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Analysis of the influence of rolling mill parameters on the quality of galvanized sheets

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----------ABSTRACT----------
This paper analyses the influence of rolling process parameters on the resulting surface micro geometry of galvanized sheets. The study focuses on the role of chrome plated work rolls, the control of thickness and mechanical properties in the weld area, and the identification of the most common defects occurring during skin pass rolling. In the experiment surface roughness measurements (R_a, RPC) were performed on samples taken from a galvanized strip, complemented by visual flatness evaluation and imprint inspection. The results confirm that the stability of technological parameters is crucial for eliminating defects and ensuring the required surface quality.
Keywords *– galvanized sheets, surface micro geometry, work rolls, flatness*

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I. INTRODUCTION

Rolling of galvanized sheets represents a technologically demanding pro-cess in which precise parameter settings, work roll quality, and the stability of the incoming material play key roles [1-2]. Modern rolling lines are designed to ensure high repeatability, accuracy, and surface quality. However, the presence of weld joints, material inhomogeneity, or insufficient roll maintenance can significantly affect the final product [3]. The aim is to ensure the required surface microgeometry, suppress significant yield stress, precisely control mechanical properties and slow down the aging process of the material. These measures lead to achieving a uniform, precisely shaped and high-quality painted appearance of the final product, which is essential in customer operations.

This paper focuses on analysing the factors influencing the quality of galvanized sheets, with emphasis on surface micro geometry, weld behaviour during rolling, and the formation of defects occurring in the skin pass rolling process.

II. IMPORTANT CONDITIONS IN THE PRODUCTION OF ROLLED MATERIALS

Chrome-plated work rolls and their significance in the process

Chrome plated work rolls are currently the standard in the production of galvanized sheets [4]. The chromium layer providesincreased surface hardness, higher resistance to abrasive wear, reduced susceptibility to imprint formation, longer roll service life, more stable rolling conditions.

Imprints on work rolls are among the most common causes of surface defects in galvanized sheets [4]. They occur under local overloading, which may be caused, for example, by non-uniform strip thickness, hard inclusions, weld joints with differing properties, surface contamination.

The chromium layer acts as a protective shield that reduces the risk of damage and thus the subsequent transfer of defects onto the strip surface, as illustrated in Figure 1.

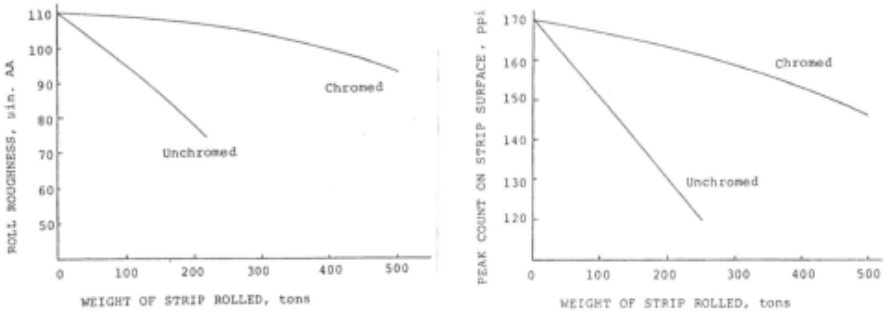

Fig. 1 Defect rate on rolls with and without coating

Rolling of welds

Weld joints on the rolls represent a critical section of the strip that can disrupt process stability [3, 5]. To safely pass the weld through the rolling mill stand, it must meet strict requirements - the same thickness as the base material, the same strip width, the same mechanical properties, the same yield point, visible surface irregularities. If the weld behaves differently from the base material, this leads to uneven roll loading, local overloading, imprint formation, strip deformation, deterioration of flatness (Figure 2).

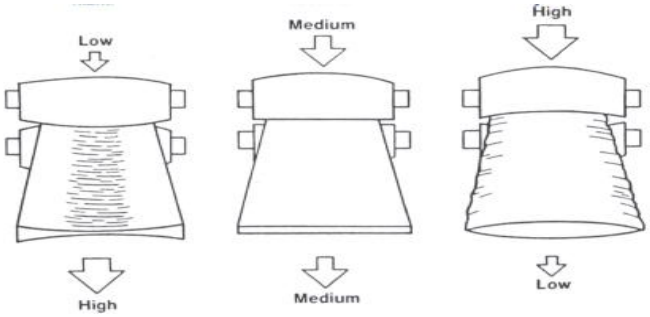

Fig. 2 During weld passage improper skin-pass mill (SPM) settings can lead to defects

From a technological standpoint, it is therefore essential to ensure that the weld is rolled under standard parameters without the need for process intervention [1]. Modern lines are equipped with automatic weld detection systems that enable timely roll opening and prevent contact between the weld and the work rolls [1, 5].

Thickness and mechanical-property inspection in the weld area

Changes in thickness or mechanical properties in the weld area can lead to significant technological issues [3]. The most common problems include increased weld thickness, harder weld metal, unsatisfactory microstructure, local strength variations.

These deviations cause uneven force distribution during rolling, which may lead to roll damage. Therefore, it is necessary to perform thickness measurement before and after the weld, hardness inspection, metallographic analysis, flatness measurement, automatic weld detection. The most effective solution is to avoid rolling welds entirely, which is achieved by automatic roll opening upon weld detection [3].

Importance of surface roughness for subsequent processing

Surface roughness is one of the most important parameters determining the quality of galvanized sheets (Figure 3, 4). It represents a set of fine irregularities formed during rolling, galvanizing, and subsequent skin pass rolling [5].

It is influenced by formability during stamping, friction between the sheet and the tool, uniformity of paint application, aesthetic appearance after painting, and adhesion of surface layers.

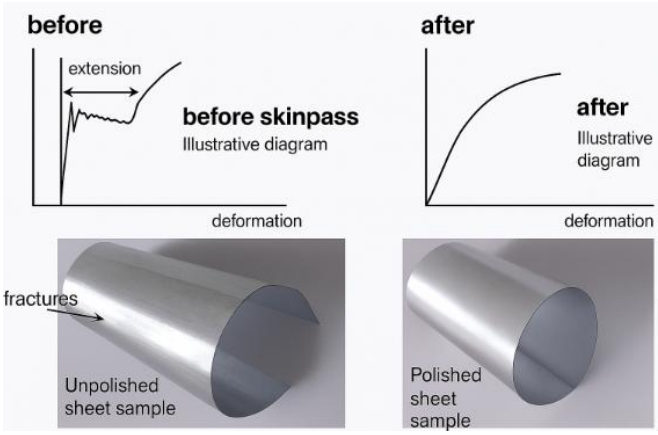

Fig. 3 Comparison of surface finishing before and after SPM

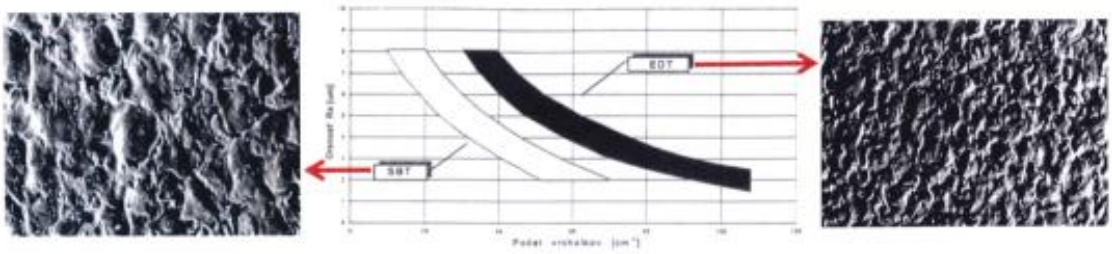

Fig. 4 Differences in rolling with uncoated rolls and chromium-coated rolls

For customers, key values include R_a (average roughness) and RPC (peak count per unit length) (Figure 5). These parameters must remain stable throughout the entire coil, as even small deviations can lead to issues during stamping or painting [5].

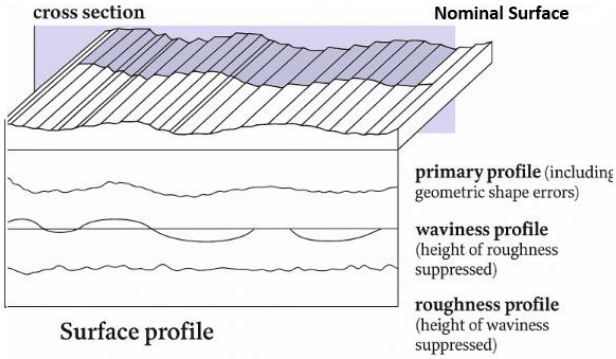

Fig. 5 Perpendicular section of the nominal surface

Methodology of Surface Roughness Measurement

Roughness measurements are carried out on samples taken from the galvanized strip. To ensure accurate results, it is necessary to follow these requirements cleanliness of the measured surface, degreasing and removal of contaminants, measurement perpendicular to the rolling direction, measurement on both sides of the sheet, sampling 10 cm from the strip edge, three measurements: edge 1 – center – edge 2.

The results are averaged and compared with customer requirements or internal standards [5].

Fig. 6 Surface roughness meters

Defects of skin pass rolling

Skin pass rolling is a process that improves strip flatness, surface micro geometry, and mechanical properties. Nevertheless, defects may occur that negatively affect product quality [1, 5].

The most common defects after rolling on the SPM:

- Strip flatness (edge or center waviness) - occurs due to non-homogeneous stresses or improper roll settings.
- Strip marking - appears as longitudinal streaks caused by contamination or damaged rolls. Illustrated in Figure 7.
- Indentations on galvanized sheet - occur when the strip comes into contact with a damaged work roll or during rolling over weld seams. Illustrated in Figure 8.
- Build ups on rolls - caused by zinc or lubricant residues; prevention includes high pressure cleaning and the use of detergents.

- Non conforming mechanical properties - deviations in tensile strength or yield strength may cause issues during stamping.
- Poor surface micro geometry - incorrect skin pass mill settings lead to excessively low or high surface roughness.
- Non uniform surface appearance - may be caused by inhomogeneous zinc coating composition or surface contamination.
- Under rolled edges - occur due to incorrect roll width adjustment or uneven roll pressure.

Fig. 7 Strip marking and under-rolled edge

Fig. 8 Roll indentations

III. CONCLUSION

The quality of galvanized sheets is the result of a complex interaction between the condition of the work rolls, the rolling parameters, and the surface micro geometry. Chromium plated rolls, properly adjusted technological parameters, and thorough inspection of weld joints represent key factors in preventing defects. Equally important is precise control of surface roughness, which influences both the process ability and the aesthetic properties of the final product. Identifying and eliminating skin pass rolling defects is essential for ensuring stable quality and meeting customer requirements.

ACKNOWLEDGEMENTS

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