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Technology of Safe Galvanochemical Process of Strong Platings Forming Using Ternary Alloy

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Abstract. Established the possibility of galvanochemical obtaining of a plating stronger than in case of chrome precipitation. Proposed precipitation of ternary alloy Co-Mo-W, which allows using the effect of synergism. Proposed and researched usage instead of sulphate-anhydride electrolyte – citrate-diphosphate and ammonia-citrate one. Achieved an increase in current efficiency of precipitated alloy and decrease in current efficiency of hydrogen, with respect to chrome precipitation, which increased safety of the galvanochemical industry. Selected the optimal ratios of components in citrate–diphosphate and ammonia–citrate electrolytes for ternary alloy Co-Mo-W precipitation. Determined the parameters of electrical effect for the galvanic process: constant current – j = 2–8 A/dm^2, pulse unipolar current – j = 4–20 A/dm^2. Achieved a high microhardness of this plating and high adhesion to base surface. Achieved greater safety of the galvanochemical technological process of ternary alloy Co-Mo-W application compared with chromium plating.

1 Introduction

Safety level enhancement in the present-day industry remains an important task, solution of which requires individual approaches for various kinds of industries. The electrochemical technology of metal parts' surface treatment, especially the process of cathode application of electrocoating, is characterized by a high level of hazard. This state is conditioned by hazardous substances usage during the production process as well as hydrogen generation. Currently, the most widely spread amongst the specified technologies is the chrome electrolytic precipitation process, which allows forming hard platings. Hydrogen generation upon these processes, except for fire hazard causing, means a low current efficiency of chrome plating, which is 10-20 % [1]. Thus, a present-day issue of the electroplating industry is the need for creation of safe processing methods for metal platings forming while maintaining their hardness.

2 Main Part

The chroming process is conducted by electrolytic precipitation using sulphate-anhydride electrolyte of a specified composition (table 1), in which the components mass relation is 100:1. When its utilization one has to monitor the concentration of hazardous substances, which shall not exceed the maximum permissible concentration (MPC) [2].

Table 1. MPC of electrolyte's substances in the air and their hazard class

Electrolyte component	Aggregative state	Hazard class	MPC in the air, [mg/m^3]		
			working area	human settlements	
				maximum single	average daily
CrO_3	aerosol	1	0,01	0,0015	0,0015
H_2SO_4	aerosol	2	1	0,3	0,1

The intensity of hydrogen generation upon this technology is inversely proportional to the current efficiency of chrome plating, which under the conditions of the cathode process is 10–20%. Another

adhesion to base surface. The drawn up diagram allows at the stage of electrolysis mode and electrolyte composition selection forecasting the ternary alloy's hardness characteristics.

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