Fundamental examination of a new concept of safety surveillance and interactive determination of safe service life for composite pressure vessels by destructive tests parallel to operation

Abstract

First we have to realise that due to composite material’s degradation under static loads (static fatigue) there is no possibility for designing a composite pressure vessel for an unlimited service life. But this in not reflected in relevant standards which, on the one hand, enables an unlimited life without, on the other hand, providing tools for retesting, that allows to reject pressure vessels or prevent further use as it is well known for metallic vessels.

Since we have recognised that the periodic inspection including hydraulic tests – with the exception of visual inspection concerning damage of the outer surface – seams to be an expensive tool with an unclear functionality concerning rejection before end of safe service life.

As consequence a tool is needed that allows limiting the life time to the appropriate end of life – not too conservative and not too careless. Considering this it is recommended to use an approach which allows combining the retesting with the assessment of residual life time. Since relevant approaches based on NDT-methods as e. g. acoustic emission are currently not developed enough this leads to a concept of destructive tests of composite pressure vessels parallel to operation.

This concept and its fundamental ideas beyond are described here visualised by some schematic diagrams. As result there is an approach for the substitution of the more harming than assisting periodical retesting of each vessel which allow predicting the adequate end of safe service life by destructive tests parallel to operation in combination with e. g. an improved inspection before filling.