Modeling Of Selective Oxidation P91 Steel

M.Danielewski[1], R.Filipek[1] and B. Kucharska[2]

[1]AGH University of Science and Technology ,
al. Mickiewicza 30, 30-059 Cracow, Poland
[1] Technical University of Czestochowa, ul. Armii
Krajowej 19, 42-200 Czestochowa, Poland

We use the extended model of selective and competitive oxidation of multi-component alloys. The model bases on the generalized Darken method of interdiffusion in multi-component solid solutions. To avoid the nonphysical values of fluxes in reacting alloy we introduce the kinetic constraint on all fluxes. This method known as "flux limitation" avoids numerical non-stabilities, speeds up the computation time and gives good agreement with experimental results.

This model enables to predict the evolution of component distributions in reacting alloy. The model is valid for time dependent boundary conditions and consequently can be used to model the more complex reactions, eg., the formation of complex oxides. The results of the selective oxidation of the P91 steel (0,1 wt.% C, 8,6 wt.% Cr, 0,25 wt.% Ni) are presented. Calculated concentration profiles are compared with the experimental data. The satisfactory agreement allows conclude that the oxidation reaction is limited by inter-diffusion in reacting alloy.

We show the evolution of chromium distribution in oxidizing steel up to 100 000 hours. The computations demonstrate that chromium depletion is the key factor determining the scale composition.