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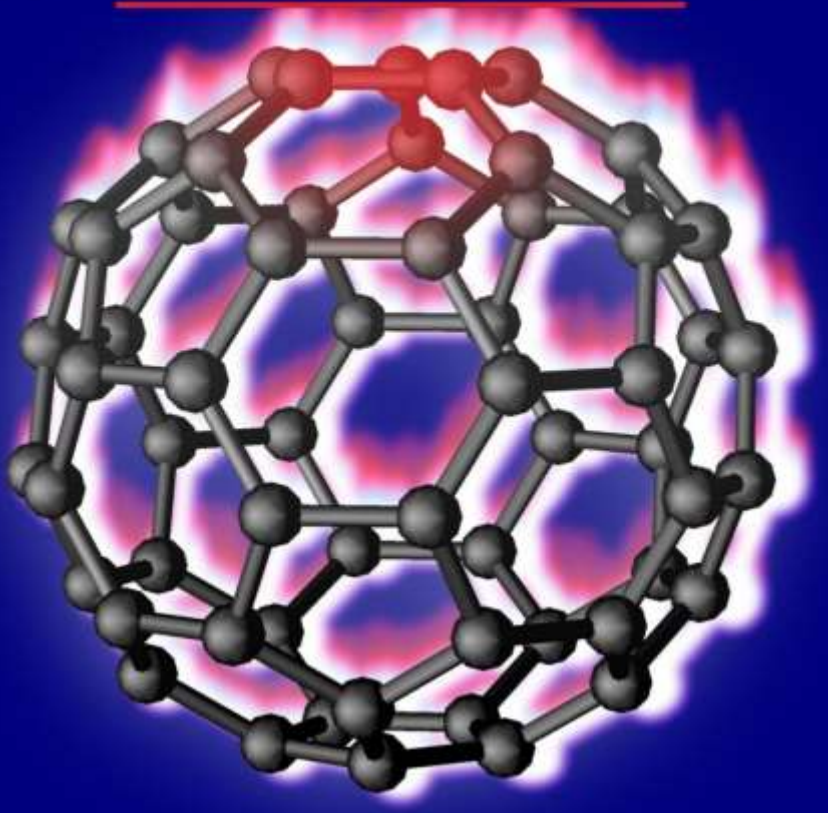

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CREATION OF COATINGS BASED ON HYDROPHOBIC SOOT

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Abstract. This work presents the results of investigations of the influence of hydrophobic soot to the coating. Obtained soot particles was investigated by scanning electron microscopy (SEM), Raman spectroscopy, Elemental analysis and etc.

1. Introduction

The development of hydrophobic and superhydrophobic materials has recently attracted a lot of attention due to the wide range of applications that these surfaces offer. Self-cleaning surfaces, anti-fouling materials, stain resistant textiles or antiicing coatings are just some examples that show the potential of these materials1 [1]. The results showed information's for production superhydrophobic coatings based on nano titanium dioxide, silica nano particles, nanotubes and polymers [2].

Soot is a material, which is made in a big quantity and mostly used to modify the properties of structural materials in the manufacture of elastomers, dyes, dry power sources, paint and coating, etc [3]. It was obtained soot particles during combustion of hydrocarbons. Thus, if fuel burns under specified conditions, it will be possible to get soot with special properties [3, 4]. In this work it was used ultrasonic wave mixer for dispersion of soot in the mixture of polyurethane and solvent 646.

2. Experimental

2.1 Materials

Polyurethane lacquer was applied for protection from mechanical and chemical impact of floors, walls, ceilings, products, etc. Solvent 646 is a mixture of toluene 50%, ethanol 15%, butanol 10%, butyl- or amyl acetate 10%, ethyl cellosolve 8%, acetone 7%. The hydrophobic soot was obtained by application electric field of 1 kV during combustion of the mixture of propane, butane, isobutene. The size of soot particles were 30-40 nanometers with the significant chain formation and tertiary structure, and the water contact angle (WCA) was larger than 146° [5]. Soot deposited on the surface of a stainless steel cylinder.

The produced soot was investigated by EDS. In Fig.1. shown EDS images of soot samples.

2.2 Preparation of coatings and dispersion of soot in the resin

Materials were mixed step-by-step. Initially polyurethane and solvent 646 were weighted and blended and then soot was mixed with slurry, then soot was rapidly dispersed to the liquid mixture by ultrasonic homogenizer under different conditions.

Table 1 presents 3 samples of coating composed of Polyurethane "Elakor-PU" lacquer (TU 2312-009-18891264-2009) resin, solvent 646, soot.

Table 1. Different samples under different conditions

Number of sample	Polyurethane, gr.	solvent 646, gr.	soot, gr.	Ultrasonic Power (25 Hz), Watt	Ultrasonic on time(second working)	Ultrasonic off time(second not working)	Min
Coating-1	5	30	1	600	2	1	5
Coating-2	5	30	2	600	3	1	15
Coating-3	4	40	3	600	5	0.5	30

Samples were prepared in different containers and then applied to the paper, tile, metal and wood.

It was used drop shape analyzer DSA25 KRÜSS GmbH for measurement of the water contact angle for surface. Three or four droplets of water were applied on the sample and then measured.

3. Results and discussion

3.1 Measurement of WCA by drop shape analyzer KRUSS

The water contact angle was measured on the tile and paper, wood, metal before and after hydrophobic coating. The obtained results are presented in the table below:

Table 2 presents the results on comparison of different coating formulations, WCA and soot concentrations.

Table 2. Comparison of different coating formulations, WCA and soot concentrations

Number	Polyurethane, gr	Solvent 646, gr	Soot, gr	Ultra sonic action, min	Soot concentration, %	Water contact angle on the tile, degree	Water contact angle on the paper, degree	Water contact angle on the wood, degree	Water contact angle on the metal, degree
Without any coating	0	0	0	0	0	47.8	98.6	40	29.9
Coating-1	5	30	1	5	2.7	93	115	105	100
Coating-2	5	30	2	15	5.4	137	136	130	128
Coating-3	4	40	3	30	6.3	141	142	136	135

3.2 Comparison of different coatings together with the CPVC

The critical pigment volume concentration (CPVC) Eq.(1) was used for formulating coatings [6]. CPVC is normal point for using a sufficient quantity of a binder for one volume of constant formulation of the paint and coating. Some properties of coating such as corrosion, glossy, abrasion changed in the CPVC (table 3) [6].

$$PVC = \frac{\text{Pigment volume concentration (soot)} * 100\%}{\text{Pigment volume concentration (soot)} + \text{binder volume (polyurethane)}}$$

Table 3. Comparison of CPVC, WCA, soot concentration and thixotropic properties

Number	Soot, gr.	Binder polyurethane, gr.	PVC, %	Flocculation	Use of dispersing agent	Thixotropic properties	Settling	Liquid stability	Concentration of soot in the formulation, %	Water contact angle on the paper
Coating-1	1	5	16.6	No	No	No	yes	No	2.7	115º
Coating-2	2	5	28.5	No	No	yes	No	yes	5.4	136º
Coating-3	3	4	42.8	No	No	yes	No	yes	6.3	142º

Conclusions

If soot was added in big quantities to the coatings at the critical pigment volume concentration (CPVC) and if the amount of soot increases coating, then hydrophobicity in the dry film of the surface becomes higher. Initial polyurethane has good resistance to the acid and alkali material, good mechanical and physical property. Introducing the soot nanostructure into the mixture of polyurethane and 646 solvent, hydrophobic coating was obtained for different surfaces such as wood, metal, tile, and paper. Additionally, thixotropic properties in CPVC were determined by application of hydrophobic soot to the hydrophobic coating-2 and coating-3.

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