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SELECTED DEFORMATION OF SOFT PLATING LAYER DURING JOINT COLD ROLLING OF THREE-LAYER STRIP

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ABSTRACT

The article presents analytical investigation for the determination of the cold plating technological process parameters. First of all it is necessary to take into account the irregularity of level-by-level deformations, because during the plating of the soft layer (brass) material is more deformed, than the material of hard (steel) layer. In the zone of selected deformation there is "creep" of the soft plating layer in connection with the fact that the soft layer has smaller withstanding capability because of lower flow stress - normal pressure on the surface of contact. It is ascertained the zone of the selected deformation length is very small, the most essential influencing on the creep degree of the soft layer renders a friction coefficient. During the three-layer package rolling without the tension of entering strip ends selected deformation is essential. When plating in the field of the selected deformation the withstanding capability of the basic layer decreases insignificantly.

1. INTRODUCTION

The contemporary development of techniques necessitate making the materials, which possess the complex of valuable properties, such as high strength, corrosion stability, wear and tear stability etc. Separate metals and alloys can not provide the needing amount of properties. That is why bimetallic compositions plays important role in producing of the new materials with special properties. The main technical advantage of bimetals is its possibility to combine different serving properties in one material. In the present time the main material, which is used for deep drawing out, is three-layers strip brass (tombac) + steel + brass with thin, strictly determined thickness of plating layer (4 - 6% of the basic steel layer's thickness).

During the development of the bimetallic strip making technological process with the preset correlation of layers' thicknesses it is necessary to take into account the irregularity of level-by-level deformations and their relation to parameters of rolling process. In the seat of deformation it may be marked out two zones: the zone of selected deformation and the zone of uniform joint

plastic deformation of layers [1,2,3]. In the zone of selected deformation there is "creep" of a soft plating layer in connection with the fact that the soft layer has smaller withstanding capability because of lower flow stress - normal pressure on the surface of contact.

In this work there were presented the findings of the non-uniformity investigation of level-by-level deformations during joint plastic deformation of the package by the scheme soft - hard - soft.

For the characteristic of deformation non-uniformity we receive the length of a zone of selected deformation and the deformation degree in it. The solution is conducted for the conditions of strip rolling without a broadening with usage the assumptions of the plate sections hypothesis. Whether for the condition of the uniform plastic deformation beginning the equalization of withstanding capability of layers is accepted irrespective of happening thus physical coupling of layers.

2. DETERMINATION OF UNIFORM DEFORMATION CONDITIONS

In accordance with the scheme of the forces which are operating on the flat infinitesimal member of the soft component in the field of selected deformation (fig. 4.2.1) the differential equilibrium equation of forces along the rolling direction is obtained.

$$\frac{dP}{dx} = [(2\tau_s - \frac{P}{2})tg\varphi \pm \mu P]\frac{2}{h} \qquad (4.2.1)$$

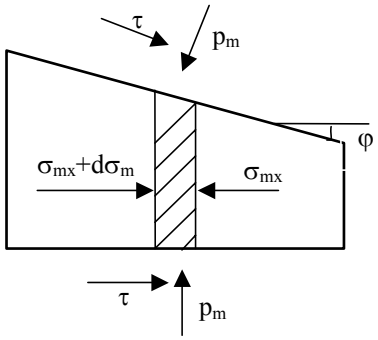

Fig. 4.2.1 The scheme of the deformation seat in the zone of soft metal selected deformation.

Where

φ - nip angle,

h_m - thickness of a plating layer.

On the way to the seat of plastic deformation normal stress can be accepted:

$$p = 2\tau_s(1 - \frac{\sigma_0}{2\tau_s}) \qquad (4.2.2)$$

Where:

σ_0 - back tension of the plating layer.

The solution of the differential equation (4.2.1) is conducted by the approximate method of numerical integration (method of finite differences) by the replacement the derivative for the finite

differences operator. Strengthening of the plating layer during selected deformation is taken into account.

For the estimation of withstanding capability of the hard basic layer within the limits of the zone of selected deformation it is necessary to decide the differential equation of the strip settling:

$$\frac{d\sigma_z}{dx} - \frac{\tau_x}{h_m} = 0 \qquad (4.2.3)$$

Where:

h_m - thickness of the basic layer.

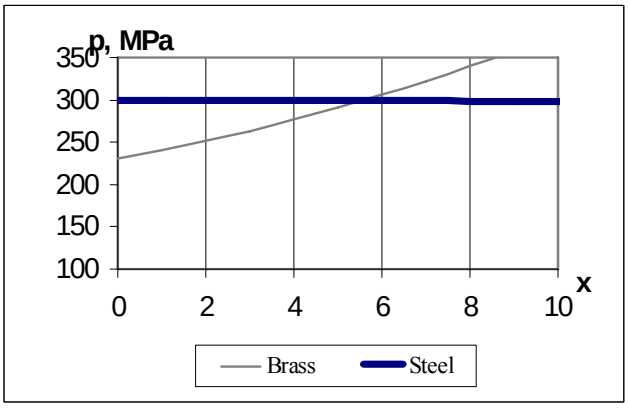

Fig. 4.2.2. Changing of the soft and hard components withstanding capabilities

During the rolling of the bars package it is necessary to interchange the sign before the second item.

The research of selected deformation value is conducted for the conditions of steel strip plating by the brass (tombac) layer by thickness 10 % from thickness of the basic layer.

On a fig. 4.2.2 the changing of the withstanding capability of the soft plating layer and hard basic layer is represented in process of moving the plate section on the seat of deformation.

The creep of the soft layer depend on: the correlation of mechanical properties of the basic and plating layers, conditions of friction on the contact surfaces, reduction degree by rolling, the correlation of the layers' thicknesses in the package, the degree of the back tension of the plating and basic layers.

The zone of the selected deformation length is very small and averages 0,1 - 0,2 mm. The most essential influencing on the creep degree of the soft layer renders a friction coefficient: by the decreasing of the friction coefficient from 0,1 down to 0,05 the creep degree increases 1,5 times.

3. CONCLUSION

1. During the three-layer package rolling without the tension of entering strip ends the selected deformation is essential and reaches 10% of soft layer's thickness.

2. Under the irregular tension operating of the strip there is the changing of the selected deformation value and if using the rational difference of tensile stresses the equalization of level-by-level deformations is reached. The condition of uniform level-by-level deformation looks like:

$$\sigma_{0h} - \sigma_{0s} = 2\tau_{sh} - 2\tau_{ss}$$

3. When plating in the field of the selected deformation the withstanding capability of the basic layer decreases insignificantly.

4. REFERENCES

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OREĐIVANJE PARAMETARA HLADNOG SPAJANJA LAMINARNIH KOMPOZITA

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REZIME

U radu je prikazan analitički pristup odredjivanja parametara hladnog spajanja laminarnih kompozita na bazi Mesinga i čelika. Polazeći od činjenice da je mesing mekši od čelika u analizi se pošlo od pretpostavke da je deformacija sendvič materijala mesing-čelik-mesing nehomogena jer mesingani sloj trpi vrstu nezavisnog "puzanja". Zaključeno je da je zona nezavisnih deformacija bitan element u konroli tehnologije spajanja iako je veoma uska, a trenje je uzeto kao dominantan u odnosu na stepen "puzanja".