HW #6

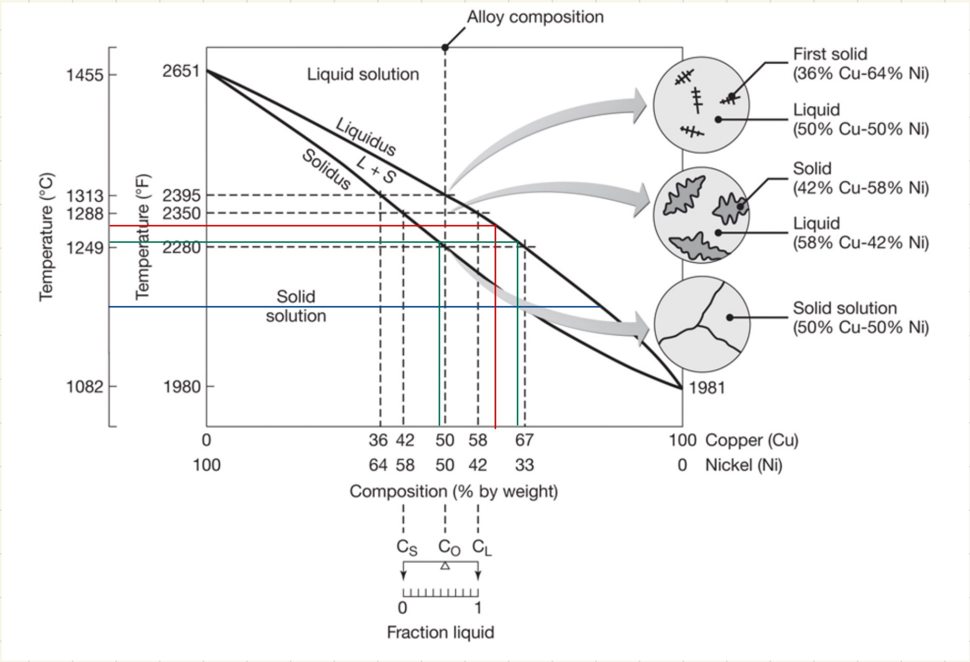
5.19 It has long been observed by foundry-men that low pouring temperatures, i.e., low superheat, promote equiaxed grains over columnar grains. Also, equiaxed grains become finer as the pouring temperature decreases. Explain these phenomena.

This phenomena is as a result of the ambient or slightly elevated temperature at the mold wall. This causes the casting to develop solidified skin of fine equiaxed grains.

5.24 In a sand-casting operation, what factors determine the time at which you would remove the casting from the mold?

1. Mold design
2. Thermal Conductivity
3. Degree of Super heat
4. Rate of pouring
5. Heat transfer.

5.61 Using **Fig. 5.3**, estimate the following quantities for a 60% Cu-40% Ni alloy: (a) liquidus temperature; (b) solidus temperature; (c) percentage of nickel in the liquid at 1250°C (2550°F); (d) the major phase at 1250°C; and (e) the ratio of solid to liquid at 1250°C.



from Fig. 5.3

a) Using $T_{L,67\%Cu} = 1249°C$

$T_{L,58\%Cu} = 1288°C$

@ 60% by interpolation:
$$\frac{.67 - .58}{.60 - .58} = \frac{1249 - 1288}{T_{60} - 1288}$$

$$-.78 = 0.09(T_{60} - 1288)$$

$$-8.67 = T_{60} - 1288$$

$$T_{L,60} = 1279°C$$

b) Using $T_{S,67\%Cu} = 1175°C$

$T_{S,58\%Cu} = 1220°C$

@ 60% by interpolation:
$$\frac{.67 - .58}{.60 - .58} = \frac{1175 - 1220}{T_{60} - 1220}$$

$$-0.90 = 0.09(T_{60} - 1220)$$

$$-10 = T_{60} - 1220$$

$$T_{S,60} = 1210°C$$

c) Percentage of Nickel in the liquid @ 1250°C

from plot, $C_S \approx 52\%$

$C_L \approx 35\%$

using eqn (5.1)

$$\frac{C_0 - C_L}{C_S - C_L} = \frac{0.4 - .35}{.52 - .35} = 0.294$$

$$\approx 29\%$$

d) major phase at 1250°C is Liquid as the composition is higher

e) The ratio of Solid to liquid at 1250°C

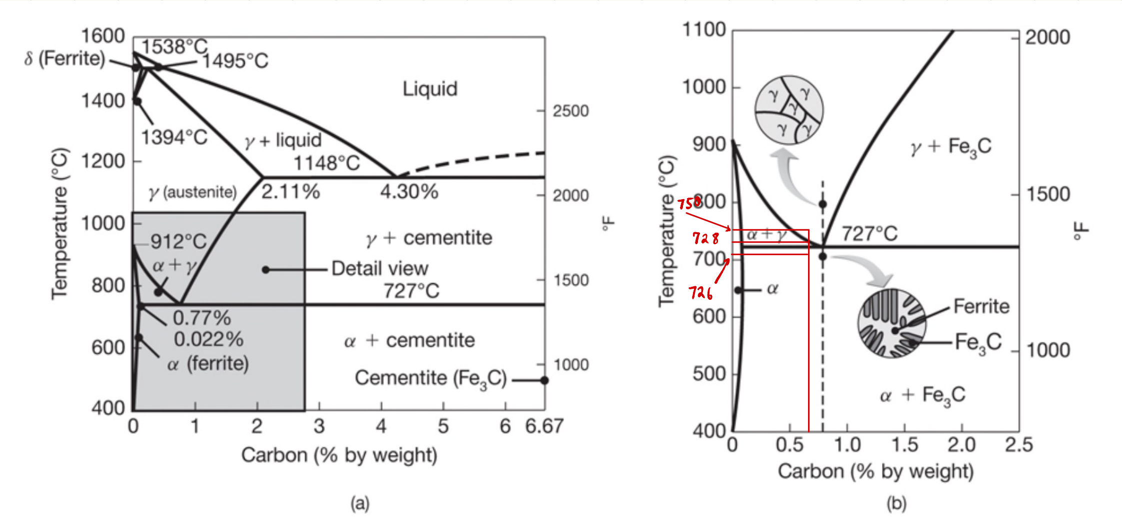
$$\text{Weight fraction of liquid} = \frac{.65 - .60}{.65 - .48} = 0.4167$$

or 41%

$$\text{Solid to liquid ratio} = 1 - .4167$$

$$= .58$$

5.62 Determine the amount of gamma and alpha phases (**Fig. 5.4b**) in a 10-kg, 1060 steel casting as it is being cooled to the following temperatures: (a) 750 ° C; (b) 728 ° C; and (c) 726 ° C.



a. Refering to Fig 5.4b, a Vertical line is drawn at 0.60% C @ 750°C. This is in the Single-phase austenite region, so the percent gamma is 100% (10 kg) and the percent alpha is zero.

b. At 728°C, the alloy will be in the two phase gamma-alpha field.

$$\text{percent alpha} = \left(\frac{C_\gamma - C_0}{C_\gamma - C_\alpha}\right) * 100\% = \left(\frac{0.77 - 0.60}{0.77 - 0.22}\right) * 100\% = 30.9\%$$

$$\text{percent alpha} = \left(\frac{C_0 - C_\alpha}{C_\gamma - C_\alpha}\right) * 100\% = \left(\frac{0.60 - 0.22}{0.77 - 0.22}\right) * 100\% = 69.1\%$$

c. At 726°C, the alloy will be in the two-phase alpha and Fe_3C region.

$$\text{percent alpha} = \left(\frac{6.67 - 0.60}{6.67 - 0.22}\right) * 100\% = 94.1\%$$