

DEFECTS - METAL WORKING AND ROLLED PRODUCTS

Defects in Metal Working Process

Defects in the Final Product of Mechanically worked metal may have originated from any one or a combination of the following: The ingot used for MW may contain defects (pores, microcracks or inclusions) which may remain as such or get aggravated during working operation.

- Operational Parameters Localized to a particular type of MW process (not following the proper practice).

Defects in Rolled Products

a) General b) Operational

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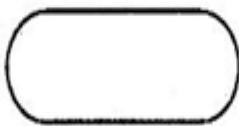
The defects may arise due to

i) Surface irregularities: The ingot or the raw material may be having irregularities due to scaling which will get trapped in the metal and remain inside the metal surface as laps. This needs to be removed by grinding and there will be metal loss. If the defect is deep and severe the product may get rejected.

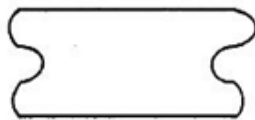
ii) Non-metallic inclusions: The inclusions may result from oxides or nitrides or silicates etc., especially in steels. These are present in the molten metal during the preparation. If less in volume may cause small cracks in the metal and if more in volume will result in severe cracks called crocodile cracks separating the product into two halves.

iii) Internal Pores: There may be pores in the product due to the presence of gases like hydrogen, oxygen, nitrogen etc.,. If too much gases are present leads to elongation of the pores and the product may become weaker. Sometimes separation may take place resulting in cracks.

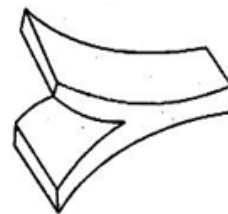
i) Barrel: Due to friction at the edges of the product barrel action takes place. Surface in contact experience severe friction as compared to center of the work. Hence, with heavy reduction in the work the center tends to expand laterally more than the outer surfaces in contact with the dies and produces barreled edges.



Barrelling



Non uniform defomation



Alligator Cracks

ii) Non uniform deformation: When the rolling conditions are such that only surface of the work piece is deformed. The cross section of the slab is deformed into the shape as shown.

The middle portion is less deformed as compared to the outer surface.

This may be due to variation in temperature in the metal. Surface temperature being more than the inside temperature of the slab.

iii) Alligator Cracks: If there is any metallurgical weakness in the metal (due to the presence of inclusions) along the centre line of the slab, fracture will occur. This results in the separation of the layer giving rise to opening of the slab which looks like an alligator mouth in opening position. Hence, the name.

Others:

i) Hydrogen cracks: During preparation of the melt in the furnace several gases try to get into the melt. Out of this Hydrogen gas diffuses into the melt to a large extent and is retained in the solid metal. Due to the presence of hydrogen in excess internal cracks appear through the cross section during rolling and cannot be used. It is a major problem with alloy steels especially.

ii) Non metallic inclusion: Inclusions are non metallics appearing in the metal as a result of entrapment. During the preparation of the molten metal non metallic like oxides, nitrides, silicates enter the melt and remain as such in the solid metal. These are discontinuities in the metal and reduce the properties of the metal. On rolling they may result in cracks which may reach a critical value and make the product rejectable.

Defects: Operational

i) Waviness..Varying thickness.

ii) Edge Cracking

i)Waviness..Varying thickness.

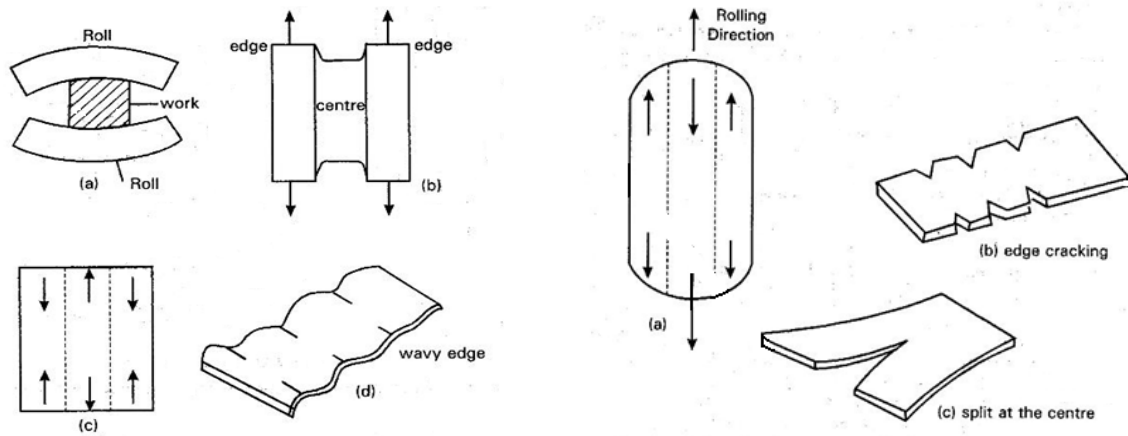
Variation in the work across the width in sheet rolling occurs because the roll gap is not perfectly parallel (a).

Since width and volume are constant and thickness is varying, the edges elongate more than the center (b).

But the sheet is a continuous body; the strains readjust to maintain continuity.

Thus the center portion is in tension and the edges are in compression (c).

The result is a wavy edge (d).



ii) Edge Cracking

The length of the center portion increases but the edges are prevented due to frictional force. As a result the material gets rounded off (a).

The edges are strained in tension leading to edge cracking along the width of the slab (b).

When the difference in the strains become excess i.e. under severe condition, split at the center of the slab occurs (c).

Source : <http://elearningatria.files.wordpress.com/2013/10/vtu-e-notes-mpiii-14.pdf>

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