Predicting the Remaining Life of Carbon Steel Studs at Flange Joints

P T Wilson/Corrosion Risk Management Pty Ltd, Melbourne/Australia;

An assessment programme to determine the optimum life before replacement has been completed for studs and nuts at a gas / condensate processing plant located approximately 10 kilometres from the coast. The corrosivity of the location was firstly evaluated with monthly measurements of salt deposition using ISO 9225 salt candles positioned at the edge of the plant and within plant vessels and piping over a period of 1 year. The studs and nuts included unprotected steel meeting the specification ASTM A320 L7 and hot spun galvanised protection to ASTM A153.

This atmospheric corrosivity rating study was used to classify the average corrosivity of the site and the possible range of corrosion rates. These results lead to an initial estimate of remaining life and was used to justify a limited replacement programme.

The second stage of the assessment programme was to establish from a limited sampling of the total population of nuts and studs the parameters that influenced the extent of loss of section. Studs were positioned in both a horizontal and vertical flange orientation. The apparent condition of the studs and nuts external to the flanges could be assessed visually without removal from the flange. However the section of the stud within the flange could not be assessed without removal from the flange, using either a hot bolting procedure or during shutdown of the plant at a scheduled inspection. With a flange having a horizontal orientation the occluded space within the flange was not free draining. This assessment programme was part of a larger programme which has the objective of extending the interval between maintenance shut downs.

The parameters used to classify the total population of studs and nuts were the operating temperature, the flange orientation (vertical or horizontal), elevation above ground, sheltered or not sheltered by pressure vessels. The condition of the remaining studs within the plant including an estimate of the maximum loss of section was estimated using extreme value statistics. The programme provided confidence in the condition of the studs and nuts in the plant and allowed a planned programme of replacement.