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Characteristic defects of metallic coatings obtained in the metallization process

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Abstract: The paper presents an analysis of decorative coatings applied during the process of vacuum metallization. The second aim of this paper is to determine types of defects that could be formed in this process.

Keywords: Metallization, Surface defects.

1. INTRODUCTION

The process of metallization could be described as coating the surface of products with a metal layer to obtain coatings that are corrosion-resistant, abrasion-resistant and decorative. It is possible to point next form of metallization: galvanic metallization (so called galvanostegy), metal spraying, fire metallization (the metal layer is coated by an immersion of a product in liquid metal), diffusion metallization, vacuum metallization and contact metallization. The processes of metallization include also: aluminizing, chromium plating, zinc coating, tin plating, cadmium plating, copperizing, nickel plating, leading, silver plating and gilding [1÷8].

During the vacuum metallization one can observe three phases of the process of coating manufacturing [5]:

a) metal evaporation, it means the process of changing the state of a metal (from solid, through liquid into gas one),
b) diffusion of a metal vapour from the source of evaporation to the coating product or the wall of a vacuum chamber,
c) condensing of a metal vapour on the product surface and creating the continuous metal layer.

The process of vacuum metallization must be conducted in separate rooms. Also the particular departments should be isolated (Fig.1) [5]. On the other hand the process of metallization could be conducted using next equipment:

a) equipment for vacuum generation and it maintaining (and also it improving),
b) proper vacuum chambers for meallizing,
c) measuring apparatus for controlling the vacuum, the thickness of a metal layer and for investigation its features (e.g. resistance).

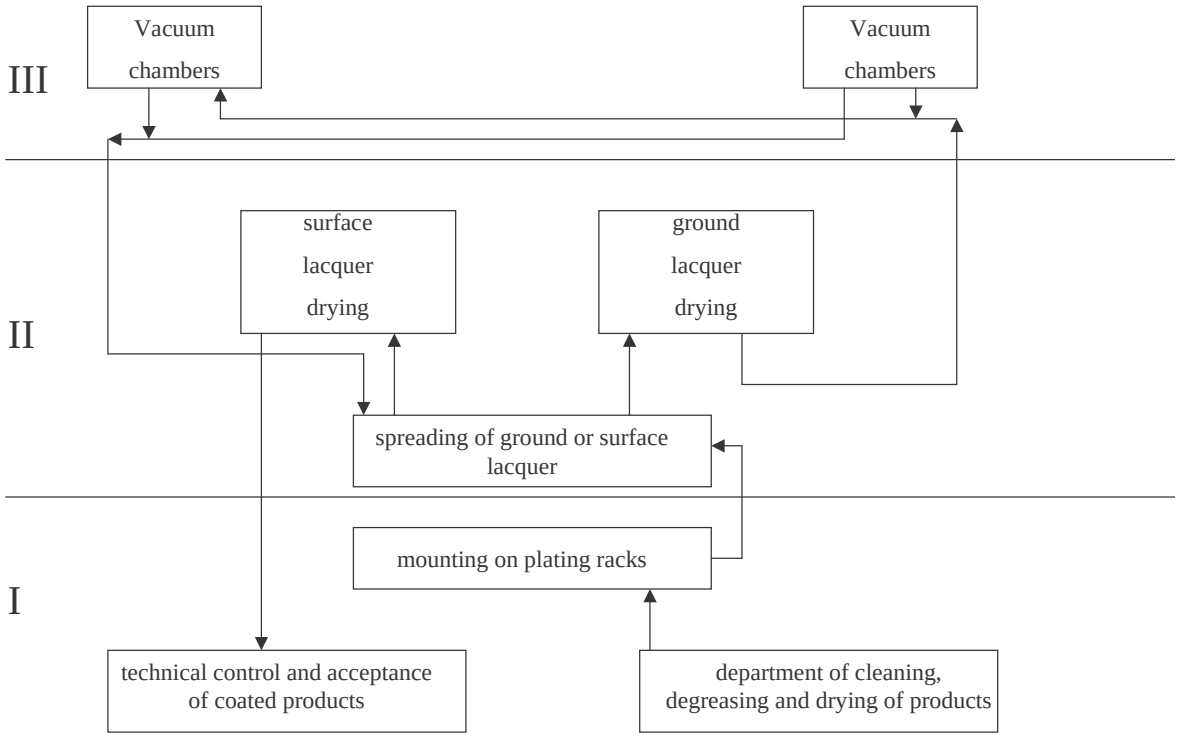

Figure 1. The scheme of a metallization department (com. [5])

2. RESULTS AND DISCUSSION

The structure of a layer and its features are depended on next parameters: conditions of processes (conditions of coating processes), cleanness of a vacuum chamber and features of an atom and molecules flux. The main element that influences the structure of a manufactured layer is the method of a base preparation. It could largely change the properties of obtained the metal film. During the treating of a product in acid bathes, alkaline bathes or water ones on the surface of a product could form pores and craters. It leads to the porous form of a coating. Also the mechanical machining could change the structure of a layer. The important changes forms also as the result of cleaning products in a process of electric or ion bombardment. But it is needed to state that this last process allows to increase the adhesion of a metal layer to the base. On the other hand one should point that the structure of a metal layer is considered with the temperature of metal melting. The metal with a high melting temperature (over 1900^{o}C) like W, Ta, Ir, Co, Ge, Si, create tight and fine-grained layers, without particular orientation. The metals from the other group (with a melting temperature from a rage 600 ÷ 1900 ^{0}C) like: Au, Ag, Cu, Ni, Fe, Cr, create tight and coarse-grained layers. The metals with a melting temperature below 650^{o}C create layers built with oriented crystals, which size proportionally depends on the layer thickness.

The process of vacuum metallization include next operations and activities:

a) cleaning (in emulsified bathes or in dissolvents),
b) drying and placing products on the plating racks,

c) ground lacquering and surface tighting and second drying,
d) metallization,
e) painting with proper lacquer and drying,
f) quality control.

The outer lacquer layer should protect the metal layer against the harmful influence of the atmosphere, mechanical and chemical damages during exploitation. The proper thickness should be from the range: 5 ÷ 10μ. Such lacquer should not react with the coating and ground layer. The lacquer could penetrate the metal layer and ground layer damaging the last one. When the colorless lacquer is applied then the obtained color is depended on the metal used in the metallization process (e.g. aluminums lets obtain a silver color). However when the dye is applied then the obtained color depends on the dye color (e.g. gold one for the gold dye) what presents Fig. 2. If the lacquer layer is too thin then the iridization is observed. When the layer is too thick the cracks and saggings could happen.

a) b)

Figure 2. Products on plating racks painted with a) colorless lacquer, b) dye lacquer (gold)

The most often occurring defects of metal layers are presented on below figures.

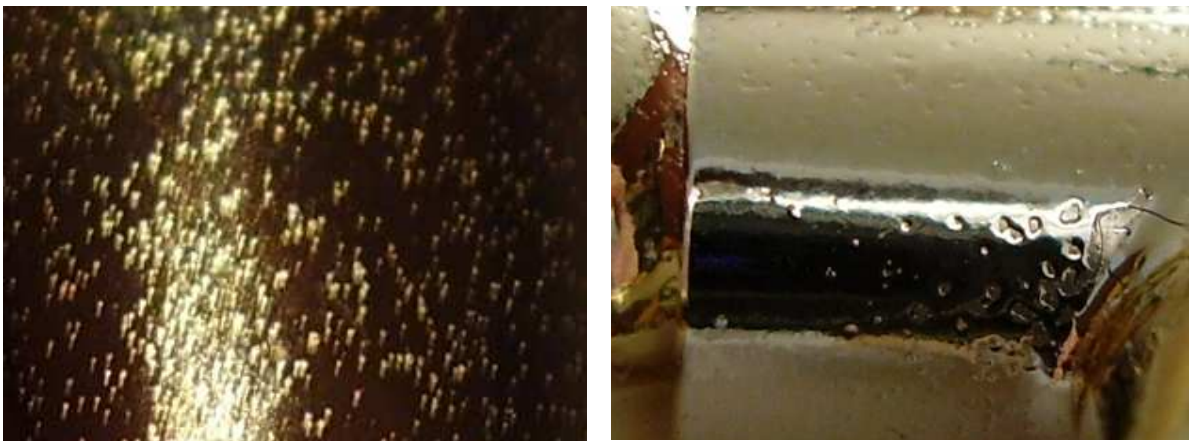

Figure 3. Surface granularity

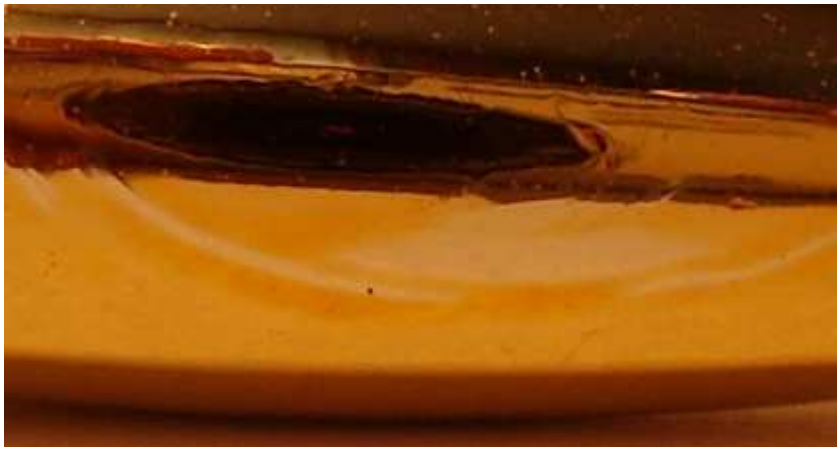

Figure 4. Translucent surface

Figure 5. Bloom on the surface

Figure 6. Surface fogging

Figure 7. Fat edges

Figure 8. Wrong shade of the surface

Figure 9. Corrosion points in a layer

The causes of the defects depends mainly on the quality of human work and responsibility. But it is possible that they are consider with secondary causes like: damaged surface, low metallization power, a wrong cleaned base or too humid air.

Almost all defects could be eliminated when all processes could be conducted with recommended parameters (proper vacuum parameters, clean preparations, adequate operation times, etc.).

3. CONCLUSION

Presented results show that the high quality of manufactured products could be obtained by applying recommended parameters of technological processes. It is consider with a fact, that the described defects are mainly results of wrong technological characteristics of conducted processes.

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