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Development of a New Testing Method for a Time-lapsed Analysis of Environmental Stress Cracking in Polymers

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The ageing mechanisms of plastics subjected to the combined stresses of mechanical load and influence of a medium are very complex. Present-day tests of plastic media resistance require very long testing periods. The creep test is the most common testing method. This process involves charging plastic samples with a constant load. The samples have to be exposed to a medium until the parts fail. The only obtainable result is the time to failure. Evaluation of crack initiation or crack growth is not possible.

This is why a new testing method, the short-term media tensile test, has been developed. The new testing equipment makes it possible to observe and analyse the process of crack initiation and crack growth. This crack observation is supported by use of a digital camera. This crack-growth information can be combined with the determined stress/strain properties. This allows a correlation to be found between the optical and mechanical measurement.

The implementation of the test system on a short-term tensile testing machine aims to reduce the cost of testing. The right choice of the boundary conditions leads to a reduction of the testing period. The greatest success seems to be achievable by a concerted variation of the load application. Samples can be loaded under the aspects of stress regulation, strain regulation or further aspects. Depending on the load case, the failure will appear in various forms and this is why typical originalities can be assigned with the load case. These results provide the basis for a further substantial development of an accelerated test concerning the influence of media on plastic.