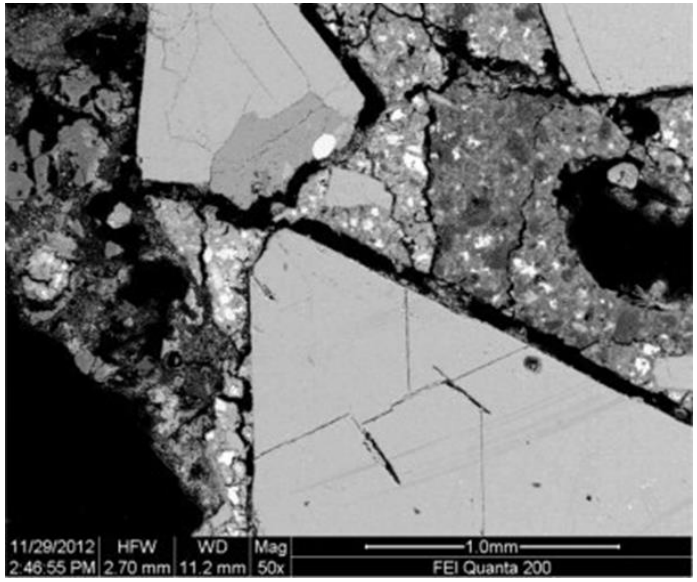


Testing of Hydration and Microstructure Characteristics

- Adiabatic and Isothermal Calorimetry
- Mercury Intrusion Porosimetry
- Pore Solution Extraction
- Optical Microscopy
- Sample Preparation Unit - SEM
- Scanning Electron Microscopy (SEM)

Adiabatic Calorimetry

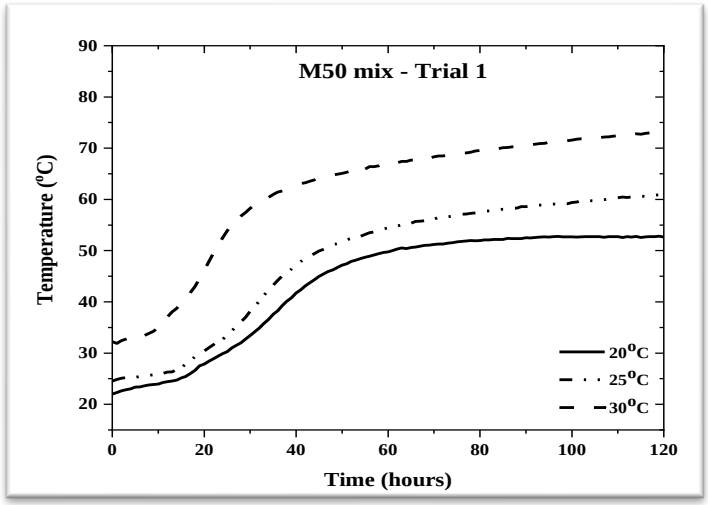
Working Principle

Temperature of the sample surroundings is maintained at the same temperature level as that of sample to prevent heat loss from the sample. The adiabatic calorimeter is used to monitor the temperature profile in concrete.

Adiabatic calorimeter

Application

The calorimeter facilitates testing of concrete mixtures to provide data for prediction of temperature rise and risk of thermal cracking in field structures.



Temperature profile of concrete placed at different temperatures

Isothermal Calorimetry

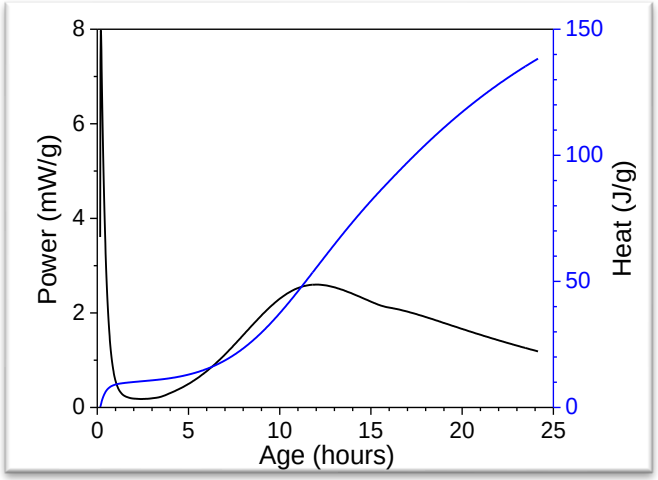
Working Principle

Isothermal calorimeter measures the heat released during cement hydration at constant temperature. I-Cal 4000 HPC from Calmetrix can be used to monitor 4 samples (up to 125 ml) simultaneously. The equipment facilitates the testing of cement past, mortar, and concrete.

Isothermal calorimeter

Application

The calorimeter is used to measure the heat of hydration and the applications can be extended to compatibility of admixtures, sulfate optimization, the hydration kinetics, and their sensitivity to temperature.



Heat of hydration (Portland cement)

Mercury Intrusion Porosimetry

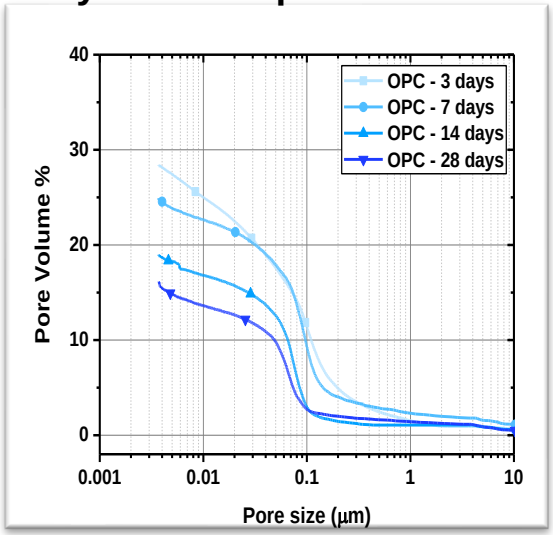
Working Principle

Mercury intrusion porosimetry (MIP) is based on the premise that a non-wetting liquid will only intrude capillaries under pressure. The relationship between the pressure and capillary diameter is described by Washburn equation.

Mercury intrusion porosimeter

Application

MIP is used to determine pore size distribution and total porosity of cement-based materials. It can be used to evaluate the durability of concrete systems.



Porosity characteristics from MIP

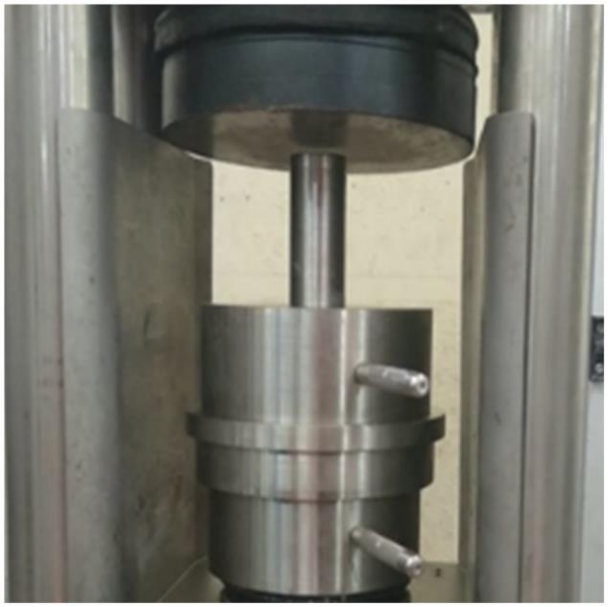
Pore Solution Extraction Device

Working Principle

Under high compressive stresses, pore solution from hardened cement paste can be extracted. Chemical composition of pore solution can be measured to understand the hydration of cement-based materials.

Application

The composition of pore solution can be used to study the influence of mineral and chemical admixtures on pore solution chemistry which directly affects the properties. Moreover, it can be used to determine the change in pH of pore solution.



Pore solution extractor

Optical Microscopy

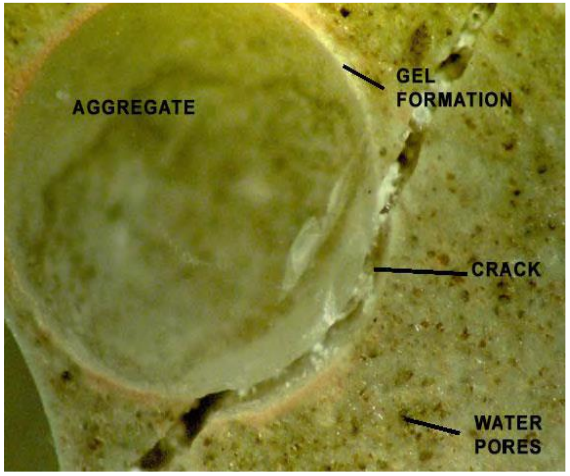
Working Principle

Light optical microscopy offers the topographical and structural characterization of a variety of sample surfaces using visible light and an array of lenses.

Optical microscopes

Application

Optical micrographs can be used to study the surface features of raw materials and cement clinker, mineral phases, ASR, voids, crack pattern.



Alkali silica reaction (ASR)

Sample Preparation Unit - SEM

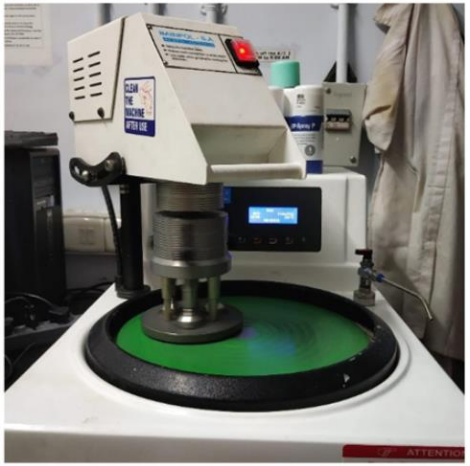
Epoxy Impregnation

Sample preparation for microstructure examination (imaging and chemical composition) of cement-based materials involves epoxy-impregnation followed by surface polishing. Epoxy-impregnation is performed under vacuum and useful in offering support to microstructure during polishing.

Epoxy impregnation under vacuum

Polishing

The polishing unit can be used to prepare various materials including raw materials, hydrated cement paste, brick, stone, and concrete.



Polishing unit

Scanning Electron Microscopy

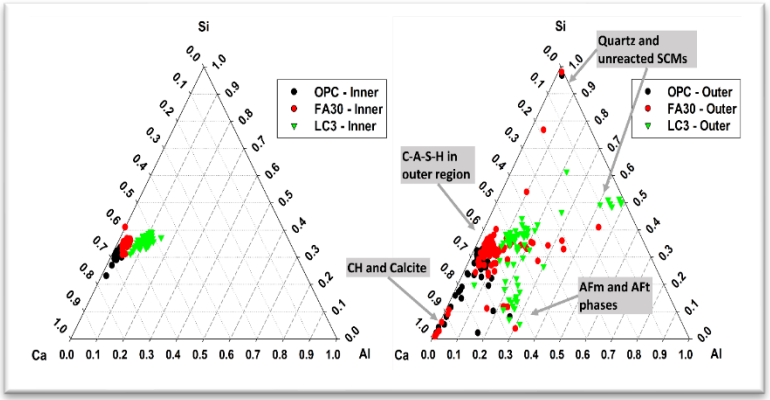
Working Principle

Interaction of electron beam and sample provides information to determine surface topography and composition of sample. EmCrafts Genesis 2000 coupled with Oxford energy-dispersive X-ray (EDX) spectroscopy device is available for microscopic imaging and chemical composition analysis.

Scanning electron microscope

Application

SEM coupled with EDX can be used for morphological and backscattered imaging of raw materials and hydrated cement matrix along with determination of chemical composition.



Chemical composition of C-A-S-H (EDX)