Latex Films with In-Plane Composition Gradients Caused by Lateral Drying

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The drying process of waterborne polymer coatings always entails a mass transport. Within simple models the flow of water mostly occurs from the bottom of the film to the top. Importantly, there also is a flow of water in the plane of the drying film, related to the so-called coffee ring effect [1,2]. This flow may be coupled to a flow of particles [3] and may induce topographical features in the final film. [4].

This work is contained with gradients in *chemical composition* rather than gradients in film height. An indicator dye contained in the aqueous phase was used to visualize these *gradients of pH*. Variable glass temperatures (−10, 4, and 20°C) and thickener content (0, 0.5, and 1.5 %) were examined. Fig. 1 shows photos taken on the drying films, showing that the pH varies from the center to the edge.

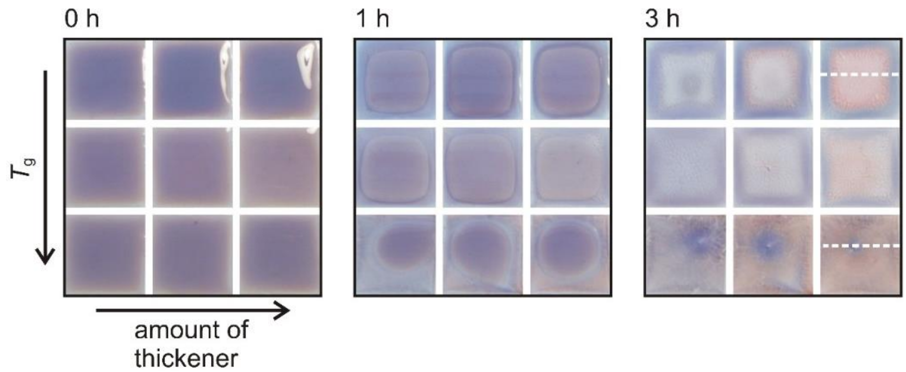

Fig. 1. Top view of drying films taken immediately after application, one hour after application, and three hours after application (when they are dry). The dry film thickness was 80 µm.

The results of this study can be summarized as follows:

1. Lateral drying can cause pH-gradients in the final film.

2. If the glass temperature (T_g) of the polymer is much below the drying temperature, the pH of the final film is low at the edge of the film. Protons are carried to the rim.

3. If the T_g of the polymer is close to the drying temperature or above, the pH of the final film is low at the center of the film. Protons flow inwards with the drying front.

4. A thickener is effective in decoupling the movement of the liquid from the movement of the latex spheres, which is needed to achieve gradients in composition.

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