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STRESS CORROSION CRACKING OF COPPER-MANGANESE ALLOYS - EFFECT OF SOME CHEMICAL VARIABLES (*)

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Copper-manganese alloys, like a few other copper alloys, exhibit stress corrosion cracking in ammonia atmosphere, also they give cracking in Mattsson's solution which is a solution of copper sulphate, ammonium sulphate and ammonium hydroxide. Four compositions of copper-manganese alloys in their homogeneous solid solution range, containing 8 to 23 percent manganese, have been tested under varying conditions of Mattsson's solution in respect of pH and copper content for an assessment of the effect of these variables on the stress corrosion behaviour of these alloys.

The samples have been used in the wire form and tested under constant tensile load. Tested in pH range of 5.0-8.5 all the alloys show minimum in cracking time versus pH plots. This minimum is attained around pH 6.6 - 6.8. Another drop in cracking time has been indicated above pH 8.0. Decrease in copper content of the solution increases the cracking time the effect of which is more pronounced at the lower values of copper content. A transition in cracking mode from inter to transgranular has been observed with a increase of manganese content of the alloy to 15% atomic percent. Transition has been found also to be pH-dependent in this alloy.

Dissolution of metal guides the crack initiation; crack propagation may also be as largely dependent on dissolution if the cracking process is viewed to be purely electrochemical. A discussion of the possible dissolution reaction involving copper and manganese in Mattsson's solutions shows the importance of copper (II) - ammine complexes in these reactions. The effect of variation in copper content on cracking time can be explained in these terms.

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Effect of pH, on the other hand, is more complicated The rise in cracking time at higher pH after the observed minimum cannot be explained in the simple term of ease of complex formation. It is proposed that the nature of film formed on the surface is more important and at some critical value pH this gives the most favourable morphology leading to the formation of a crack nucleus. Potential measurements at different pH support this view to some extent.

Transition in cracking mode from inter to transgranular can be explained in the light of shift of reactive sites from grain boundaries to grain interior which is an outcome of alloying effect itself. The pH dependence of transition is a result of slight change of boundary and matrix potentials the difference in which is deemed to provide the driving force in the dissolution process.

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