



CEMENT ADDITIVES DIVISION TECHNICAL SERVICES

Cement Reproduction and Testing

THE MAPEI C-ADD CEMENT ADDITIVES DIVISION IS PLEASED TO ANNOUNCE THE OFFERING OF THE WORLD CLASS TECHNICAL SERVICE TO THE CEMENT MANUFACTURING INDUSTRY. THE MAIN GOAL IS TO ASSIST CUSTOMERS TO PRODUCE CONSISTENT AND UNIFORM PRODUCTS, OPTIMIZING THE CEMENT PRODUCTION COSTS AND INCREASING COMPETITIVENESS.

THE C-ADD TECHNICAL SERVICES ARE COVERING THREE MAIN AREAS:

1. LABORATORY CEMENT REPRODUCTION AND TESTING
2. INDUSTRIAL MILL AUDITS AND PLANT ASSESSMENTS
3. ANALYTICAL TECHNICAL SERVICES

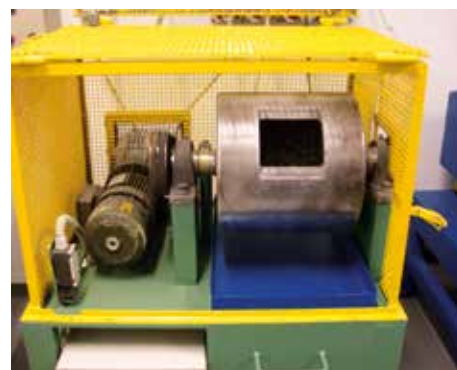
By using suitable laboratory ball mills along with operation parameters and specific grinding media designed to simulate industrial grinding we can reproduce all types of modern cements. Through a precise control of grinding time and thanks to the possibility of using different raw materials, we can perform accurate studies on the effect of composition, particle size distribution, and presence of secondary cementitious materials on cement quality.

Detailed grinding tests are frequently performed in order to compare the grindability of different clinkers and materials. The effects of thousands of cement additives formulations on fineness and coating (grinding effect) and cement hydration (chemical effect) can be thoroughly described and understood.



All modern equipment for cement quality testing is available:

- **Mechanical performance:** flexural and compressive strengths of cements can be measured in both mortar and concrete, using modern equipment (mixers, jolting apparatus, steel moulds, strengths testing machine), reference sand and aggregates.
- **Flow and mortar slump:** water demand is a very important parameter for the correct use of cement on site.
- **Setting time:** a Vicat apparatus allows the measurement of initial and final setting times in various temperature conditions. The effect of accelerating and retarding admixtures can be demonstrated.
- **Specific surface:** a very important parameter for hydraulic binder reactivity is the specific surface, defined as the cumulative surface of each particle contained in a cement mass. A modern and reliable Blaine apparatus enables the correct estimation of this value.
- **Fineness:** an air-jet sieve permits the measurement of fineness and particle size distribution.
- **Pack-set and powder flowability:** the pack-set index describes the tendency of a cement powder to flow. It is a useful parameter to predict and prevent difficulties during silo unloading or during transportation. This parameter can be strongly influenced by cement additives.

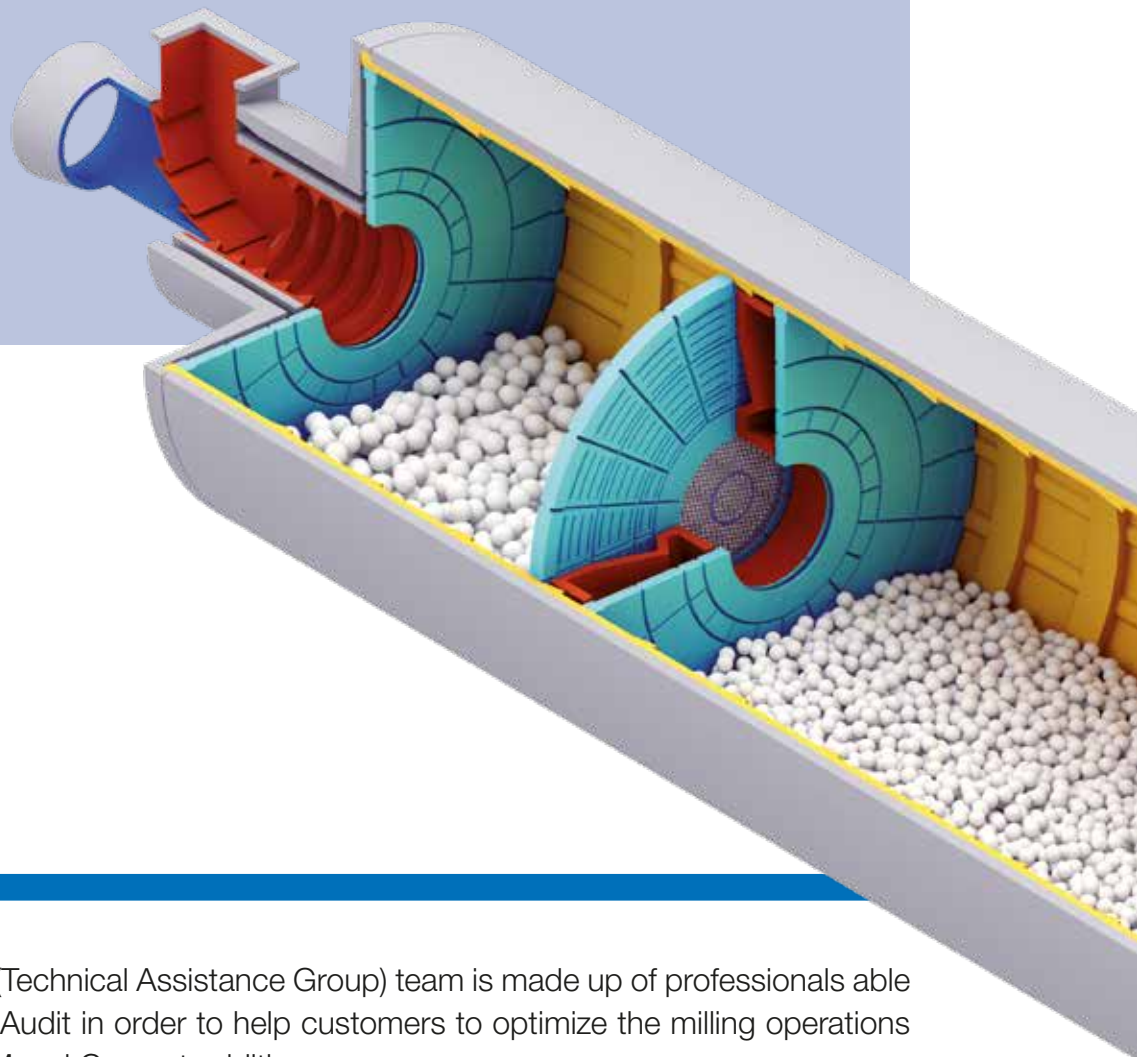


Industrial Mill Audits and Plant Assessments

WHAT IS A MILL AUDIT?

A PROCESS MILL AUDIT IS A COMPREHENSIVE CHARACTERIZATION OF A GRINDING CIRCUIT AT A SPECIFIC POINT IN TIME, WHILE OPERATING UNDER STEADY CONDITIONS.

THE AIM OF THE MILL AUDIT IS TO MAKE A FULL EVALUATION OF THE OPERATION AND CONDITION OF THE GRINDING CIRCUIT IN ORDER TO IDENTIFY AREAS OF IMPROVEMENT, PREVENT PROBLEMS AND TAKE STRATEGIC DECISIONS.



The Mapei TAG (Technical Assistance Group) team is made up of professionals able to perform Mills Audit in order to help customers to optimize the milling operations with the use of Mapei Cement additives.

OUR PLANNING

We normally need three days in the plant to perform the necessary measurements, collecting samples and data.

DAY 1. KICK-OFF MEETING:

- Safety first! Check list.
- People involved.
- Timing.

DAY 2. MILL RUNNING - AT THE MAXIMUM FEED RATE UNDER STABLE CONDITIONS:

- Dynamic Separator efficiency.
- Air flow and temperatures measurements.

DAY 3. MILL STOP - CRASH STOP CONDITIONS:

- Axial Test.
- Sampling of Clinker and all the other raw materials.

RESULTS

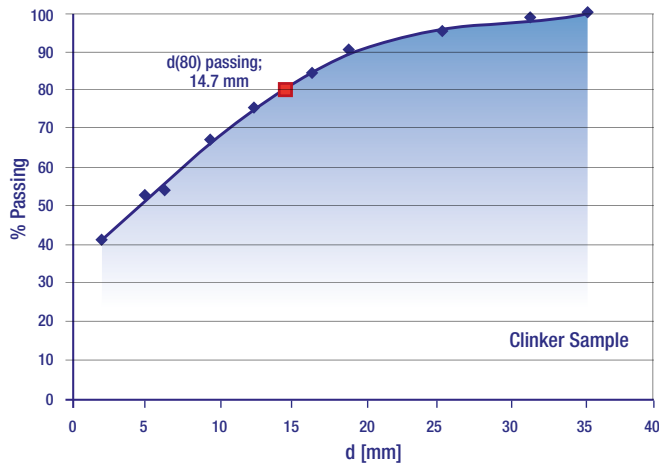
Depending on the specific plant targets, the analysis of the data will allow the plant to identify the improvement areas.



Industrial Mill Audits and Plant Assessments

1]

PARTICLE SIZE DISTRIBUTION OF RAW MATERIALS



The optimization of the ball charge, in particular of the first compartment, is crucial for the best performance of the mill.

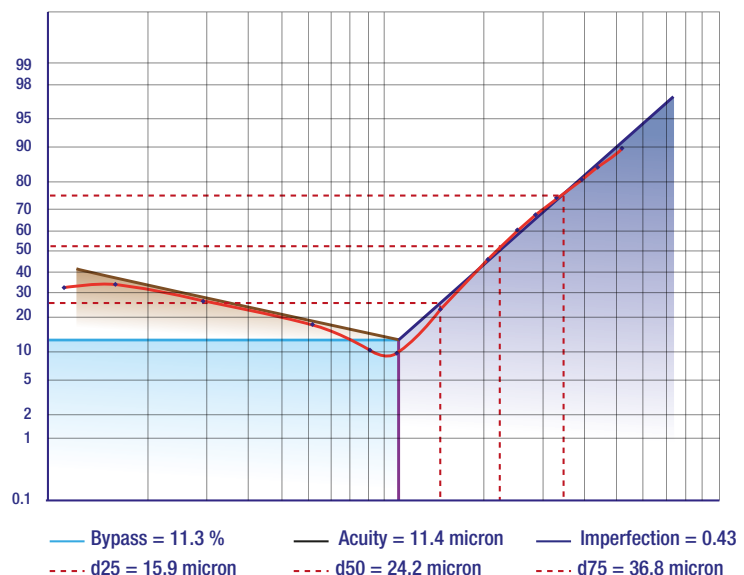
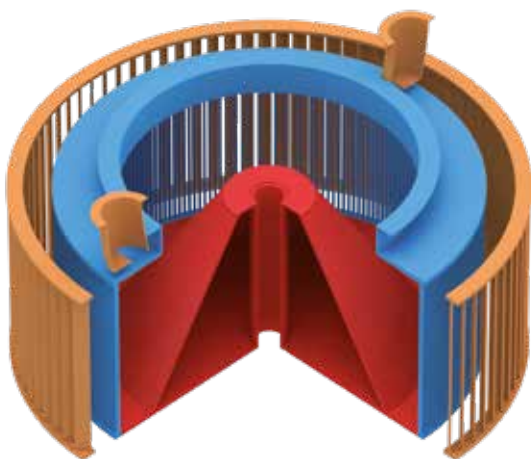
Based on the average size of the clinker particles, the distribution of the ball charge will change drastically.

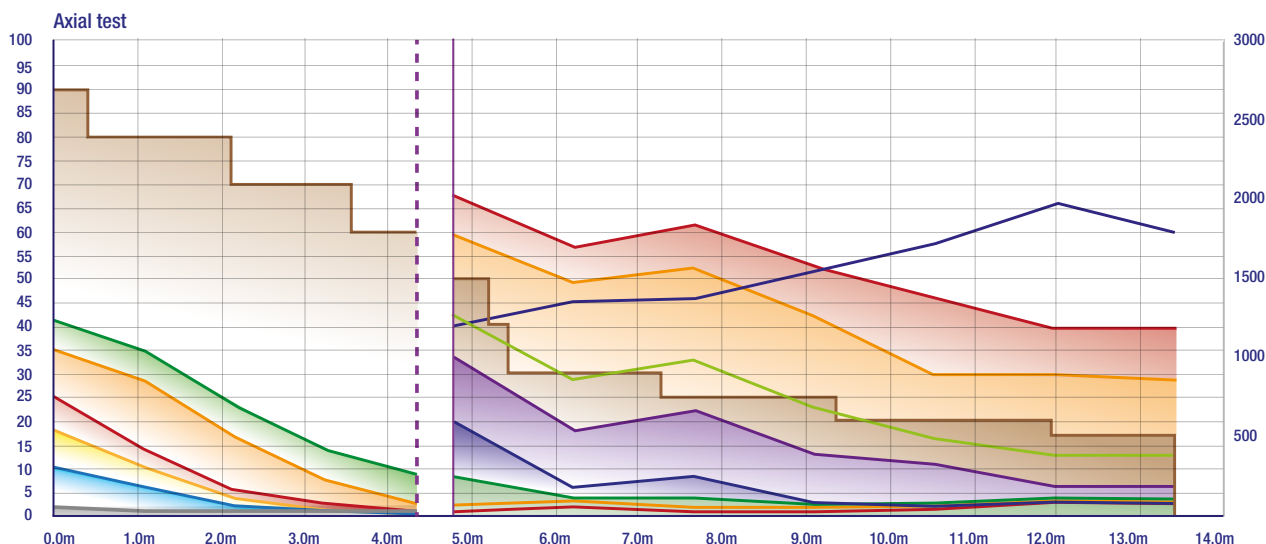
2]

TROMP CURVE

The Tromp curve defines the probability of a particle of a certain size to be rejected to the coarse stream of the separator.

It allows the determination of the separator efficiency and to define the mass balance of the grinding circuit.

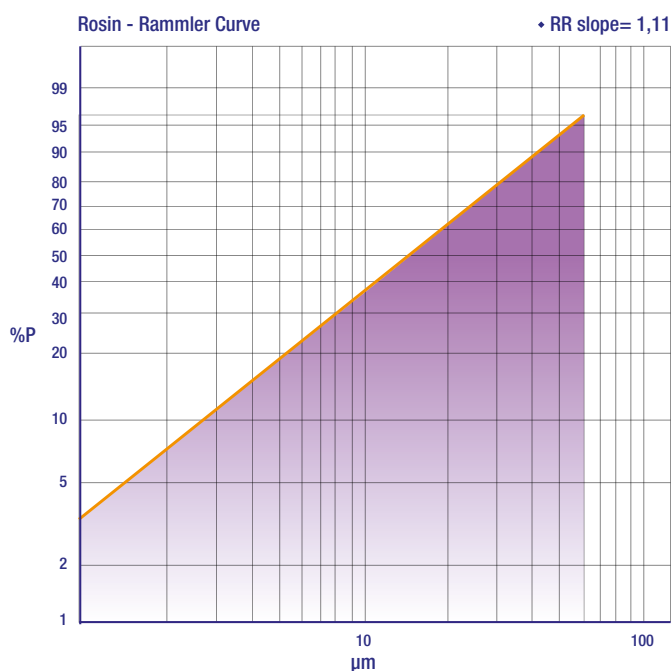




3]

AXIAL TEST

This procedure allows the plant to verify the performance and if necessary to adjust the ball charge. It is very useful to perform the Axial Test before the planned maintenance period. In this case it is possible to adjust the ball charge after analysing the results.



4]

ROSIN-RAMMLER CURVE

The Rosin-Rammler curve is a mathematical method which is used to describe the particle size distribution of the cement powder particles.

The value of the slope of the RR distribution gives important information concerning the efficiency of the grinding circuit and the quality of cement (and its effect on concrete).

Analytical Technical Services

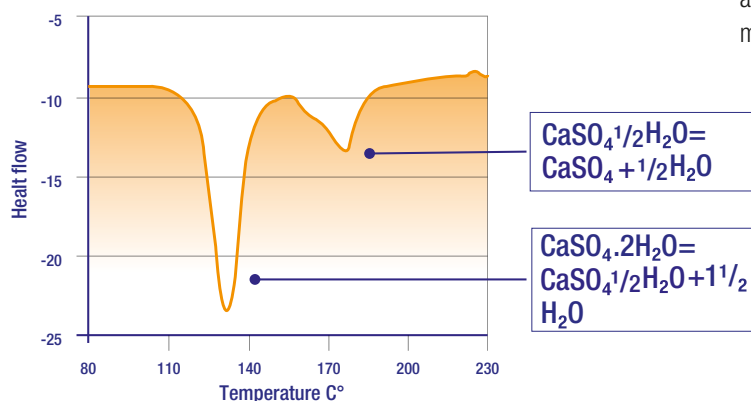
- Investigate and improve the reactivity of mineral phases in the clinker to achieve greater strength development characteristics.
- Provide services to troubleshoot cement quality issues from field applications, including abnormal concrete setting behavior, slump loss, extended strength development, discoloration and surface cracking.
- Conduct in-depth investigation on clinker mineral phases related to crystal size and its distribution, reduced condition, burning temperature, primary and secondary cooling rates, etc., and provide recommendations on the kiln operation conditions.
- Evaluate gypsum dehydration as well as sulfate balance in the finished cement product and also in the cementitious systems containing supplementary cementitious materials and chemical admixtures. Proactively assist cement users to optimize concrete mixture design to achieve optimum material combinations and reduce the risk of incompatibility.
- Provide oil-well cement expertise and support.



Differential scanning calorimeter (DSC)

Gypsum dehydration rate is an important parameter impacting cement performance. Severe gypsum dehydration can negatively affect normal cement hydration profile; change hydration kinetics; and modify cement mortar/paste flowability behavior and concrete slump characteristics, etc.

The DSC can determine gypsum dehydration rate, provide guidance on finish mill operations and predict its cement performance in concrete mixtures.





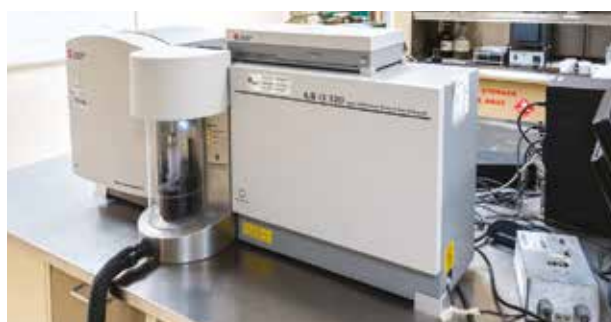
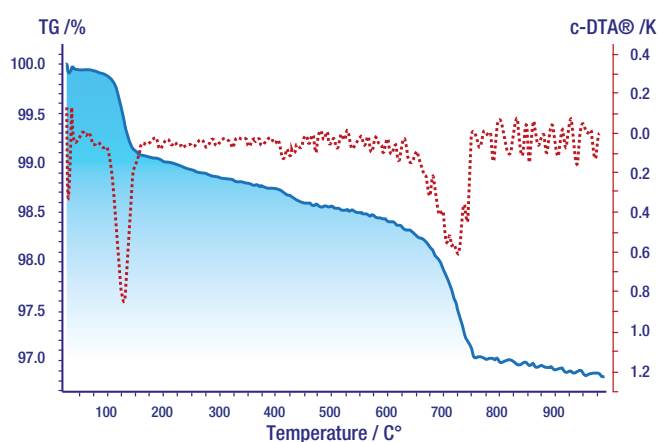
Differential thermal analysis (DTA) and thermogravimetric analysis (TGA)

Almost all the materials respond to the thermal changes.

Thermal analysis is an unique tool for determining mass and energy changes when the materials are subject to heat treatment.

During the process, cement signature characteristics - such as syngenite, calcium hydroxide and calcite - are registered and quantified.

Such information is frequently used to diagnose many issues with cementa quality, storage flowability and pre-hydration.

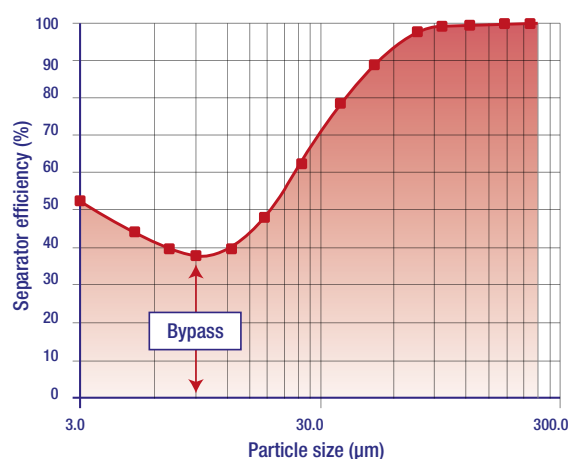


Particle size distribution (PSD) and Tromp Curve

Cement grinding is an energy-intensive process. If separator performance is not optimized, a significant amount of grinding energy is unnecessarily wasted.

Therefore, frequent evaluation of the grinding process is important to maintain cost effective finish mill operation. In addition, grinding aids play a crucial role in the separator efficiency.

A well-designed grinding aid can reduce the reject stream and minimize the bypass.

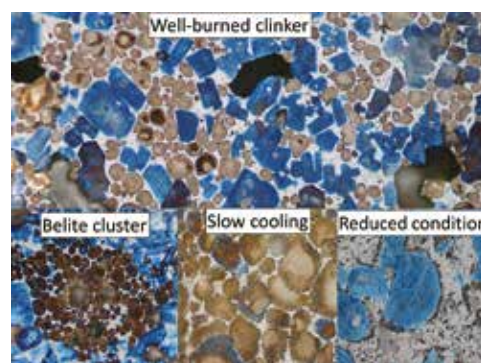


Analytical Technical Services



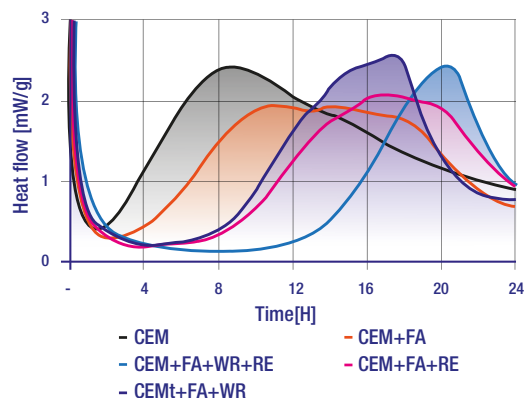
Optical microscopic analysis

Burning, cooling and process conditions of the kiln at cement plants are directly responsible for the reactivity of clinker mineral phases and the quality of cement. Optical microscopic analysis directly reveals the burning process of the clinker, including the sizes of the crystals and their distribution in the matrix, kiln atmosphere and reduced condition, burning temperature, and primary and secondary cooling rates.



Conductive Isothermal Calorimeter

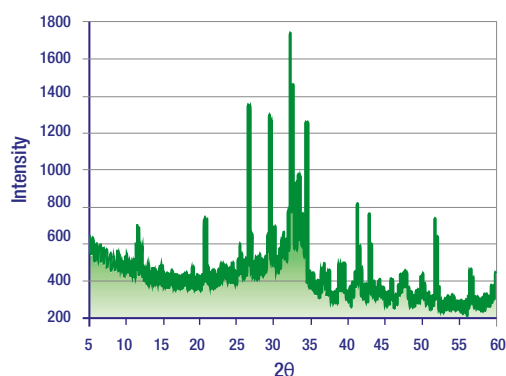
The Isothermal Calorimeter is an excellent tool to determine cement hydration kinetics and monitor the cement hydration process. The hydration profiles from calorimetric tests can predict sulfate balance, strength development potential and cement compatibility in concrete mixtures as well as helping to troubleshoot concrete performance issues in the field.





Quantitative X-Ray Diffraction analysis (QXRD)

The QXRD is an excellent tool to evaluate the mineral phases in materials. It reveals important features of cement minerals including the “true” amount of individual phases, the type of calcium sulfate, and polymorphism of calcium silicates, aluminates and ferrite. The information provides guidance to the cement processing condition. More importantly, it is a powerful tool for troubleshooting performance issues in the field.



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