



The RF-33 system, its versions and features

RF-33	performing CRI/CSR tests according to ASTM D 5341 or ISO/DIS 18894 Standards
RF-33/KK	producing own coke and performing CRI/CSR tests according to ASTM D 5341 or ISO/DIS 18894 Standards
RF-33/TV	performing CRI/CSR tests according to ASTM D 5341 or ISO/DIS 18894 Standards with continuous probe weighing
RF-33/RDI	testing iron ores, pellets and sinter according to ISO 4695, ISO 7215, ISO 4696-1 and ISO 4696-2 Standards

The RF-33 system, its versions and features

1. The base RF-33 system

is for testing coke quality by the standard CRI/CSR test, in accordance with the ASTM D 5341 or ISO/DIS 18894 Standards.

2. The first extended version called RF33/KK

has been designated for producing of max. 10 kg coke in laboratory conditions and then testing that coke by CRI/CSR test according to ASTM D 5341 or ISO/DIS 18894 Standards.

The RF33/KK system is unique not only in its technical parameters but also as the broadness of its possible applications is concerned. In the same equipment carbonization of the tested coal (coal mixture) can be done as well as the subsequent testing of the product by determining its CRI/CSR values.

Quenching of the produced coke is carried out immediately in the retort, using so called dry quenching method either by an intensive flow of gaseous nitrogen, or natural cooling with selected cooling rate. Also combination of both methods is possible. In this way, the laboratory procedure of producing coke sample from the tested coal (or coal mixture) approximates to the normal conditions of industrial coke production in coking batteries.

It has been established that close enough correlation exists between the qualitative CRI/CSR parameters from this test and those for the coke produced in an industrial coking battery from identical coal mixture. In this way, based on the laboratory tests, quality of the industrially produced coke (i.e. its CRI/CSR values) can be predicted for different coal mixtures being intended as the charge. Thus, the RF33/KK system can be utilized, among others, in the coal charge preparation process (coal sorts' choice and mixing) for the real coking process in industrial coking batteries.

We would also like to turn your attention to the fact that not all the systems for determining CRI/CSR parameters, being offered on the market by many suppliers, fulfill the requirements of the ISO/DIS 18894 Standard. In some cases, discrepancies were found out in the test retort design as well as in keeping the prescribed temperature patterns there. Information about the importance of keeping all the prescribed parameters of test systems for determining CRI/CSR values can be found in a comprehensive study released on the meeting of "European Cokemaking Committee" held on May 29 to 31, 1995 in Linz, Austria. The findings presented in that study resulted from cooperation between the institutions "DMT Gesellschaft für Forschung und Prüfung mbH" and "Institute for Ironmaking and Fuel Technology". This work was one of fundamental sources for establishing the ISO/DIS 18894 International Standard.

3. The RF-33/TV version

stands for further modification of RF-33 system and fulfills the needs of dynamic control of blast furnaces. The system has been supplemented with continuous sample weighing during reaction time of the CRI test. In this way it is possible to monitor the weight loss rate in dependence on gas pressure value in the retort. Such a system has been installed and is operated at "École Centrale Paris" in Paris, France. It is used there, among others, for testing properties of charcoal that is used, instead coke from coal, in Brazilian blast furnaces, as well as for commercial needs of some European coking coal importers. A remarkable feature of the system is that it allows studying how the gas pressure in the retort influences the course and intensity of reactions in the retort, together with analyzing off-gases that escape from the

reaction. The retort itself is equipped with thermocouples for monitoring the temperature field in coke sample, according to recommendations of the European Cokemaking Committee.

The system offers broad software facilities, including for measurement and registration of temperatures in the test furnace and of temperature field in the retort, of temperature gradients and deviations from the required temperature values. Mass flowmeters are used to ensure exact gas flow measurement and regulation during the CRI test. Following matters are of great importance, too: measuring the inlet and outlet pressure of gases in the retort, automatic testing of leak tightness of the retort before the test start, and the possibility of connecting the off-gas analyzer to an automatic data logger. According to the French user's opinion, our system belongs to the most sophisticated European systems for testing coke properties.

All three above systems i.e. RF-33, RF-33/KK, and RF-33/TV are equipped with a testing drum (tumbler) for performing the CSR test (according to ISO/DIN 18894 Standard). Again, this tumbler has been designed in compliance with recommendations of the European Cokemaking Committee. Therefore, it is equipped with exact regulation of the actual rotational speed. It followed from comparative tests that the common solution (a mechanical gear with counting the drum rotation) was not satisfying. It is necessary to keep the actual rotational speed within the range of 20 ± 0.1 rpm (i.e. angular speed within 120 ± 0.06 °/sec).

All these three systems of RF-33 family are equipped with powerful software that also ensures long-time archiving in detail of all relevant measured data. Thus, it is then possible to perform a detailed analysis of any accomplished test and to prepare detailed documentation to that test in case of commercial disagreements, or so.

4. The **RF-33/TV/RDI** system

is the latest and most complex version of the original RF-33 system for testing coke quality. That version is primarily designated for testing iron ores, pellets and sinter and is equipped with relevant software tools for doing such tests. Nevertheless, if the necessary software modules for production of 10 kg of coke and a test drum for CSR testing are included in the system, it can be used for all the above described tests, too. This means (if necessary) coke can be produced in laboratory conditions from raw coking coal and then subjected to CRI/CSR testing, too. Thus, in general, it can be said that the RF-33/TV/RDI system can serve for studying high-temperature physically-chemical properties of metallurgical raw materials in the environment of technological gases.

The RF-33/TV/RDI system satisfies all needs and conditions of the Standards ISO 4695, ISO 7215, ISO 4696-1 and ISO 4696-2 for testing iron ores, pellets and sinter. Optionally, it is also possible to deliver a specialized software tool which enables the user to arrange own (atypical) test patterns e.g. for doing scientific experiments.

The RF-33/TV/RDI system is composed of several individual parts that can be combined in various modifications according to the purpose. These are: a special electrically (resistance) heated furnace for heating the retort with test sample, a thermobalance set, a retort cooling equipment, a device for automatic insertion and removal of retort from the furnace, a rotational drum for carrying out tests according to ISO 4696-1/ ISO 4696-2 Standards, a system for distribution of technological gases, a waste gas outlet system, and a control system that ensures functioning of the entire facility, including the registration of test runs and test results. The advantage is that the system can be expanded at any time if a new test with other specific requirements appears.