Lead & its Alloys

Introduction:

- The major properties of (Pb) include:
  - Heavy weight.
  - High density (11.34 g/cm$^3$).
  - Softness.
  - Malleability.
  - Low melting point.
  - Low strength.
  - Low electrical conductivity.
  - High coefficient of expansion.
  - High corrosion resistance.
Introduction:

- The Uses:

  - Manufacturing of storage Batteries.
  - Tetra Ethel Lead (anti Ingredient in high test gasoline.
  - Manufacture of many high grade paints.
  - As high Balance & weight.
  - Shielding against ($\beta$ & $\gamma$) rays.
  - Gaskets for Calked joint in (C.I Pipe).
  - Cable sheathing (coat of wire).
  - Equipment in chemical industries (roofing material, pipe for transporting water & chemist).
  - High corrosion resistance.
Lead & its Alloys

Lead Alloys:

- Sb, Sn are the most common alloying elements.
- (Sb – Pb) phase diagram is shown in fig. (38), this is a simple eutectic system with the eutectic composition of (11.2%) Sb.
- Sb is generally added to (Pb) to raise Recrystallization $\theta$T.
  
  increase ($\sigma, R_c$) see table (5).

<table>
<thead>
<tr>
<th>% Sb</th>
<th>$\sigma$ (psi)</th>
<th>$R_B$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2500</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>4700</td>
<td>9.1</td>
</tr>
<tr>
<td>6</td>
<td>6840</td>
<td>11.8</td>
</tr>
<tr>
<td>12</td>
<td>7480</td>
<td>15</td>
</tr>
</tbody>
</table>

Table (5) properties of cast Lead – Antimony alloys

Fig. (38): The (Sb – Pb) Phase diagram.
(Pb – Sn) alloys:

- The phase diagram of this alloys is the same as fig. (38), simple eutectic system with eutectic point, located at (61.9% Sn at 361 °f).
- It is used as a solder 60% Pb – 40% Sn.
- It is used (solder) for their melting characteristic.
- Terne metal (10 – 25% Sn) is used for:
  - Coat steel sheet for roofing.
  - Automotive fuel tank.
- Pb alloys contain (Bi + Sn + Cd) eutectic used in:
  - Low melting point
  - Electric fuses
  - Sprinkler system
  - Boiler plugs
Lead & its Alloys

- (Pb – Sn – Sb) are widely used in the printing industry as type metal.

- Pb: provide low cost, low melting point, ease casting.
- Sn: increase fluidity, reduce brittleness, impart finer structure.
- Sb: provide hardness, wear resistance, lower casting °T.

1. **Electro Type metal**: uses Backing material for the electro formed Cu shell.
2. **Foundry Type metal**: uses exclusively for hand composition.
3. **Lino Type**: (84% Pb + 12% Sb + 4% Sn)

- Low melting point
- Short °T range during solidification
- Ternary eutectic max. strength

4. **Lead – base bearing alloys (Babbitts)**:

   - Pb – Sb – Sn + As
     - 83% 15% 1% 1%
     - (Pb + Sn) + Ca + Ba + Mg.

They are used for automotive connecting rod, Cam shaft bearing, Diesel engine bearing, Car journal bearing.

**Heat Treatment of Pb alloys:**

- **(99% Pb – 1% Sb) Antimonal Lead**:
  - heat treated at 235 °f, Quenched, aged 150 day.

- **(96% Pb – 4% Sb) hard lead**:
  - The same heat treat as (99% Pb + 1% Sb).