ABSTRACT

Erosion-corrosion on ash lock internal surfaces means that these equipment are continuously refurbished through weld build-up, followed by post weld heat treatment (PWHT). The deterioration of mechanical properties of the ash locks after numerous PWHT cycles has been a concern. A graphical prediction model based on experimental work on this material grade has been derived previously to predict the mechanical properties after a number of PWHT cycles. The validity of the model was, however, questioned. Ash lock, 210AL-3401, was scrapped for the purpose of testing the effect of several PWHT cycles on the mechanical properties and microstructure to determine whether the current model is valid or needs to be optimised.

Test samples of the ASTM A 302 Grade B manganese-molybdenum material were cut from the shell and top dome parent metal and shell-to-dome weld of the test ash lock and subjected to a number of additional simulated PWHT cycles with holding times ranging from 2 to 100 hours. This was followed by mechanical testing, i.e. tension -, hardness - and Charpy V-notch impact testing, in accordance with SA-370, and metallographic examination after each PWHT cycle.

Test results showed that actual measured tensile properties for the shell and dome samples were generally higher than what was predicted by the current model and, similar to hardness, followed an overall downward trend with increasing PWHT cycles for the shell, dome and weld. Impact toughness for the shell and dome was mostly above the minimum required values, but after 100 hours of additional PWHT impact toughness was below the minimum required values when tested at 0°C and above minimum required values when tested at higher temperatures. Impact toughness for the shell-to-dome weld showed an overall increase with increasing PWHT. Metallographic examination showed an overall increase in quantity and size of molybdenum carbides and spheroidisation of the cementite phase for the shell and dome samples with increasing PWHT. Significant coarsening of the carbides together with an increase in the level of spheroidisation resulted in a rapid decrease in tensile properties and impact toughness with increasing PWHT. Similar effects were observed on the microstructure of the weld samples, but no significant effect on impact toughness was observed.