FLAT SURFACES TO OBTAIN HIGH QUALITY PRODUCTS

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Abstract*: Abstract. First stages of molten-charge steel-making and casting process are to be considered in order to obtain high –quality surface hot-rolled plates. Non-distructive tests consist in directing an activating energy to a sample of rolled product. Slabbing of continuous casting ingots, free from surface defects, is the main requirement for obtaining high-quality surface flat rolled products. Ingot blank heating specifications in gravity–discharge furnaces include, beside temperature range, formation of a certain sort of slag, non-adherent, easily removable, but also thick enough to ease removing of insignificant surface defects during descaling. The defect displays pierced gap, either single or in groups at plate surface. Non-metallic inclusion groups, various grain sizes, decarburization may also-appear, depending on the cause. Surface defects also show due to rolls, rollers and additional rolling–mill outfits condition. Both sides of the product are to be carefully checked to detect these defects.*

Keywords: *surface defects, lamination, flat-rolled bubbles, ingot film, non-distructive controlle*.

1. Intoduction

Progress made in the last twenty years in metallurgical engineering may be summarised as follows:

- development of continuous computer–aided processes to replace the discontinuous ones, outdated;

- introduction of total quality concept and its implementation as follows: quality of technologies; accurate running of outfits; quality of checking; quality of product; large-scale up-to-date thermomechanical treatment techniques of rolled products [1].

These innovative techniques resulted in high-quality metallurgical products, with the following features: physico-mechanical and technological characteristic coupled with the chemical composition; dimensional accuracy; minimum power consumption, raw material and materials.

As there were some problems concerning rolled product surface appearance in Iron and Steel Company- Arcelor Mittal Galati, this work deals with this topic [2].

Non-distructive tests consist in directing an activating energy to a sample of rolled product. The alteration of the activating energy gives some information on surface quality of rolled product, when measured out [3].

2. Experimental results

Among the defects occurring at hot –rolled plate surface there are: ingot film, flat-rolled bubbles, piercing, lamination, mill scale traces, roll scale, etc.[4,5].

a). Ingot film

This defect usually shows on the plate sides corresponding to the ingot crop. The region between matrix metal and ingot skin is filled with scale. Groups of satellite oxide inclusions are noticeable in the defective area. The features of metallic microstructure are decarburation and grain size, figure 1.

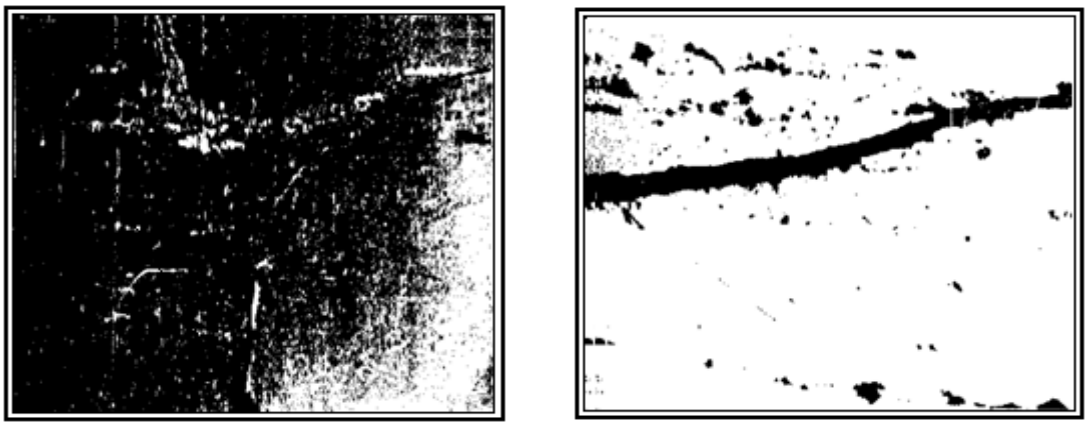
Cause of defect: the defect occurs during rolling process due to existent drops and burrs placed on ingot and slabbing surface.

Caution a high-quality surface of castings is a condition to avoid ingot film formation.

b). Flat-rolled bubbles

Defective area displays thin metal plates, elongated parallel to the rolling direction, which sometimes may separate from the plate surface. Defective area contains groups of defects [6,7].

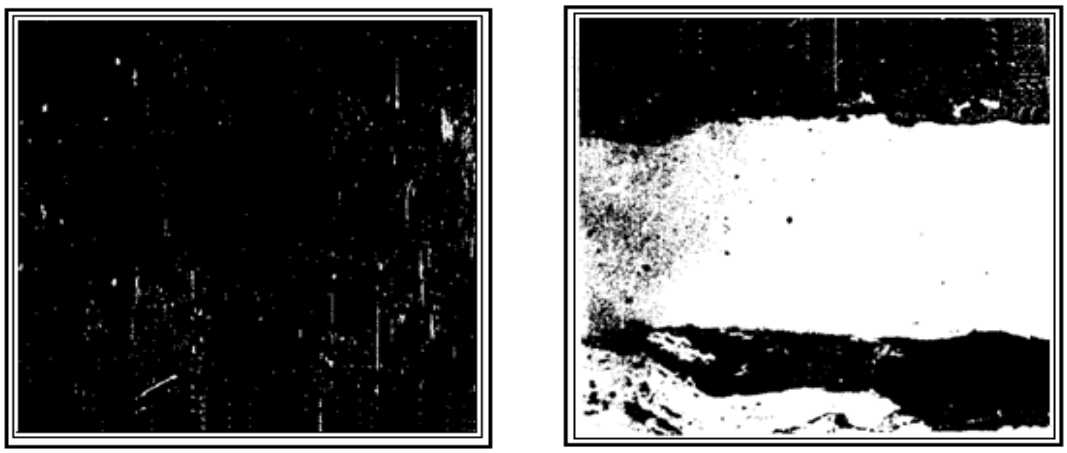
The defect is often accompanied by red scale traces and cracks at plate surface.



a) **b)**

Figure 1. *Ingot film: a. appearance; b. materials microstructure in the defective area (x100)*

Defective microstructure contains oxides bubbles and oxide inclusion groups around cracks. Matrix metal displays course grains and is slightly decarburized in the defective area, figure 2. Cause of defect: flat–rolled bubbles formation is a consequence of either cell-structure bubbles opening during heating process or continuous cast ingots and slabs rolling [8].



a) **b)**

Figure 2. *Flat-rolled bubble at hot-rolled plate surface: a) appearance; b) material microstructure in the defective area (x 100)*

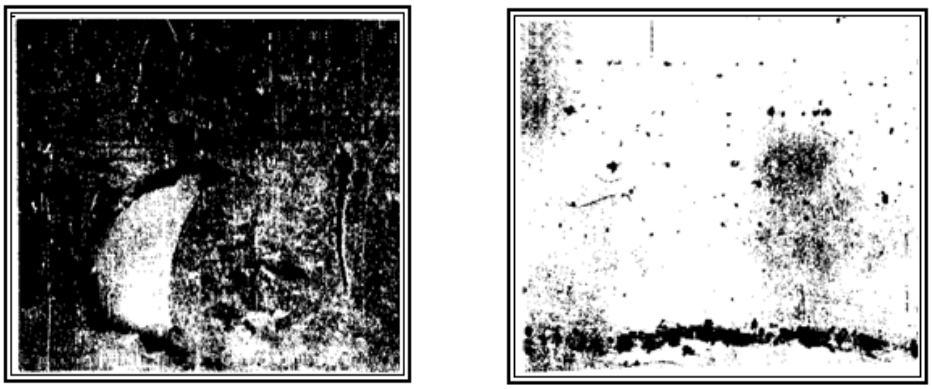
Caution melting, deoxidation and casting process must ensure an ingot skin of maximum thickness coupled with a minimum number and size of cell-structure bubbles. Ingot and slab heating process specifications must also be observed Hand direct fire heating is also necessary to remove the defects [9].

c). Piercing.

The defect displays pierced gap, either single or in groups at plate surface. Non-metallic inclusion groups, various grain sizes, decarburization may also-appear, depending on the cause, figure 3. Cause of defect: piercing occurs due to presence of shrinkage porosities, non-metallic inclusions, bubbles and films into the ingots and slabs.

It may also occur due to uneven layout in the steel of deoxidising agents, especially Al, which may cause structural non-uniformity. As a consequence, low deformability results in plate surface course damage [10, 11].

Caution molten charge steel-making and casting process specifications must be observed so as to decrease non-metallic inclusions percent and



a) **b)**

Figure 3. *Piercing at hot-rolled plate surface: a) appearance; b) magnified microstructure (x200)*

diminish change of occurrence of ingot films and other ingot and slabs defects. Continuous deoxidizing agent feeding must be ensured [12].

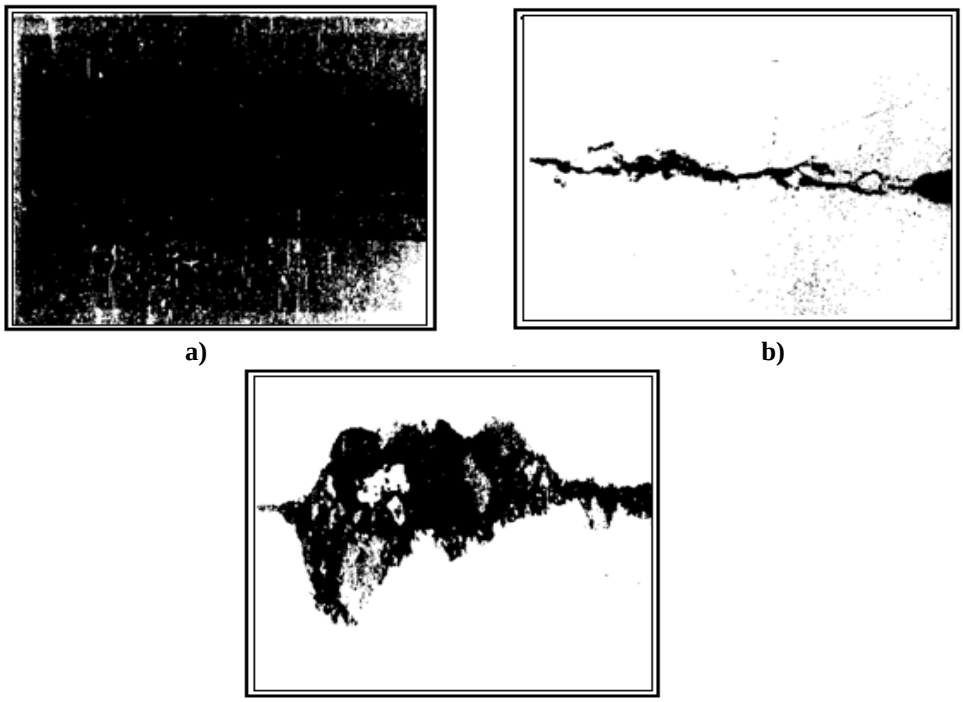
d). Lamination

Lamination means gaps or division of plate thickness in two, figure 4.

Cause of defect the defect occurs as a consequence of a defective molten charge steel making, deoxidisation and casting process.

Most frequent mistakes are: ingot crop incomplete filling, defective protection of feeder, inadequate deoxidisation of killed or semi-killed steels, high temperature of steel during the casting process.

Caution molten charge steel-making, deoxidation and casting process specifications must be observed.



a) **b)**

c)

Figure 4. *Lamination: a) appearance; b) oxidized crack in lamination area c) exogenous inclusions in the defective area (x200)*

Shrinkage defects must be cut until complete removing [13].

e). Mill scale traces

Pickled hot-rolled plates defect displays bright black scale traces with clear edges, elongated parallel to the rolling direction or clase. The complex microstructure of mill scale may be noticed, figure 5.

Figure 5. *Black mill scale traces at pickled hot-rolled strip surface*

Cause of defect: mill scale traces occur due to pickle contamination with mineral oils exceeding 0,5 g/l , coupled with pickle low temperature . Caution pickle must be kept free from mineral oils.

f). Roll scale

Defective area displays point-like inclusions or hot- pressed scale traces in matrix metal during hot-rolling process. It may extend all plate length or place itself at plate edges. The defect usually occurs after pickling and after removing air-contact scale [14].

a) .

Figure 6a. *Traces of roll scale at hot-rolled plate surface*

b)

Figure 6 b. *Point like, due to defective rolls*

Roll scale is due to not-observance of heating ranges of slabs in gravity-discharge furnaces when excess-air coefficient exceeds. There are also other reasons such as: inadequate running of the rolling-mill, figure 6a; inadequate descaling; use of defective (burned) rolls, figure 6b.

Caution : scale formation may avoided through; effective descaling means ; observances of slab heating ranges ; avoidance of slab overheating ; use of rolling mill stand within its working life ; avoidance of wear rolls ; avoidance of rolls overheating [15].

3. Conclusion

Recent professional research of pipes and plates fabrication process for big inch seamwelded pipes revealed possibilities to obtain high-technological products as well as present-day endowment of Arcelor Mitall Steel departments .

Limitation of mechanical characteristics range is to be carried out through rigorous checking of all

technological parameters throughout the entire fabrication process, beginning with molten – charge steel making, continous casting and ending with controlled rolling .

Recent fabrication solutions of high-resistances and tenacity heavy plates , respectively seam-welded possibilities of updating heavy plates production in Iron and Steel Company –Arcelor Mitall Galaţi so as increase products added value .

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