Abstract:

The German Institute for Construction Technology, (DIBt), has worked out a new Technical Approval Guideline for joint sealing compounds used in plants that deal with water contaminating substances (i.e. pure chemical liquids or mixtures thereof), so-called „LAU Facilities“. These Technical Approval Guidelines imply the use of successive loading in form of a cyclic expansion at –20°C, a cyclic compression at +50°C as well as a cyclic shearing at –20°C at joints with parallel faces. The goal of this research project was to verify whether examination of specimens with parallel faces allows conclusions on the material behavior of specimens with crossed joints.

This study was conducted using four joint sealing compounds which have a technical approval for construction applications dealing with water contaminating substances. In verbal agreement with the DIBt, all specimens were loaded to identical deformations, independent of the expansion capability defined by their technical approval. The examinations were carried out with a novel testing device which was developed during this research project. The testing device was supported financially by the DIBt.

The Technical Approval Guideline includes visual evaluation of the joint sealing material after testing. Specimens made from three of the four examined materials did not show any failure after the cyclic tests. Some specimens of the fourth material showed cohesion failure. The deformation examined on this material was greater than the allowed deformation capability.

Cohesion failure was observed near the corners and the faces. There was no adhesion failure at the faces. In situations where failure of the crossed joints was noted parallel faces had also failed.

For two materials the traction tests with the FEA–program ANSYS were checked. The phenomenological based models after Mooney–Rivlin, Yeoh, and Ogden were used for getting the hyper–elastic material behavior. With consideration of the compressibility the stress–stretch–curves obtained in the tests can be forecasted by FEA with good correlation. The simulations show that local stress peaks arise in the range of the corners and in direct proximity of the joint flanks. Stretching the parallel joint around the factor 2 more strongly than the cross joint produces locally the same principle stress S1 in both joints.

The Technical Approval Guideline calls for a factor of 1.5. The simulations confirm this with regard to the entire specimen.