Drying Behavior of Hard Particulate Coatings

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Coatings prepared from suspensions of non-deformable particles, such as ceramics, polymer latex particles with high glass transition temperature, some metals, and semiconductor nanocrystals, are used for a wide variety of applications. However, due to their brittle nature and the tendency to exhibit weak particle-particle bonds, drying-induced stresses often lead to cracking. The particle size distribution, addition of binder, and the drying conditions influence stress development, microstructure formation, and the cracking behavior.

In this research, we studied aqueous coating systems containing ceramic particles with tailored particle size distributions. Some dispersions were modified by the addition of soluble binders and latex binders. Stress development and weight loss were monitored under controlled drying conditions (temperature and humidity). The coating stress was determined by a cantilever beam deflection method[1, 2]. Cantilevers with a soft border[3, 4] were used to limit lateral drying and improve stress measurements. The effects of the border were investigated using both analytical and experimental approaches. SEM and cryoSEM techniques were used to relate stress development and cracking behavior to changes in the coating microstructure. The effect of binder additives on stress development and microstructure formation were also explored. From these results, recommendations for designing the coating composition and drying conditions are made to eliminate or reduce cracking and improve performance.

References

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