\* by LECO Instrumente  
– Pilzno (Czech Republic)



# INSTITUTE FOR CHEMICAL PROCESSING OF COAL

INSTYTUT CHEMICZNEJ PRZERÓBKI WĘGLA

ul. Zamkowa 1 • 41-803 Zabrze • tel.: 32 271 00 41 • fax +48 32 271 08 09

e-mail: [office@ichpw.pl](mailto:office@ichpw.pl) • [www.ichpw.pl](http://www.ichpw.pl)

Konto: Bank Pekao SA Zabrze PL23 1240 4227 1978 0000 4846 0608

SWIFT: PKOPPLPW NIP: PL6480008765, REGON: 000025945, KRS: 0000138095

