Abstract

The presented work contributes to the durability prediction of the pressure vessel components considering both the real loading and the fatigue process including the on-the-crack closure behaviour based sequence effects.

In the first, part the existing fatigue strength concepts and their possible application within the construction of apparatus are explained. In particular, the local fracture mechanics concepts are discussed in detail. Afterwards a summary of the established damage accumulation hypothesis and possible loading cases is provided.

In the second part, the fatigue strength of the welded joints is covered, whereby the conceptual differences between the calculation of the untreated and treated welded joints are pointed out. The determination of the material properties of the treated welded joints receives particular attention. At the end, a closed concept is proposed which covers the fatigue problems discussed and which considers the real damage processes. The necessity of the methodical separation of the untreated and treated welded joints is clearly emphasised in this connexion.

In the third, part numerical pre-investigations are performed. From these, the following recommendations are discussed regarding the specifications on model, discretisation and material. A general approach to numerical investigations of such problems completes this chapter.

In the last part, four different calculation examples are introduced and compared with the existing experimental results. It should give a closed picture about the application possibilities of the method used in this work. The experimental results were an integral part of the DFG-Project No: 0722097 [1].

A qualitative improvement of the lifetime prediction of the untreated and treated welded joints, as well as increasing the safety in the apparatus construction represent the aspired target of this work. The evaluation, adaptation and application of the existing local fatigue concepts, combined with using elastic and elastic-plastic FE-Analyses, make this target possible.