FACTA UNIVERSITATIS
Series: **Physics, Chemistry and Technology** Vol. 3, N° 2, 2005, pp. 205 - 216

COLOUR PARAMETERS, WHITENESS INDICES AND PHYSICAL FEATURES OF MARKING PAINTS FOR HORIZONTAL SIGNALIZATION

UDC 667.653.4 : 535.6; 667.653.4 : 625.746.5

Aleksandra R. Zarubica[1], Milena N. Miljković[1], Milovan M. Purenović[1], Vesna B. Tomić[2]

[1]Department of Chemistry, Faculty of Natural Sciences and Mathematics, Višegradska 33, 18000 Niš, Serbia and Montenegro
[2]City Planning Center Niš, 18000 Niš, Serbia and Montenegro

Abstract. *The present paper describes the assessment of colour parameters of industrial paints for horizontal signalization (designed as POM S1 and POM S2 / ZEB 1 and ZEB 2) of white colour hue, coming from two different producers ("Pomoravlje" and "Zorka") with reference to an independent sample (IND 0) and some physical properties of each sample. Colorimetric characterization of samples was performed using a reflectance spectrophotometer "Update Colour Eye 3000". Standard and modified test methods (ASTM) were performed to establish physical properties of the paints. The industrial paints show better values for the investigated parameters and properties and satisfy standards prescribed by law. POM S2 sample with dry film thickness, similar to the same of other samples, provides the best physical features maximizing quality and minimizing protection cost.*

Key words: *colour parameters, marking paints, physical features, reflectance spectrophotometric method, whiteness index*

1. INTRODUCTION

Organic coatings for thin layers marking of asphaltic and concrete surfaces are produced on the basis of synthetic binders, extenders and pigments, as well as special additives, which provide fast drying, good adhesion and visibility, weather and friction resistance. These marking paints are used for horizontal signalization of roads, highways, pedestrian crossings, parking lots, and for other marking types in industries and wide consumption [1-3].

The above-mentioned paints have to satisfy appropriate quality, physical, chemical and technical properties. That means they have to provide good visibility on the roads in conditions of daily and night driving, to possess corresponding roughness and longlast-

Received February 3, 2005

ness in the requested time interval. The composition of organic coatings and the way of application have to guarantee good reflective characteristics of horizontal signalization. This effect may be attained adding small glass beads by spraying or covering coatings using them. The glass beads consist of SiO_2, Na_2O and K_2O mixture, CaO, MgO, Al_2O_3 and Pb, the contents of which may be determined by chemical analyses for silicate materials [1-3]. All quoted properties and paint quality have to coordinate with traffic load of roads.

The present paper describes the assessment of colour parameters of the paints of white colour hue, coming from two different producers, with reference to an independent sample and some physical properties of each sample.

THEORETICAL PART

Numerous systems exist for the systematization - objective measurement of colours. The most important are: Commission International de l' Eclairage (CIE), Deutche Institut fur Normung - German Standard Institute (DIN), Natural Colour System (NCS), Ostwald's and Munssel's systems [4-6]. CIE and DIN chromatic systems are scientifically recognized as the basis for numerical evaluation of colours and the calculation of differences between them. Modern colorimetry is based on the Grassmann's laws of additive mixing.

Reflectance curves - optical features of objects

The processes of reflectance and absorbance in combination with the chemical and structural features of objects are responsible for the appearances of almost all objects and their colours. Quantitative measure of object affection on the light striking it may be determined on the basis of reflectance curves, i.e. absorbance. The light striking an object will be affected by interaction with the object in a number of different ways. Measurements of the fractions of light either reflected or transmitted at different wavelengths are usually presented as curves in which percentage of reflectance (transmittance) or of absorbance is shown at each wavelength. The relation of the shape of the curve to the curves of known hues gives some indication of the object colour.

Numerical evaluation of colour

The system of coordinates designated as L*, a* and b* was recommended by CIE in 1976. One colour is completely determined by three coordinates: L*, a* and b* or L*, C* and H* [4-6].

L* is the vertical coordinate of a three-dimensional system of colours, which has values from 0 (black) to 100 (for white);

a* is the horizontal coordinate the values of which range from –80 (green) to +80 (red);

b* is the horizontal coordinate the values of which range from –80 (blue) to +80 (yellow).

The angle H*, the colour hue, is expressed in degrees (H* = 0 corresponds to red, H* = 90 to yellow, H* = 180 to green, H* = 270 to blue);

C* - the colour saturation, represents the mentioned colour distance from a non-multicoloured point, which corresponds to a* = b* = 0 [4-6].

Colour is determined by three dimensions by David and Katz, owing to its interpretation in coloured space: H (the hue), L (the lightness) and C (the chroma) [4-6].

Multicoloured (yellow, red, green, blue) and non-multicoloured nuances are distinguished according to colour hue.

The colour lightness presents a measure in which one colour is light or dark expressed in light degrees from white to black colour.

The saturation describes the colour intensity and represents the distance from the black-white axis [4-6].

Colour coordinates are calculated by the following equations:

$$L^* = 116(Y/Yn)^{1/3} - 16 \quad (1)$$

$$a^* = 500[(X/Xn)^{1/3} - (Y/Yn)^{1/3}] \quad (2)$$

$$b^* = 200[(Y/Yn)^{1/3} - (Z/Zn)^{1/3}] \quad (3)$$

$$C^* = (a^{*2} + b^{*2})^{½} \quad (4)$$

$$H^* = \text{arctg}\,(b^*/a^*) \quad (5)$$

$$E^* = (L^{*2} + C^{*2})^{½} \quad (6)$$

The values designated as Xn, Yn and Zn are standardized values, which are related to a theoretical ideally white specimen. They may be found in tables of standards [6].

Tristimulus values

Tristimulus values are calculated from spectral reflectance factors, R(λ), covering the range 400-700 nm. In a 0-1 scale these factors express the reflectance at each wavelength as a decimal fraction of that reflected by a perfect reflecting diffuser identically illuminated. R(λ) is multiplied by S(λ), the relative spectral power distribution of the illuminant, by each of the three colour matching functions $\bar{x}(\lambda), \bar{y}(\lambda), \bar{z}(\lambda)$ and by the scaling factor κ. Three summations are:

$$\begin{aligned} X &= \kappa \sum R(\lambda) \cdot S(\lambda) \cdot \bar{x}(\lambda) \\ Y &= \kappa \sum R(\lambda) \cdot S(\lambda) \cdot \bar{y}(\lambda) \\ Z &= \kappa \sum R(\lambda) \cdot S(\lambda) \cdot \bar{z}(\lambda) \end{aligned} \quad (7)$$

The colour matching functions are also the tristimulus values of the equal-energy spectrum and at each wavelength the chromaticity coordinates are given:

$$x = \frac{\bar{x}}{\bar{x} + \bar{y} + \bar{z}}, y = \frac{\bar{y}}{\bar{x} + \bar{y} + \bar{z}}, z = \frac{\bar{z}}{\bar{x} + \bar{y} + \bar{z}} \quad (8)$$

These are plotted in a right-angled triangle.

Whiteness index (W) assessment

The study of reflective characteristics of white object is analogous to the one of any object. Whiteness is an attribute by which an object is judged to approach the preferred white.

The earliest studies merely used average reflectance through the visible spectrum as the scale for whiteness. This was hardly satisfactory.

The individual preference for whites makes optical criteria of whiteness variable from one observer to another. Due to their high reflectances factors throughout the visible spectrum, white materials have high tristimulus values X, Y and Z.

Different formulations for the whiteness assessment are currently used, such as those by Berger, Hunter and Stensby. All of them are in accordance with the illuminant D65-10.

The calculations of whiteness indices using tristimulus values are expressed as:

$$W_{(CIE)} = Y + 800(0.3138 - x) + 1700(0.3310 - y) \quad (9)$$

$$W_{(Berger)} = Y + 3.452Z - 3.908X$$
$$W = Ry + 3Rz - 3Rx \quad (10)$$

$$W_{(Hunter)} = L - 3b \quad (11)$$

$$W_{(Stensby)} = L + 3a - 3b \quad (12)$$

It is likely that the best whiteness index will be based on an equation that locates the position of an ideal white and measures whiteness as the distance in colour space from the sample to that ideal.

Calculation of colour differences

The equations for the calculation of colour differences are defined on the basis of theoretical conclusions, experience and experimental results [6].

$$DE^* = [(DL^*)^2 + (Da^*)^2 + (Db^*)^2]^{½} \quad (13)$$

$$DE^* = [(DL^*)^2 + (DC^*)^2 + (DH^*)^2]^{½} \quad (14)$$

DE* – total colour difference

Da* – the difference on the red-green coordinate ($Da^* = a^*_{sample} - a^*_{standard}$)
+ Da* marks redder, - Da* marks greener;

Db* – the difference on the blue-yellow coordinate ($Db^* = b^*_{sample} - b^*_{standard}$)
+ Db* marks yellower, - Db* marks bluer;

DL* – the difference in lightness ($DL^* = L^*_{sample} - L^*_{standard}$)
+ DL* marks lighter, - DL* marks darker;

DC* – the difference in chroma ($DC^* = C^*_{sample} - C^*_{standard}$)
+ DC* marks more brilliant, - DC* marks more opaque.

DH* – the difference in colour hue is calculated by equation:

$$DH^* = [(DE^*)^2 - (DL^*)^2 - (DC^*)^2]^{1/2} \quad (15)$$

EXPERIMENTAL PART

The following paints for horizontal signalization were used in the experiment: a sample prepared in laboratory conditions as a standard one (designed as IND 0), two samples of one producer - Industry of Paints and Varnishes "Pomoravlje" – Nis (designed as POM S1 and POM S2), and two of the other producer "Zorka" – Sabac (designed as ZEB 1 and ZEB 2). The mentioned independent standard (IND 0) was made of acrylic resin (33%), extender - magnesium calcium carbonate (31%), pigment - titanium (IV)-oxide (14%), solvents - acetone and toluene (1/11; 22%). The samples POM S1 and POM S2 were produced by the adequate technological procedure with addition of special additives and glass beads; also, the samples ZEB 1 and ZEB 2 were produced using the industrial technological procedure with additives. The chemical compositions of final industrial paints were patented. Paints were applied on steel surfaces. The steel surfaces were degreased with alkaline solutions with surface-active agents and emulsible substances. The paints were applied by spray gun (nozzles were of diameter 0.5-5 mm, selected according to the viscosity of the paint and pressure).

Colorimetric characterization of samples was performed by a reflectance spectrophotometer "Update Colour Eye 3000".

The spectrophotometer is the integral part of a system, which components are a computer and its metric programs [5,6]. This instrument measures spectral reflectance of samples at 16 wavelengths in the range of visible spectrum (400-700 nm). A holographic net with a diode cell is used as a monochromator. The illuminant is xenon flash bulb. The computer or networked computers may be used as a system with one place or a system with more places [5,6].

Reflectance spectra, CIELAB coordinates, tristimulus values, whiteness indices (by CIE and Berger's systems) were recorded. The values were determined for three standard illuminants such as daylight, incandescent and fluorescent light. The measurement geometry was d / 10º. The computer was with one place.

The measured CIELAB coordinates were used for the calculation of the colour differences: total colour difference (DE), difference of lightness (DL), differences on the red-green (Da) and on the blue-yellow (Db) coordinates.

According to the corresponding standards, test methods were performed in order to establish physical properties of the paints. Dry film thickness was measured by non-destructive gages with digital display on ferrous substrate. Adhesion test comprised "cross-cut test" as a procedure for assessing the resistance of paints to separation from substrate when a right-angle lattice pattern was cut into the coating, penetrating through to the substrate (ASTM D 3002/3359). Flexibility/Elasticity was assessed by "bend-test" bending painted sheet metal over a definite radius of conical mandrel that allowed an indication of the elongation and adhesion of a paint film due to bending stress (ASTM D 522/1737). Impact resistance was evaluated by "impact test-falling weight test" procedure as a resistance of a coating to cracking and peeling from a substrate when it is subjected to a deformation caused by a falling weight, dropped, yielding rapid deformation (ASTM D 2794). Coating hardness was evaluated by measuring the damping time of an oscillating pendulum by Køning.

The investigation of chemical resistance of paints was performed using modified standard method. Selected chemical agents were applied over filter papers on the above-mentioned crosscut surfaces of paints during the defined time intervals (30 s - 7 days).

RESULTS AND DISCUSSION

The spectrophotometer automatically used three illuminants, designated as:

1. daylight (D65/10),
2. incandescent (A-10),
3. fluorescent light (TL 84/10) [7,8].

The CIE standard illuminant D 65, which corresponds to natural daylight, at a correlated colour temperature of about 6500 K, should be chosen for colour measurements in accordance with International Standard (IS) [9]. The standard illuminant A, which represents the light of a tungsten lamp and corresponds in its spectral distribution to a perfect black body at a temperature of 2856 K, should be specified and chosen for colour measurements and the colorimetric determination of a special metamerism index [10].

These two illuminants are relevant for our experimental measurements because the analyzed samples have to satisfy good visibility in conditions of daily and night driving. Here the results are presented for these illuminants. The results of tristimulus values of the studied samples are given in Tables (1-5).

Table 1. Tristimulus values of the sample IND 0

	X	Y	Z	x	y
D65–10'	74.27	79.33	78.60	0.3198	0.3417
A – 10'	88.18	79.59	26.13	0.4548	0.4105

Table 2. Tristimulus values of the sample ZEB 1

	X	Y	Z	x	y
D65–10'	79.36	84.56	87.72	0.3154	0.3360
A – 10'	93.46	84.49	29.04	0.4515	0.4082

Table 3. Tristimulus values of the sample ZEB 2

	X	Y	Z	x	y
D65–10'	79.00	84.26	86.58	0.3162	0.3372
A – 10'	93.19	84.24	28.70	0.4521	0.4087

Table 4. Tristimulus values of the sample POM S1

	X	Y	Z	x	y
D65–10'	80.12	85.41	90.84	0.3125	0.3331
A – 10'	93.76	85.06	30.01	0.4490	0.4073

Table 5. Tristimulus values of the sample POM S2

	X	Y	Z	x	y
D65–10'	80.19	85.31	92.19	0.3112	0.3310
A – 10'	93.56	84.88	30.39	0.4480	0.4064

The obtained tristimulus values (Tab. 1-5) were used for the calculation of the whiteness indices by CIE and Berger according to Eq. (9,10).

- ♦ Whiteness indices of the sample IND 0
  ILLUMINANT C 2D 65-10' ILLUMINANT C 2
  C.I.E. ' 82 Whiteness = 56.39 Berger Whiteness = 77.26.

- ♦ Whiteness indices of the sample ZEB 1
  ILLUMINANT C 2D 65-10' ILLUMINANT C 2
  C.I.E. ' 82 Whiteness = 74.76 Berger Whiteness = 95.71.

- ♦ Whiteness indices of the sample ZEB 2
  Illuminant C 2D 65-10' Illuminant C 2
  C.I.E. ' 82 Whiteness = 71.74 Berger Whiteness = 92.79.

- ♦ Whiteness indices of the sample POM S1
  ILLUMINANT C 2D 65-10' ILLUMINANT C 2
  C.I.E. ' 82 Whiteness = 82.81 Berger Whiteness = 105.01.

- ♦ Whiteness indices of the sample POM S2
  ILLUMINANT C 2D 65-10' ILLUMINANT C 2
  C.I.E. ' 82 Whiteness = 87.34 Berger Whiteness = 109.40.

The number of measurement for each parameter was two and the instrument showed only the average value. The repeatability, with which spectral reflectance or spectral reflectance factors, as well as colour coordinates and tristimulus values can be measured, should be better than the following values: 0.2% of the reading or 0.001 (absolute). The accuracy should be better than the following two values: 0.5% of the reading or 0.002 (absolute).

The whiteness indices of the industrial paints products are significantly higher than the same ones of the sample made in a simple laboratory conditions (approximately 15 - 30 units). These values satisfy whiteness colour quality prescribed by IS. It may be presumed that technological production operations are correctly done. The highest W is established for the POM S2 sample (87.34/109.40); it may be ascribed to adequate technological procedure and chemical composition. It presumes the contents of special additives and glass beads, which provide good colour parameters, visibility and retro reflective characteristics. The explanation for the samples ZEB 1 and ZEB 2 is similar, but the difference is that they do not contain glass beads. Small W differences between industrial paints (POM S2 and POM S1 / ZEB 1 and ZEB 2) may be caused by somewhat different conditions of mixing, preparation of substrate surface, substrate impact and application of paints of the same producer.

Table 6. The colour difference between the samples ZEB 1 (batch) and IND 0 (standard)

Standard		IND 0			
Batch		ZEB 1			
Colour differences CIELAB Standard D65–10' L 93.6 a -0.7 b 1.2					
Illuminant			L	a	b
D65–	10'	DE 0.86	0.76 Lighter	0.20 +a	0.35 +b
A –	10'	DE 0.96	0.81 Lighter	0.28 +a	0.42 +b

The results of colour differences between ZEB 1 and IND 0 samples (Tab. 6) show that the sample ZEB 1 is lighter (0.76/0.81), redder (0.20/0.28) and yellower (0.35/0.42). These differences and a total colour difference (0.86/0.96) satisfy two allowed criteria M&S 83 A (DE ≤ 1.5) and CMC (DE ≤ 1.4), given by IS [7,8].

Table 7. The colour difference between the samples ZEB 2 (batch) and IND 0 (standard)

Standard		IND 0			
Batch		ZEB 2			
Colour differences CIELAB Standard D65–10' L 91.5 a -1.2 b 1.5					
Illuminant			L	a	b
D65–	10'	DE 0.36	0.10 Lighter	0.10 +a	0.33 +b
A –	10'	DE 0.42	0.07 Lighter	0.17 +a	0.38 +b

It appears (Tab. 7) that the sample ZEB 2 is lighter (0.10/0.07), redder by coordinate "a" and yellower by coordinate "b" than the sample IND 0; all differences are in the allowed limits.

Table 8. The colour difference between the samples POM S1 (batch) and IND 0 (standard)

Standard		IND 0			
Batch		POM S1			
Colour differences CIELAB Standard D65–10' L 91.0 a -1.1 b 2.7					
Illuminant			L	a	b
D65–	10'	DE 0.67	0.37 Lighter	0.20 +a	0.52 +b
A –	10'	DE 0.80	0.42 Lighter	0.32 +a	0.60 +b

It is seen (Tab. 8) that the sample POM S1 is lighter (0.37/0.42), redder (0.20/0.32) and yellower (0.52/0.60) than IND 0. The differences are smaller than the allowed values by the cited criteria.

Table 9. The colour difference between the samples POM S2 (batch) and IND 0 (standard)

Standard		IND 0			
Batch		POM S2			
Colour differences CIELAB Standard D65–10' L 92.3 a -1.3 b 0.1					
Illuminant			L	a	b
D65–	10'	DE 0.9	0.83 Lighter	0.30 +a	0.78 +b
A –	10'	DE 1.1	1.00 Lighter	0.70 +a	0.96 +b

Regarding the results (Tab. 9), it is obvious that the sample POM S2 is lighter (0.83/1.00) redder (0.30/0.70) and yellower (0.78/0.96); all quoted differences are smaller than the allowed values by criteria, prescribed by IS.

The results of calculation and comparison of colour differences between each sample and the independent one (Tab. 6-9) show a similar relation of colour parameters as tristimulus values of samples (Tab. 1-5), which is in accordance with Eq. (1-6) that represents a direct proportion between colour coordinates and tristimulus values. It may be suggested that colour differences can be predicted by tristimulus values.

Graphic presentations of the calculated colour differences and values of lightness of the same producer samples are shown in Fig. (1,2).

- The colour difference between the samples ZEB 2 (batch) and ZEB 1 (standard)

Standard		ZEB 1			
Batch		ZEB 2			
Colour differences CIELAB Standard D65–10' L 94.9 a -1.6 b 2.8					
Illuminant			L	a	b
D65–	10'	DE 1.1	0.6 Lighter	0.4 +a	0.9 +b
A –	10'	DE 1.4	0.7 Lighter	0.6 +a	1.0 +b

```
      COLOUR PLOT              Illuminant D65–10'              LIGHTNESS
             +b  1.0                                             L              1.0
             +                                                   +
             + B                                                 +
             +                                                   +B
             +                                                   +
             +                                                   +
1.0  -a+++++ + +++++a+  1.0                                      0
             +                                                   +
             +                                                   +
             +                                                   +
             +                                                   +
             +                                                   +
             -b  1.0                                             D              1.0

             r)                                                  p)
```

Fig. 1. Graphic presentations: r) colour differences between ZEB 2 and ZEB 1;
p) difference of lightness B is design for a batch

On the basis of the graphic presentation of colour differences (Fig. 1), it appears that the sample ZEB 2 is lighter than the sample ZEB 1, redder and yellower than the same one. The total colour differences by both illuminants (1.1/1.4) satisfy the two allowed limits, given by M&S 83 A and CMC criteria.

- The colour difference between the samples POM S2 (batch) and POM S1 (standard)

Standard		POM S1			
Batch		POM S2			
Colour differences CIELAB Standard D65–10' L 93.6 a -0.7 b 1.2					
Illuminant			L	a	b
D65–	10'	DE 0.86	0.76 Lighter	0.20 +a	0.35 +b
A –	10'	DE 0.96	0.81 Lighter	0.28 +a	0.42 +b

```
      COLOUR PLOT              Illuminant D65–10'              LIGHTNESS
             +b  1.0                                             L              1.0
             +                                                   +
             +                                                   +B
             +                                                   +
             + B                                                 +
             +                                                   +
1.0  -a+++++ + +++++a+  1.0                                      0
             +                                                   +
             +                                                   +
             +                                                   +
             +                                                   +
             +                                                   +
             -b  1.0                                             D              1.0

             r)                                                  p)
```

Fig. 2. Graphic presentations: r) colour differences between POM S2 and POM S1;
p) difference of lightness B is design for a batch

It may be seen from (Fig. 2), that the sample POM S2 is lighter than the POM S1 for two illuminants. By coordinate "a", the tested sample is redder and by coordinate "b" it is yellower. The differences DE (0.86/0.96) are smaller than the allowed values by the cited criteria.

The comparison of colour differences between the samples of the same producers may be proved because those results have to be in accordance with regulations determining potential colour deviations in the production or application of paints. Similarly, colour differences obtained in the experiment (Fig. 1,2) can be explained using the aforementioned reasons.

The obtained results of the physical properties are presented in Table 10.

Table 10. Physical properties of the examined samples

Sample coatings	Dry film thickness (μm)	Hardness (s)	Adhesion (degree)	Flexibility /Elasticity (mm)	Impact resistance (cm)
IND 0	350 - 380	24	2	8.0	80/100
ZEB 1	400 - 420	36	0	9.9	95/100
ZEB 2	440 - 490	33	1	9.7	90/100
POM S1	450 - 470	38	0	10.0	100/100
POM S2	470 - 490	39	0	10.0	100/100

Coating thickness accurately maximizes quality and minimizes material costs. In order to perform satisfactorily, coatings must adhere to the substrate on which they are applied, must provide considerable hardness as a result of successful crosslinking protecting coatings of a mechanical force. The results show that the paints POM S2 and POM S1 have the best physical properties (Tab. 10) in the case where similar dry film thicknesses are reached. It can be attributed to the correct technological production procedure and chemical composition.

Chemical resistance was investigated against chemicals that may simulate industrial atmosphere or exploitation conditions: 5% sodium chloride, conc. sulphuric, nitric and perchloric acids, acetic acid and diethyl ether (Tab. 11).

Table 11. Chemical resistance of the examined samples

Sample	5% sodium chloride (degree)	Sulphuric acid (degree)	Nitric acid (degree)	Perchloric acid (degree)	Acetic acid (degree)	Diethyl ether (degree)
IND 0	9	8 – 9	9	8 – 9	9	8 – 9
ZEB 1	10	9 – 10	10	9 – 10	10	10
ZEB 2	10	9 – 10	10	9	9 – 10	10
POM S1	10	9 – 10	10	9 – 10	9 – 10	10
POM S2	10	10	10	10	10	10

Chemical resistances (Tab. 11) are relatively similar and range from 8/9 (IND 0) to 10 (POM S2). Greater values of chemical resistances are established for the industrial paints, which prove correct composition and production operations satisfactorily for their purpose.

CONCLUSIONS

On the basis of the investigation of colour parameters and some physical properties of paints for horizontal signalization from two different producers compared to an independent sample prepared in laboratory conditions, it may be concluded that:

Industrial paints show better values of the investigated parameters and properties and satisfy standards prescribed by law.

POM S1 and POM S2 as samples of monocomponent paints coatings produced on the basis of synthetic binder, pigment and extender, as well as special additives, provide fast drying, good adhesion and visibility, chemical, weather and friction resistance. These coatings are characterized by high abrasion and wear-out resistance that is intensified in the presence of reflective glass beads. They have good adhesion for asphaltic, concrete, stone and steel surfaces. Due to a high covering power, roads marking may be successfully attained applying one coating layer. The organic coating - marking paint application is easy and fast.

The POM S2 sample with dry film thickness similar to the one of other samples provides the best physical properties, maximizing quality and minimizing protection cost. This experiment may be an example of reflectance spectrophotometric method application for the analyses of the final industrial colours, determining colour deviations in the production of paints using the results for control or regulation of the process.

REFERENCES

1. L.E. Nielson, *Mechanical Properties of Polymers*, Reinhold Publishing Corp., New York, 1962, s 23.
2. P. Quednau, Polyisocyanatvernetzendes Acrylharz fur luft und ofentrocknende Anwendung, Reinhold-Albert-Nachrichten 3 (1969) s 4-8.
3. Lj.D. Rašković, *Osnovi polimernog inženjerstva*, Univerzitet u Nišu, Tehnološki fakultet u Leskovcu, Leskovac, 1995.
4. M. Novaković, Teorija i tehnologija oplemenjivanja tekstila bojenjem i štampanjem, BMG-Beograd, 1996.
5. K. Mc Laren, *The Colour Science of Dyes and Pigments*, Adam Hilger Ltd., Bristol, 1986.
6. D.B. Judd, G. Wyszecki, *Colour in Business, Science and Industry*, John Wiley & Sons, New York, 1975.
7. M. Miljković, M. Purenović, A. Zarubica, V. Tomić, Z. Savić, 3rd International Conference of the Chemical Societies of the South-Eastern European Countries on Chemistry in the New Millennium-an Endless Frontier, Bucharest, Romania, 2002, Book of Abstracts, Volume I, pp. 153.
8. Lj. Rašković, Lj. Despotović-Kostić, A. Zarubica, *16th International Congress of Chemical and Process Engineering*, Praha, Czech Republic, 2004, Summaries 5 - Systems and Technology, pp. 2018.
9. International Standard, Paints and Varnishes-Colourimetry, *Principles*, ISO 7724/1-1984.
10. International Standard, Paints and Varnishes-Colourimetry, *Colour measurement*, ISO 7724/2-1984.

PARAMETRI BOJE, INDEKSI BELINE I FIZIČKA SVOJSTVA ORGANSKIH PREMAZA ZA HORIZONTALNU SIGNALIZACIJU

Aleksandra R. Zarubica, Milena N. Miljković, Milovan M. Purenović, Vesna B. Tomić

Ovaj rad opisuje određivanje parametara boje industrijski proizvedenih organskih premaza za horizontalnu signalizaciju (označenih kao POM S1 i POM S2 / ZEB 1 i ZEB 2), belog tona boje, dva različita proizvođača ("Pomoravlje" i "Zorka") u odnosu na nezavisni uzorak (IND 0) i neka fizička svojstva svakog pojedinačnog uzorka. Kolorimetrijska karakterizacija uzoraka je izvršena refleksionim *spektrofotometrom tipa "Update Colour Eye 3000". Standardne i modifikovane test metode su korišćene radi utvrđivanja fizičkih svojstava organskih premaza. Industrijski proizvedeni premazi pokazuju bolje vrednosti ispitivanih parametara i svojstava i zadovoljavaju standarde propisane zakonom. POM S2 uzorak sa debljinom suvog filma, sličnom istoj ostalih uzoraka, obezbeđuje najbolja fizička svojstva povećavajući kvalitet do maksimuma i snižavajući cenu zaštite do minimuma.*