Modelling the Diffusion of Alloying Elements from Bulk Steel into Molten Copper During Brazing

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Brazing as a joining phenomenon was known to mankind since the time immemorial. Industrial significance of brazing was explored in the last half of 20th century for various applications like joint fabrication for heat exchangers, electronic packaging and other structural machinery. This increase in the usage has brought in scientific interest among the academia around the world to make it a viable research area. Although Cu is the first choice of material for brazing, new alloys with significantly lower eutectic temperatures were being developed every day. In our experiment, we deal with brazing of stainless steel (EN 1.4034) with Cu as braze filler at various holding times. Main problem with brazed joints is the efficiency and operational life of joints in the long run. One point of view in this regard is the diffusion of various alloying elements present in the stainless steel into the liquid filler layer under the applied temperature. This diffusion results in formation of precipitates in the filler layer which condense upon cooling and cause cracking in the joint leading directly to its failure. It is a very dangerous for the overall life of such brazed joints and the one we discovered in our study. The diffusion of alloying elements like Cr and Mn into brazed joint were observed in our system when 1.4034 steel was brazed with Cu filler in a sandwich. This resulted in formation of Fe, Cr and MnS precipitates in the middle of copper layer when the system was cooled down to room temperature. The study was modelled using various solutions predicted from Fick's second law of diffusion [1] and diffusion coefficients are calculated from [2].

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[1] Poirier, D. R., & Geiger, G. (Eds.). (2016). *Transport phenomena in materials processing*. Springer.

[2] Iida, T., & Guthrie, R. I. (2016). *The Thermophysical Properties of Metallic Liquids: Volume 2: Predictive models*. OUP Oxford.