



IIT ROORKEE



NPTEL ONLINE
CERTIFICATION COURSE

MELTING AND CASTING OF CAST METALS

Production of Nonferrous metals and alloys

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Melting Practices

Factors to be considered

- Wide variation in densities & melting point of alloying elements
- Non-uniformity in chemical composition because of segregation
- Formation of non-metallic inclusions
- Loss by vaporization
- Absorption of gases
- Furnace atmosphere

Problems due to variation in properties

- Creates difficulty in distribution of alloying elements in the melt (Li, Mg, P, Be, Si float up and get oxidized quickly), Use of master alloy advocated
- Heavier metals tend to settle at bottom (Pb in Cu)
- Zn and P vaporize at working temperature of Cu alloys (use of master alloys or addition just before pouring, to prevent this)
- Formation of drosses and non metallic inclusions (Problem severe if densities of alloy and oxides are nearly same)
- Control of ambient atmosphere/filtration may prevent formation of oxides

Casting defects during pouring and solidification

- Aspiration effect
- Shrinkage defect
- Surface defect
 - Due to reaction between molten metal and ingredients in molding aggregate
- coarse grained structure
 - Alloys with large freezing ranges are usually susceptible to formation of coarse grained structure. Grain refiners like Al and Mg used.
 - Use of nucleating agents in melt before pouring
 - By superheating
 - By vibration (for pure metals)
 - using chilling (for pure metals)

Copper and its alloy castings

Issues in casting pure copper

- High conductivity (high purity to be maintained)
 - Alloying elements decrease electrical conductivity
- Problem of O_2 in copper (cause cuprous oxide)
- Problem of hydrogen (forms porosity)
- Melting is done in crucible as fluxing and degassing are easier.
- Melt is deoxidized with Li or calcium boride available in sealed copper tubes

Aluminum and its alloys

- Aluminium reacts readily with atmospheric moisture to form aluminium oxide.
- Dissolution of hydrogen
- Al is generally melted under a halide flux cover (NaCl:KcL:NaF), which prevents further oxidation and dissolves Al_2O_3
- Dissolved hydrogen removed by degassing operation, usually by plunging hexachloroethane tablets.
- Most of Al alloy castings need to be grain refined.

Magnesium and its alloys

- High demand in aerospace industries because of low density, high specific strength, good castability, machinability and weldability
- Mg-Al-Zn alloys are largely used for castings (small addition of manganese increase corrosion resistance)
- Zirconium is used as grain refiner in Mg alloys.
- Usually melted in steel kettles.
- Requires protection against oxidation (exposed magnesium bath is protected by sprinkling sulphur powder)
- Usually die cast (reacts with silica and oxygen, so molding sand mixed with sulphur and boric acid used)

THANKS

