

# MSE200-002, Chapter 9

## Homework solutions

**9.12.**  $C_0 = 0.65\%$ ,  $T = 723^\circ\text{C} + \Delta T$ ,  $C_\alpha = 0.02\%$ ,  $C_\gamma = 0.8\%$ ,  
 $X_\alpha = (0.8\% - 0.65\%) / (0.8\% - 0.02\%) = 19.2\%$ ,  $X_\gamma = 1 - X_\alpha = 80.8\%$

**9.13.**  $C_0 = 0.25\%$ ,  $T = 723^\circ\text{C} - \Delta T$ ,  $C_\alpha = 0.02\%$ ,  $C_\gamma = 0.8\%$ ,  
(a)  $X_\alpha = (0.8\% - 0.25\%) / (0.8\% - 0.02\%) = 70.5\%$ ,  $X_{\text{pearlit}} = 1 - X_\alpha = 29.5\%$   
(b)  $X(\text{eutectoid ferrite}) = X_{\text{pearlit}} (6.67\% - 0.8\%) / (6.67\% - 0.02\%) = 26.0\%$   
 $X(\text{eutectoid cementite}) = X_{\text{pearlit}} (0.8\% - 0.02\%) / (6.67\% - 0.02\%) = 3.5\%$

**9.14.**  $C_{\text{Ferrite}} = 0\% \text{ C}$ ,  $C_{\text{Cementite}} = 6.67\% \text{ C}$ ,  $X_{\text{Cementite}} = 7\%$ , find  $C_0$   
 $X_{\text{Cementite}} = (C_0 - 0) / (6.67\% - 0) = 7\%$ ,  $C_0 = 0.467\% \text{ C}$

**9.15.**  $C_\alpha = 0.02\%$ ,  $C_\gamma = 0.8\%$ ,  $X_\alpha = 45\%$ , find  $C_0$   
 $X_\alpha = (0.8\% - C_0) / (0.8\% - 0.02\%) = 45\%$ ,  $C_0 = 0.449\% \text{ C}$

**9.16.**  $C_\alpha = 0.02\%$ ,  $C_\gamma = 0.8\%$ ,  $X_\alpha = 5.9\%$ , find  $C_0$   
 $X_\alpha = (0.8\% - C_0) / (0.8\% - 0.02\%) = 5.9\%$ ,  $C_0 = 0.754\% \text{ C}$

**9.21.**  $C_\alpha = 0.02\%$ ,  $C_\gamma = 0.8\%$ ,  $X_\alpha = 20\%$ , find  $C_0$   
 $X_\alpha = (0.8\% - C_0) / (0.8\% - 0.02\%) = 20\%$ ,  $C_0 = 0.644\% \text{ C}$

**9.22.**  $C_0 = 0.55\%$ ,  $T = 723^\circ\text{C} - \Delta T$ ,  $C_\alpha = 0.02\%$ ,  $C_\gamma = 0.8\%$ ,  
(a)  $X_\alpha = (0.8\% - 0.55\%) / (0.8\% - 0.02\%) = 32.1\%$ ,  
(b)  $X_{\text{pearlit}} = 1 - X_\alpha = 67.9\%$   
 $X(\text{eutectoid ferrite}) = X_{\text{pearlit}} (6.67\% - 0.8\%) / (6.67\% - 0.02\%) = 59.9\%$   
 $X(\text{eutectoid cementite}) = X_{\text{pearlit}} (0.8\% - 0.02\%) / (6.67\% - 0.02\%) = 8.0\%$

**9.25.**  $C_0 = 1.10\%$ ,  $T = 723^\circ\text{C} - \Delta T$ ,  $C_{\text{cementite}} = 6.67\%$ ,  $C_\gamma = 0.8\%$ ,  
(a)  $X_{\text{preeutectid cementite}} = (1.10\% - 0.8\%) / (6.67\% - 0.8\%) = 5.1\%$ ,  
(b)  $X_{\text{pearlit}} = 1 - X_{\text{preeutectid cementite}} = 94.9\%$   
 $X(\text{eutectoid ferrite}) = X_{\text{pearlit}} (6.67\% - 0.8\%) / (6.67\% - 0.02\%) = 83.8\%$   
 $X(\text{eutectoid cementite}) = X_{\text{pearlit}} (0.8\% - 0.02\%) / (6.67\% - 0.02\%) = 11.1\%$

9.52. a) Martensite; b) quench + tempering; c) Pearlite structure (similar to the structure with hardness Rc5), isothermal transformation; forget d, e, f