Thermodynamic Investigation of Cement Corrosion due to Delayed Ettringite Formation

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The simple thermodynamic model for predicting the equilibrium phase assemblage in system $3CaO \cdot Al_2O_3 – CaSO_4 \cdot 2H_2O – Ca(OH)_2 – H_2O$ in a temperature interval 0 – 100 ^oC is described. The model is based on minimization of Gibbs potential of total chemical reaction in considered system.

It is established, that at lack of water the calcium hydroaluminate $4CaO \cdot Al_2O_3 \cdot 19H_2O$ and ettringite $3CaO \cdot Al_2O_3 \cdot 3CaSO_4 \cdot 32H_2O$ pass in less water contained hydrates $4CaO \cdot Al_2O_3 \cdot 13H_2O$, $3CaO \cdot Al_2O_3 \cdot 6H_2O$ and $3CaO \cdot Al_2O_3 \cdot CaSO_4 \cdot 12H_2O$. At repeated humidification of hardening cement such phases turn again to more stable in given conditions $4CaO \cdot Al_2O_3 \cdot 19H_2O$ and ettringite. This transformation is accompanied by substantial growth of volume of a solid phase that is the probable reason of destruction of a cement stone. It is established, that for reduction of risk of corrosion owing to DEF it is necessary to slow down the processes of moisture exchange in hydrated cement.