LUBRICATION AND DEFECTS IN EXTRUSION

Lubrication in Extrusion Process

The following are the requirements of a lubricant in hot extrusion:

- It must have a low shear strength
- It must be stable enough without breaking down at high working temperatures.
- The most widely used lubricant for steels and nickel based alloys is "molten glass".

The process using molten glass as lubricant is called "Ugine-Sejournet Process". The steps involved are:

- The billet is heated in inert atmosphere.

- It is coated with glass powder before it enters the extrusion container.
- The glass coating serves as a lubricant and also as a thermal insulator, thereby reducing heat loss from billet to container wall and other tools.
- The thickness of glass film between extrusion and die is about 25 microns.

Interaction between optimal lubricant, temperature and ram speed:

- If ram speed is too low, the lubricant is thick because of low initial extrusion pressure. This exhausts the glass reservoir rapidly. This increases cost of lubricant.
- If the ram speed is too high, the glass film becomes too thin and friction increases.
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Important requirements of lubrication:

- The lubricant film must be complete and continuous to be successful.
- Any gaps in film develops shear zones in metal which eventually develop into surface cracks.

Defects in Extrusion

1) **Laminations of glass/ oxide** into the interior of extrusion.
   Cause: Improper lubrication method
   Remedy: To provide optimum lubrication on the outside of billet and to use optimal ram speed.

2) **Extrusion defect:**
   The last 1/3rd of extrusion may have oxides and other impurities in it rendering it unfit for use because of poor mechanical properties. This leads to the formation of “annular ring of oxide” in the extruded product.

Cause: The metal in the middle ($2/3^{rd}$) is first extruded as it moves faster than the periphery of billet due to friction. This tendency of extrusion defect increases with friction between billet and container wall.

Remedy: The last $1/3^{rd}$ of billet is left out without extruding it. But this is economically not feasible. Instead a "follower block" is widely used. This block is slightly smaller diameter than the container and it scalps or scrapes the billet, leaving behind the oxide layers in the container.

3) **Axial Hole/ Funnel**:

It is an axial hole in the back end of extrusion.

Cause: Rapid radial flow of metal during extrusion of last $1/4^{th}$ of billet.

Remedy: Inclining the face of the ram at an angle to the ram axis.

4) Surface Cracking:

It is in the form of rough surface or fir-tree cracking.

Cause: i) Longitudinal tensile stresses generated as extrusion passes through the die.

ii) Very high ram speed for the given temperature.

Remedy: Use of optimal ram speed and billet temperature and heating the container.

5) Center Burst (or Chevron Cracking):

Cause: Low extrusion ratios and low friction in the deformation zone at the die.

Remedy: Increasing the friction at tool-billet interface to obtain a sound product.

6) **Variation i**n hot worked structure and properties:

This is the non-uniform properties of the extruded product, having variation in properties from front to back end.

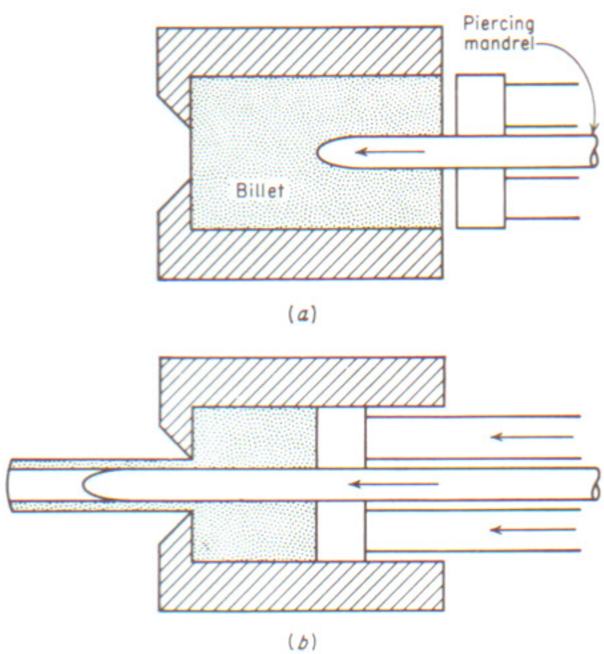
Extrusion of Tubes

By piercing and extruding in one step:

This method is better compared to the one using a mandrel.

The piercing mandrel and the ram are operated by two separate hydraulic systems. This requires a double action extrusion press. Steps:

i) First the piercing mandrel is withdrawn and the billet is pressed with the ram.



ii) Next, the billet is pierced with the sharp mandrel, ejecting a metal plug through the die.

iii) Then the ram advances and extrudes the billet over the mandrel to produce the tube.

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