

Macro-segregation:

Macro-segregation occurs over a large distances, between the surface & the center of the casting (fig 9).

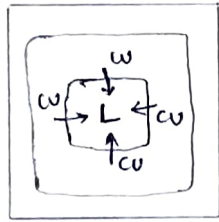
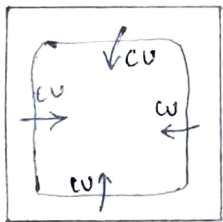
The surface, which freezes first, contains slightly more than the average amount of the higher melting point metal (nickel is an example).

The center of the casting contains more of the lower melting point metal (say copper).

Fortunately, the difference in composition is rather small & usually is not significant.

We can not eliminate macro-segregation by a homogenization treatment because the diffusion distances are too great.

Macro-segregation can be reduced by hot working.
 } Requires temp above recrystallization
 } temp but below melting point
 } for plastic deformation



Metals are plastically deformed above their recrystallization temp, so material recrystallize during deformation.

Fig 9: Macro-segregation occurs over a large distances in a casting and can not be eliminated by homogenization in a practical period of time.

Yield strength, hardness → low

ductility
↓
high

Other controls over Segregation:

In addition to homogenization or hot working, we may be able to minimize segregation by other means.

One of these method is rapid solidification processing. If cooling is exceptionally rapid, the atoms will be "frozen" into random and uniformly distributed positions in the lattice.

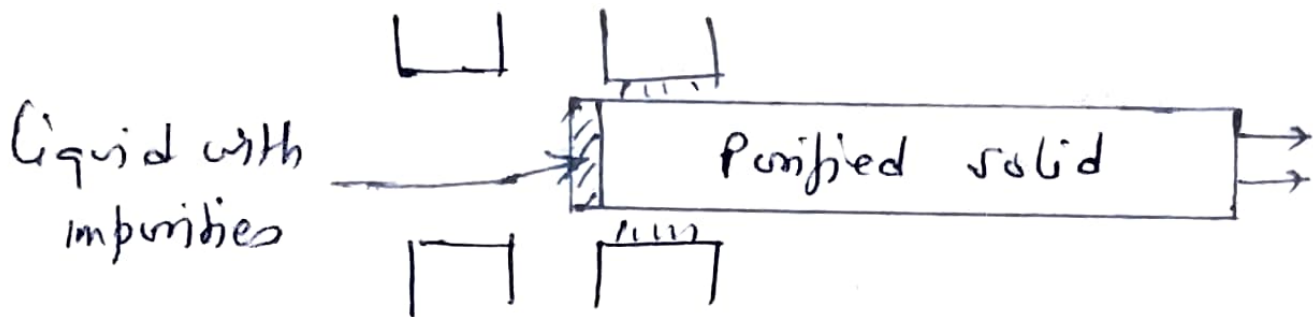
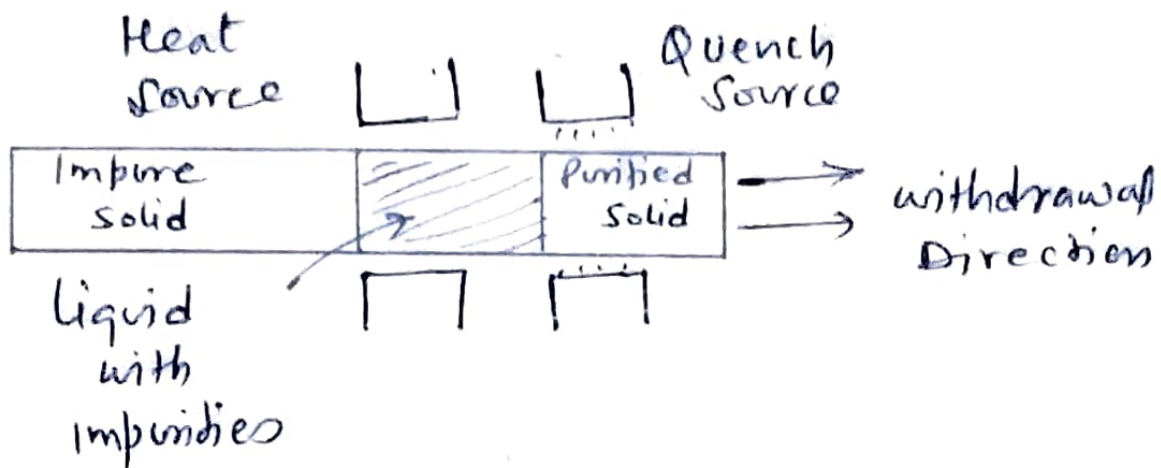
In this case, there is not even enough time for the atoms to begin to diffuse to produce the high concentration of high melting point components in the center of the first solid to form. (27)

We may also find, when trying to produce pure materials, that impurities will be rejected into the last regions to freeze, resulting in segregation. This is a problem particularly when producing high purity silicon used as the basis for semiconducting electronic devices.

One way of improving the purity is to use a process known as zone refining. A rod of the material is moved at a very slow speed through a furnace with a very narrow high-temperature zone (fig 2).

The rod is melted over only a short length at any particular time. The impurities, which have a low solubility in the solid metal, collect in the molten zone.

As the molten zone moves down the rod, the impurities are gradually carried to the end of the rod. After several passes, the impurities will have collected at the end, which is then removed from the rod.



(a)