ELECTRODEPOSITED COATING FROM VIETNAMESE RAW MATERIALS-PIGMENTED SYSTEM

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I. INTRODUCTION

Electrodeposited paint and coating is one of the most important progress in the protective coating industry in the last 30 years. This method has been developed rapidly due to great advantages both economically and technologically: improved adhesion and protection to the metal substrates, free of fire hazards, uniform film thickness, freedom from sags, high efficiencies in utilization of paint materials [1,2]. The electrodeposition of film forming materials prepared from Vietnamese vegetable oils has been reported succesfully in recent years [2]. In this paper we present some new data on studying the electrodeposition of pigmented systems.

II. EXPERIMENTAL

Materials:

Electrodepositied film-forming material was prepared from Vietnamese tung oil (Aleurites Montana) by well known technique. The paint having pigments and all other additives was properly formulated.

The paint colours are black and red brown.

Methods:

Deposition of paint was carried out in special glass tanks, capacities from 2 to 16 litres. Electrical energy was supplied by special DC-power station (max 200V-100A). Cathode is from stainless steel and anode was steel panel of 100x100x1mm specially cleaned and prepared for tests.

Analysis:

According to proper methods of analysis and testing for electrodeposited paints and coating [3,4].

III. RESULTS AND DISCUSION:

III.1.Characteristics of pigmented systems

Studying the original unpigmented systems showed that quality of paint films depends on a serie of factors connected to the cleaning process, composition of bath, technological conditions for electrodeposition and curing regime. All that is true for the pigmented systems, too. The influence of some particular factors is presented and discussion here.

The investigation in a large range of *total dry content* demonstrated that if having been formulated properly, the paint can be electrodeposited easily from suspension. By stepwise thinning process it can observe a critical concentration, under it, the deposition of film forming material did not take place even for a long lasting experiment. At very low dry content as low as 3%, the film formed is very thin

and the pigment is not able to hide totally the metalic surface. The polymer concentration influences markedly the bath viscosity. The pigmented paint is a dispersed system having suspending solid particles in aqueous medium. The paint with too low dry content presents difficulties both in electrodeposition process and in maintaining its stability. Under low viscosity conditions, the pigments tend to settle if not stirred continuously. Generally speaking, these systems are thermo-dinamically unstable but the rate for pigment settlement depends on the difference of specific gravities and on the viscosity of solution. Preserving in closed vessels, paint of black colour is stable for months while that of red, brown and their shades are stable only for days. After along staying period, the settled paints can be adjusted again to its optimal parameters and redispersed for further use. The hiding power of paint depends on the film thickness and the pigment content of the paint but too much pigment is not desired because it can lead to difficulties in electrodeposition and finally to bad fiml qualities. When the dry content exceeds a limit (approx.18%), the viscosity increases exponentially and the electrodeposition rate decreases rapidly due to low mobility of charged particles. The dry film weight present a characteristic maxima vs dry contents of paint (Fig.1).

Intially, the increase of dry content leads to better film qualities (increasing thickness, uniformity and gloss), but exceeding optimal concentrations, the amount of deposited paint decreases, the fiml become coarser, its gloss visibly reduced.

a. The electrical tension applied to paint system contributs largely to the deposition rate and the fiml quality. Each paint system has its specific resistance, conductivity and needs optimal tension for electrodeposition process.

Too low tension makes the deposition impossible but too high tension is very harmful because it promotes the side reactions (hydrolysis of water, generation of bubbles of gase at electrodes...)

Fig.2 presents the influence of tension on the electrodeposited process (measured by deposited film-weight).

It's seen that the weight of material is increasing with the applied tension but the quality of the paint film is not the same. For our paint system, the applicable tension could range from as low as 3V to as ligh as 45V. AT 45V, the side reactions are dangerous and heat emitted becomes violent, making the paint film useless.

Applied in short time, high tension creates local discharges and many film defects, gives it poorer appearance and less protective quality. The electrodeposition of film forming material in preseense of pigments is carried out nomally but agitation is required to prevent settlement of heavy pigments which cause colour drift (the shades change from dark to light during working time).

b: Throwing power (TP) is an important and peculiar parameter for every electrodeposited paint, reflecting its ability to penetrate to inaccesible areas (shielded metalic surface [5]). The throwing power of a paint system depends on a serie of factors, such as applied tension (u), current density (i_A), duration of deposition bath composition and volum resistivity [1,2]. Fig.3 illustrates the influence of applied tension on the throwing power of our black paint.

It's clearly that the electrodeposited paint from tung-oil has good TP. When the distance and the surface of electrods are fixed, the TP is proportional to the applied tension. Too high tension is harmful for paint film and creates excessive local heating in the bath.

By varying paint formulation, it is possible to obtain different paints, having TP from 20 to 80% of various colours. However, paint film of best quality often obtained from baths having optimal throwing power. The dependence of TP on dry vontents present a maximal character, too.

c. Duration and temperature of deposition :

Duration of deposition depends on the dry content. pH, tension... and has been established for each system seperately. At the constant voltage deposition, the process is stopped when the current reachs the quasistationary region.

The temperature shows its effect in the deposition in two ways : low temperature decreases the rate of deposition but too high temperature favours side reactions and causes loss of volatile bases, reducing solubility and may lead to precipitation of the resin. The optimal conditions for depodition need moderate temperature (range from 18 to 30).

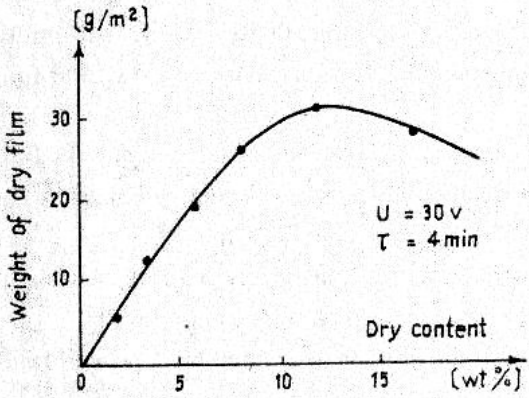

Fig 1. The influence of dry content of paint on dry film weight

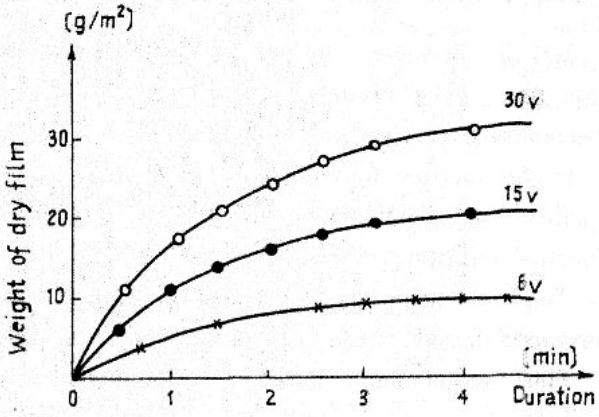

Fig 2. The influence of applied tension on the weight of dry electrodeposited film

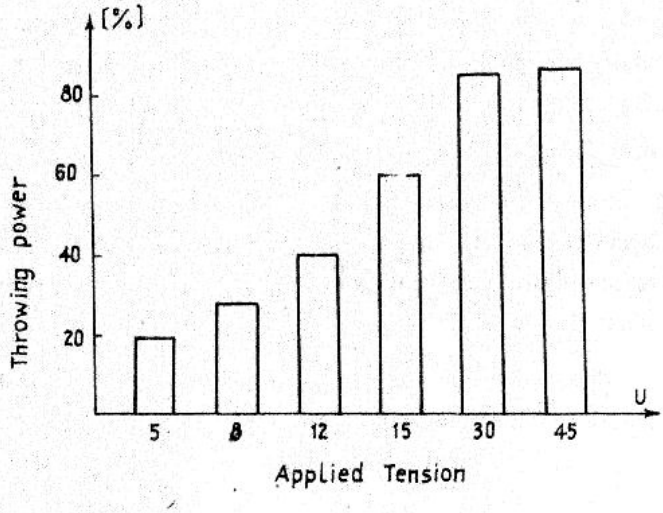

Fig 3. Influence of applied tension on throwing power of black paint

III.2. Perfomance of pigmented paint

The laboratory studies allowed us to establish necessary conditions for synthesis and put in practice a technological procedure of application of one electrodepositing paint instalation.

The paint film characteristics are following:

STT	TECHNICAL DATA	SDD	SDD	SDD
1	Color	Unpigmentted, transparent	Black	Red-Brown
2	Impact strength [kg.cm]	50	50	50
3	Scratch hardness [g]	1900	2000	1850
4	Gloss [%]	60-60	85-90	67-85
5	Fineness of dispersion [μ]	-	10	10
6	Thickness [μ]	15-25	18-25	15-25
7	Elasticity-Toughness [mm]	1	1	1
8	Humidity-thermal cycle	35d	>41d	>41d
9	Adhesion [%]	100	100	100

These paints have been applied successfully to protect a serie of metalic issues in the last two years and continue to be in function in practice.

IV. CONCLUSIONS

1. The viscosity of paint solution depends strongly on the dry contents and on the pH values. The optimal painting regime requires a suitable viscosity that keeps up the mobility of charged particles in water.

2. The painting tension exercises a huge influence on the weight and the thickness of coating film as well as on the rate of electrodeposition. The optimal tension has to ensure a high rate coating together with high physico-protective perfomances of painting film.

3. The throwing power of paint system depends on a serie of factors: viscosity composition, tension, presence of additives and other impurities. The investigated paint presents high resestivity, has good throwing power at moderate applied tension (18-30V).

The pigmented paints have been applied in practice since 1992.

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SƠN ĐIỆN DI TỪ NGUỒN NGUYÊN LIỆU DẦU VIỆT NAM
(HỆ SƠN CHỨA PIGMENT MÀU)

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Các đặc trưng của những hệ sơn điện di chứa pigment màu chế tạo từ dầu chẩu (Aleurites montana) được trình bày và thảo luận. Những điều kiện kết tủa mạng tối ưu phụ thuộc vào hàm khô tổng, thể hiệu sơn, liều lượng pigment, năng lực phân tán và những thông số công nghệ khác. Sơn với năng lực phân tán từ 20 đến 80% và màu sắc khác nhau đã được phối chế. Ảnh hưởng của hàm khô đến trọng lượng màng khô và năng lực phân tán thể hiện biến thiên qua một cực đại. Những tính năng kỹ thuật của màng sơn tạo ra từ các thành phần tối ưu, màu đến và nâu đỏ như sau :

- Độ bền va đập : 50 kg.cm - Độ bám dính 100%.
- Độ bóng (%) : 65-90
- Độ cứng (phương pháp vạch xước) : 1850-200g,
- Độ dày màng sơn (micron) : 15-25,
- Độ bền uốn (mm) : 1,0
- Độ bền chịu nhiệt ẩm (ASTM D 2247-68 (80) : 35-41 chu kỳ.