

Qualification and lifetime modelling of fibreglass pipe

Abstract

Procedures for qualifying fibreglass pipes are discussed here in relation to industry needs. The ultimate elastic wall stress (UEWS) test appears to provide an efficient means of rating pressure pipe, and indeed vessels, for the case where weepage failure occurs resulting from the accumulation of matrix cracks. The principle behind the UEWS test is to identify, from the pressure-strain response, a pressure level below which damage growth is either negligible or at least sufficiently low to avoid failure within the design life. The version of the UEWS test most often used involves the application of groups of 10 one-minute pressure cycles at increasing pressure values, recording the hoop or axial strain. The onset of non-linearity in the pressure-strain relationship can be accurately determined and enables a safe long term pressure level to be identified. The UEWS test appears to provide a desirable alternative to the currently used procedure laid down in ISO 14692, which involves an expensive series of long term constant pressure tests, as described in ASTM 2992, running for a period in excess of 10 000 h. It is shown here that the UEWS test reflects the cyclic fatigue behaviour of fibreglass pipe, but further work on the relationship between cyclic and static behaviour would be desirable. It has been shown that a Miner's law approach is effective in modelling damage due to combined static and cyclic effects, and that damage can be directly related to matrix crack growth. This approach could form the basis of a future procedure for describing lifetime behaviour of glass reinforced epoxy pipes under any required combination of static, fatigue, hydrostatic and non-hydrostatic (multiaxial) loading.

Keywords — Fatigue behavior, fibreglass pipe, matrix cracks, uews test, weepage