Inorganic-organic Hybridfoams

By Andree Barg

Abstract

A aim of this work was to develop a new hybrid-mineral foam with a ceramic structure on the basis of inorganic and organic components. The inorganic compound, carrying an alumosilicate structure similar to zeolite, was used to give the foam a good mechanical stability, while the organic compound should take care of a hydrophobic behaviour and for a decrease of the brittleness. The basis to built the alumosilicate was the reaction between an aluminiumsilicate solid (metacaolin) with a high chemical activity and waterglas. First the aluminium from the metacaolin is dissolved by the alkali hydroxides to form $[Al(OH)_6]^{3-}$. After the amount of solved $[Al(OH)_6]^{3-}$ increases the formation of the alumosilicate starts. While the inorganic reaction takes place, the mixture is foamed by the decomposition of hydrogen peroxide to oxygen and water.

The ^{29}Si-NMR and ^{27}Al-NMR-Spectroscopy were in the centre of the research methods, using solution and solid-state technics (MAS, CP-MAS). It is a very useful way to investigate the molecular changes during the reaction process.

In combination with the NMR-Spectroscopy the FTIR was used to supplement and to verify the structure found by NMR.

With the help of the Magnetic Resonance Imaging (MRI) technology three-dimensional illustrations of the samples could be provided, which form a basis for computer-assisted evaluations. (MRI).

The DSC (Diffential Scanning Calorimetry) is with the determination of the reaction enthalpy and the transformation temperature of the different components a large assistance.

The results obtained from the different measurements were used with success in the development of the hybridfoams. Different possibilities could be found by suitable foam stabilizers to steering the foam structure of the product. In this way different application types, e.g. as heat insulator or acoustic absorbers, were made accessible for the foams.

By the modification with organosilans we have achieved a high hydrophobic property of the entire foam body. The combination with organic polymers leads to samples with a flexible character under reduction of the stability against high temperature.