



IIT ROORKEE



NPTEL ONLINE
CERTIFICATION COURSE

MELTING AND CASTING OF CAST METALS

Foundry Practice for Production of Gray Iron

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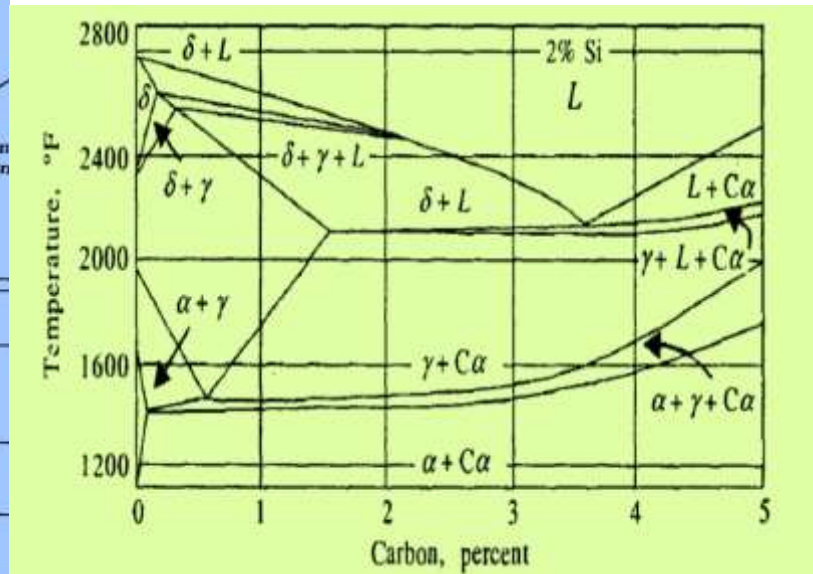
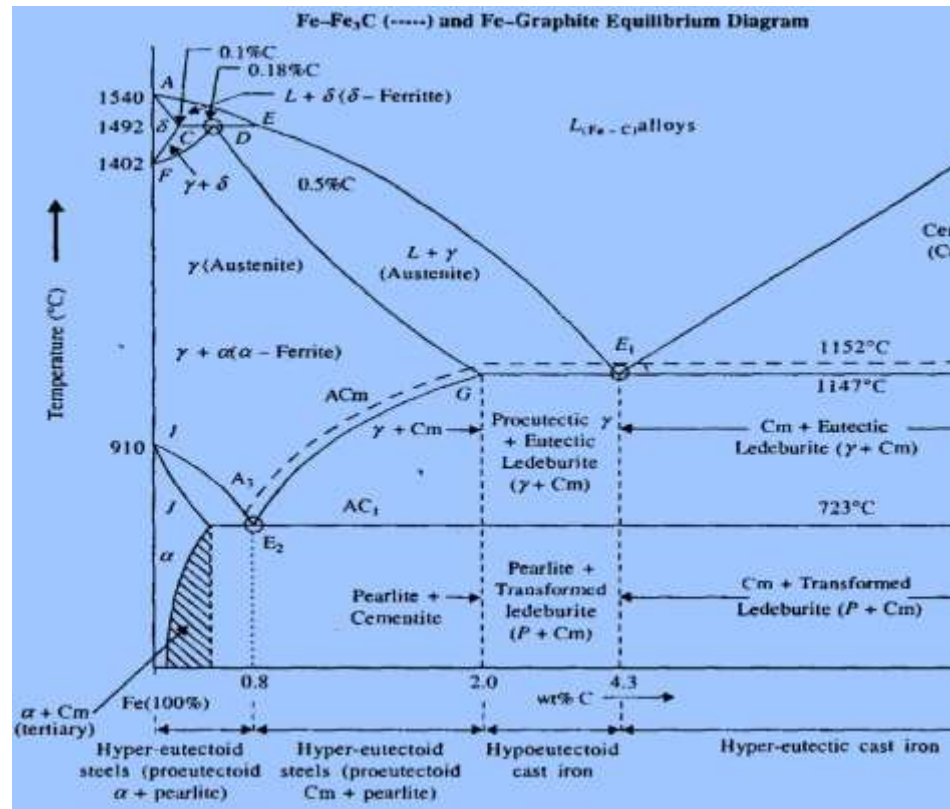
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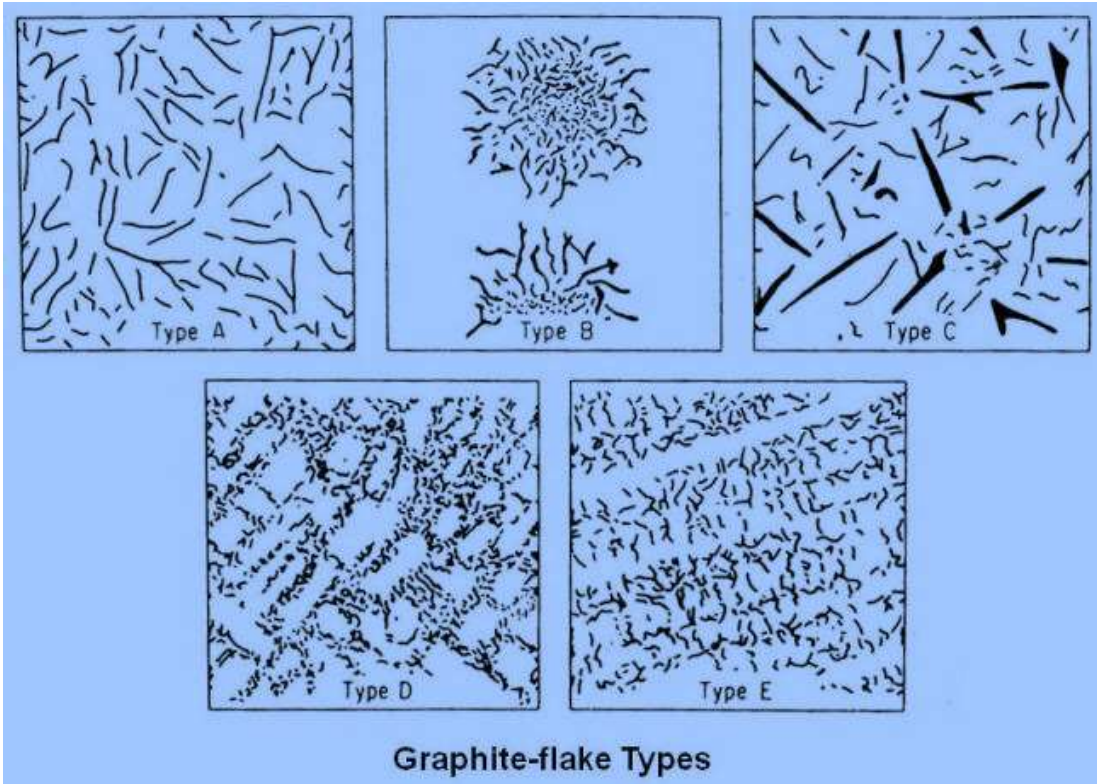


Metallurgy of Gray Iron

- Solidification of Fe-C-Si alloy system
- Graphitization during solidification and in solid state
- Chemical composition effects
- Types of graphite flakes







Type A: Uniform distribution

Type B: Rosette groupings

Type C:
Superimposed flakes

Type D & Type E:
Interdendritic segregation

MOLDING

- Green sand molding most commonly practiced.
- Properties desired
 - Green compression & shear strength, dry compression strength, permeability, moisture content, etc.
 - When sand heated to $\sim 1500^{\circ}\text{F}$, possibility of chemical reaction between sand & metal and adherence of fused on material on metal increases.
 - Sea coal, gilsonite, coke, graphite, pitch etc. may be added to sand for preventing the formation of fused products.
 - Grain size of 6, 12, 20, 30, 40 & 50 mesh (if $> 75\%$, promote rough surface)
 - Excessive 270 mesh, fines, pan.....reduce ease of molding & permeability, increase expansion difficulties.



Foundry properties of Gray Iron

- Fluidity characteristics
- Shrinkage characteristics
- Relationship of gating design to
 - Pouring rate
 - Dirt prevention
 - Thermal gradient effects

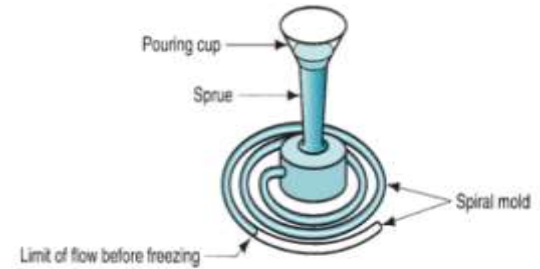


Fluidity

$$CF = \%C + (1/4 \%Si) + (1/2 \%P)$$

(CF of 4.55 for maximum fluidity)

$$\text{Fluidity (Inches)} = (14.9 \times CF) + 0.5T - 155 \quad (T = ^\circ F)$$



- Maximum fluidity occurs when pouring temperature is high & composition is eutectic one.
- Hypereutectic Gray Iron: Loss fluidity because of kishing, precipitation of carbon flakes as liquid metal cools.

Shrinkage Characteristics

- Solidification Shrinkage = $2(\% \text{ graphitic carbon} - 2.8)$
- ΔV (% volume change) may be +ve or -ve.
- $(\% \text{ Total Carbon} = \% \text{ Graphitic Carbon} + \% \text{ Combined Carbon})$
- For ordinary Gray Iron (~2.9 to 3.1% graphite carbon), no risering is needed for the purpose of solidification shrinkage.
- If graphitization is complete, % of total carbon & % of graphite carbon are equal.



- If no graphitization has occurred, % of graphitic carbon is zero.
- If about 0.5 to 0.8% combined carbon exists in Gray Iron, it generally indicates that microstructure is largely pearlitic.
- For white iron, ~5.6% shrinkage
- Riser presence, even required in case of gray iron as riser pressure gives rise to sound casting.

Inoculation

- Inoculation treatment is used to establish nucleation centres for precipitation of graphite into small type A flakes uniformly distributed in the matrix.
- Its advantage are:
 - Improved mechanical properties
 - Control of graphite structure
 - Elimination/reduction of iron carbide
 - Prevention/minimizing of undercooling¹⁸

Inoculation practice

- Inoculation in Ladle/ in mold
- Use of tablets, made by bonding powdered inoculant with wax or stearic acid
- A typical graphitizing inoculant has 72%Si, 1%Mn, 1% Ca, 2% Al and 4% Fe.
- In mold inoculation compensates for fading of primary inoculant, which might have occurred prior to pouring.



Heat Treatment of Gray Iron

Benefits:

- Improved machinability
- Wear resistance
- Strength
- Stress relief



THANKS

