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Characterizing the appearance of medium glossy surfaces

Michael Osterhold*, Kornelia Armbruster

DuPont Performance Coatings, Wuppertal, Germany

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ABSTRACT

For characterizing the overall appearance of a coating system mainly two different techniques are used in the automotive and paint industry. The mechanical profilometry combined with Fourier techniques and the "wave-scan" instruments. In 2006 the new "wave-scan *dual*" was introduced by Byk-Gardner for detecting the appearance of surfaces with lower gloss (medium glossy), e.g. primer-surfacers and EC. Within the framework of different studies results of evaluations of applicability and limitations of the "wave-scan *dual*" for characterizing the appearance of medium glossy surfaces will be presented.

1. Introduction

For characterizing the overall appearance of a coating system mainly two different techniques are used in the automotive and paint industry. The mechanical profilometry combined with Fourier techniques (FFT) yields detailed information of the surface topography, and substrate influences or other effects on the final coating appearance can be described [1–17]. To simulate the visual impression obtained from optical inspection of surface structures, the German company Byk-Gardner developed the so-called "wave-scan" instruments. For the last 5 years the "wave-scan DOI" has been used to evaluate appearance on glossy surfaces (topcoats), with the separation of the structure spectra in several different wavelength-ranges in addition to the parameters LW and SW which have been used already for a longer time. In 2006 the new "wave-scan *dual*" was introduced by Byk-Gardner for detecting the appearance of surfaces with lower gloss (medium glossy), e.g. primer-surfacers and EC. One advantage of this instrument is a time saving optical investigation of surface structures in an early state of the coating process. Within the framework of different studies results of evaluations of applicability and limitations of the "wave-scan *dual*" for characterizing the appearance of medium glossy surfaces will be presented.

2. Methods

2.1. Mechanical surface characterization

Surface profiles presented in this report were measured by mechanical profilometry using the Hommeltester T 8000 (Hommel-Etamic, Germany). For all measurements, a so-called datum system (without skids) with a diamond tip radius of 5 μm was used. The vertical resolution of this mechanical profilometric system is approx. 0.01 μm. The surface profiles were recorded over a scan length of 48 mm. A cut off wavelength of 8 mm was used to separate between roughness and waviness profile. The evaluation of the mechanical profile measurement according to typical roughness parameters – e.g. average roughness Ra – gives an integrated information about the surface structure. In comparison to roughness parameters, Fourier techniques (FFT) yield a more detailed characterization of the surface structure.

For wavelengths from 10 to 1 mm (integral 1, long waviness) and from 1 to 0.1 mm (integral 2, short waviness), the intensities of the autopower spectra are added up and used for further evaluation of the surface structures (see, e.g. [14]).

* Corresponding author.
E-mail address: michael.osterhold@deu.dupont.com (M. Osterhold).

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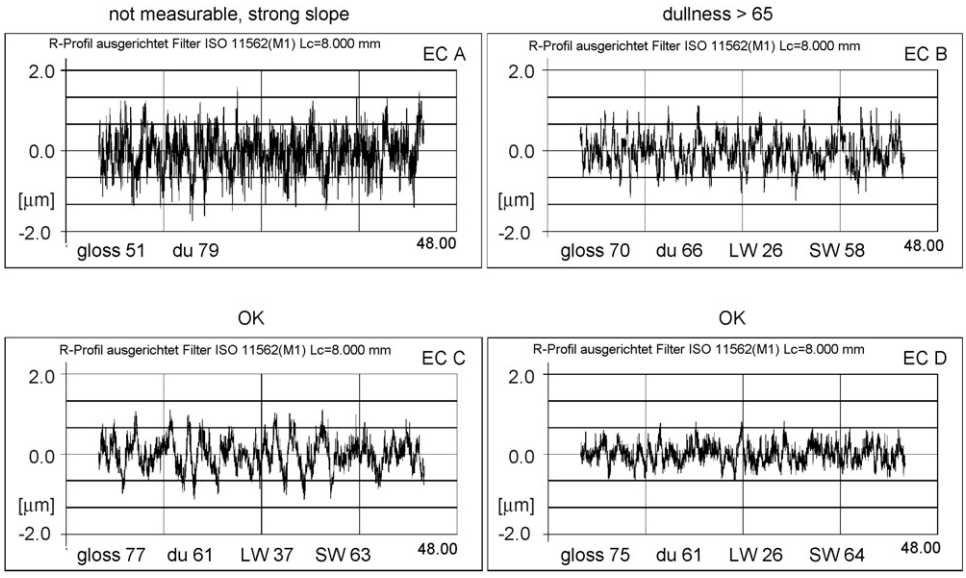

Fig. 1. Roughness profiles of EC (variation coating system).

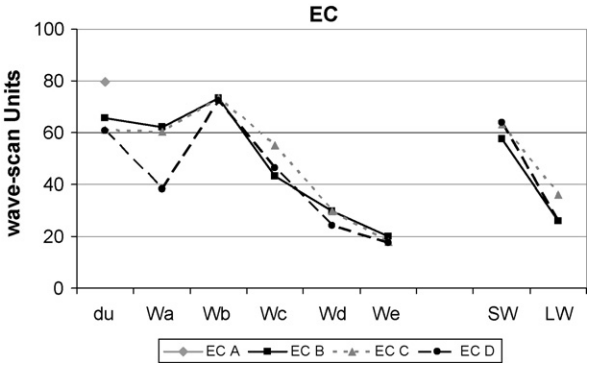

Fig. 2. Structure spectra, SW and LW of EC (variation coating system).

2.2. Optical surface characterization

2.2.1. Wave-scan

Since 2006 the optical determination of coating structures is carried out by the wave-scan dual (former instrument wave-scan DOI). Here, the measuring principle is based on the modulation of the light of a small laser diode reflected by the surface structures of the sample. The laser light shines on the surface at an angle of 60°, and the reflected light is detected at the gloss angle (60° opposite). During the measurement, the "wave-scan" is moved across the sample surface over a scan length of approx. 10 cm, with a data point being recorded every 0.027 mm. The signal is divided into 5 wavelength ranges in the range of 0.1–30 mm and processed by mathematical filtering. For each of the 5 ranges a characteristic value (Wa 0.1–0.3 mm, Wb 0.3–1.0 mm, Wc 1.0–3.0 mm, Wd 3.0–10 mm, We 10–30 mm) as well as the typical wave-scan-values longwave (LW, approx. 1–10 mm) and shortwave (SW, approx. 0.3–1 mm) is calculated. Low wave-scan-values mean a smooth surface structure. Additionally a LED light source is installed in the

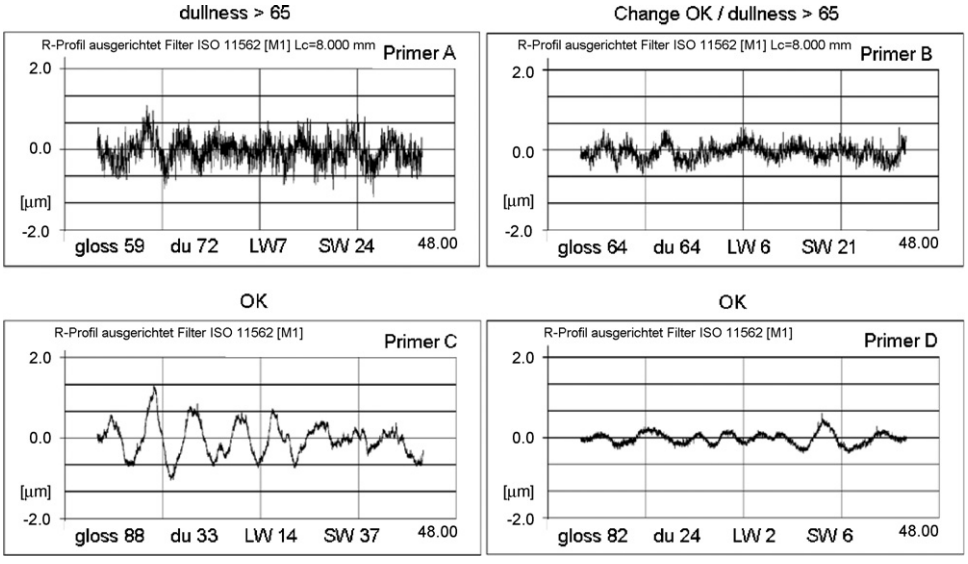

Fig. 3. Roughness profiles of primer-surfacers (variation coating system).