1. X-ray diffraction (XRD)

The phase distribution of the powders was investigated by X-ray diffraction, on a Bruker D8 ADVANCE x-ray diffractometer (figure 1). This instrument uses an x-ray tube with a Cu anode as the primary x-ray beam source. It emits 8 keV with corresponding wavelength of 1.54 Å and operates at 40 kV and 40 mA. The detector is moving as fast as the source (θ/θ set up), while the sample stay motionless. The data were collected in a 2θ range 2-72°, with step size 0.02° and time 0.2 sec per step and wereevaluated with Diffrac.Eva v3.1 software.

Bruker D8 ADVANCE x-ray diffractometer

2. Infrared Spectroscopy (FTIR-ATR)

FTIR measurements were carried out using a Fourier Transform IR spectrophotometer (Jasco 4200 Type A). The FTIR spectra, in the wavenumber range from 400 to 4000 cm^{-1} and resolution 4 cm^{-1}, were obtained by the KBr pellet technique. The pellets were prepared by pressing a mixture of the sample and dried KBr (sample: KBr approximately 1:200) at 7.5 t/cm^2. The evaluation of FTIR spectra was carried out by the use of Jasco Spectra Manager™ Suite software. The Figure 4 shows Jasco 4200 Type A spectrophotometer.

Jasco 4200 Type A FTIR spectrophotometer

3. Laser Granulometry

Particle size distribution of the samples was determined with Malvern Mastersizer, which uses laser diffraction technology. It does this by measuring the intensity of light scattered as a laser beam passes through a dispersed particulate sample. This data is then analyzed to calculate the size of the particles that created the scattering pattern All Samples were dispersed in Water under sonication.

Laser Granulometry instrument, Malvern Mastersizer Micro

4. XRF

Elemental analysis of raw material (fly ash) was conducted by the use of XRF SRS 3400 Bruker spectrometer. Different conditions are used for the detection of the elements:

- PET crystal for the detection of Al, Si and S at 30 kV & 100 mA.
- Crystal LiF200 for the detection of Ca and K at 50 kV & 60 mA.
- Crystal LiF200 for the detection of Fe at 60 kV & 50 mA.
- Crystal OVO-55 for the detection of MgO and Na at 30 kV & 100 mA.

5. Compression Strength

Compression tests were carried out on a TONI-technik uniaxial testing press, 7 days after the specimens' preparation. The load rate was set at 1.5 kN/s, according to the EN 196.1 requirements. Three specimens for each synthesis were prepared and tested under compression.

6. Atomic Absorption Spectroscopy (AAS)

AAS was used to determine the concentration of Al and Si in the solution, after the leaching of the solid paste on a Varian AA240FS.

7. Scanning Electron Microscopy (SEM)

The morphology as well as the phase stoichiometry of the samples was examined using a JEOL JSM-5600 Scanning Electron Microscope equipped with an OXFORD LINK ISIS 300 Energy Dispersive X-Ray Spectrometer (EDX). The samples were gold or graphite coated prior to measurement.

Photo of JEOL JSM-5600 Scanning Electron Microscope