UNIFORMITY OF COATING ON SMALL PARTICLES

by

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This work is part of a continuing effort to determine the uniformity of distribution of coating deposited onto particles. Earlier work has shown that for large particles, tablets, the distribution of coating between individual tablets can be measured and controlled.

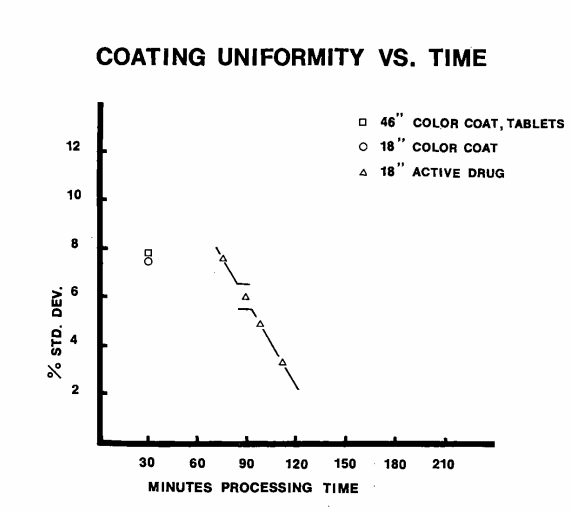
In 1971 and 1972 work was performed to determine the uniformity of colored coatings on tablets in an 18" Wurster unit (1). This was done to establish a "typical" distribution of coating prior to testing the first 46" unit so that comparisons could be made between units. Up to this time a large scale multiple nozzle unit had not been built and there was concern whether tablets coating in such a unit would be as evenly coated as those coated in the 18" unit which had been in use for many years.

This early work established a norm for what might be considered a uniform cosmetic coating on tablets. Uniformity was determined by using a water soluble dye in the coating and measuring the absorbance of the dye when single tablets were dissolved in distilled water. Standard deviation from tablet to tablet was found to be 7.2% in the 18" Wurster unit and 7.6% in the 46" unit. These were fairly short runs of about 40 minutes.

In 1982 the issue of uniform coating became more important when an active ingredient was added to a coating. In this case it was necessary to achieve a uniform distribution of the active ingredient among all the pieces coated. It was found that the active coating could be rapidly applied, but that the distribution of the ingredient was not as uniform as desired when coating times were short. At this time we began to focus on uniformity as a function of coating time. Time data is presented in Figure 1 and shows an excellent correlation between coating time and improved uniformity (decreasing standard deviation).

Uniformity of Coating on Small Particles

FIGURE 1



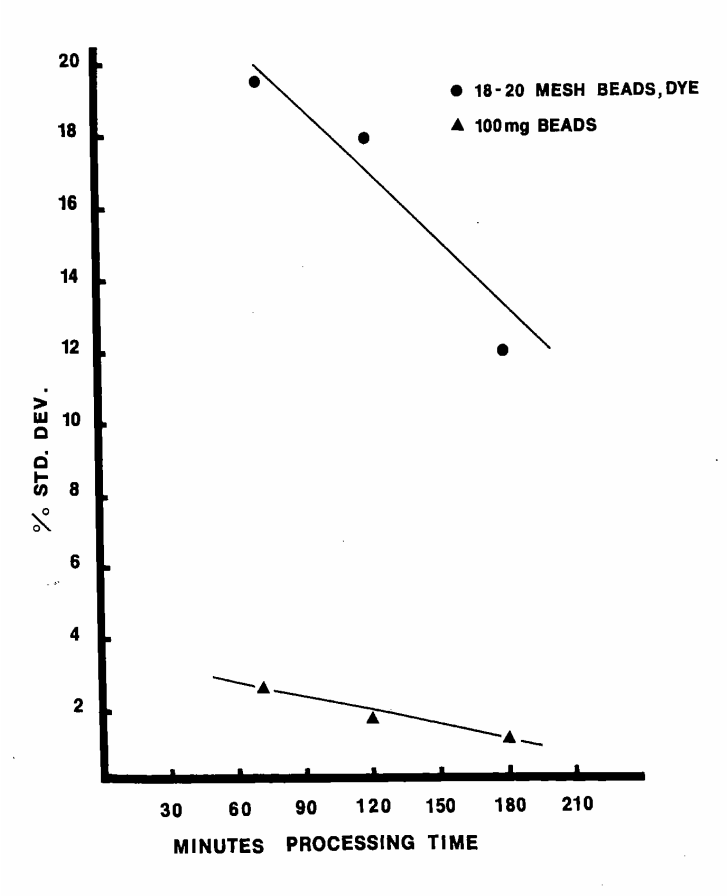
The term "uniformity" is somewhat ambiguous and must be carefully defined to have meaning. Sample size is an important measure in determining uniformity. It is possible to have apparent

uniformity on one scale while having gross unevenness on a smaller scale. We are now working on measuring coating uniformity on smaller particles. In certain cases we have observed that heavier than anticipated coatings are required to achieve a particular benefit. While there are several reasons why this might be so, one reason is uneven coating. As particle size is reduced surface area increases markedly, and surface area is what must be covered with coating for controlled release effects. Simply applying a specific amount of coating is not sufficient if it is not applied evenly and reproducibly over the surface of the product.

Our recent work was performed using 18/20 mesh (840 - 1000 nm) non-pareils, which were coated in a Wurster column using a water soluble dye (Blue #2) and water soluble binder. Coating times of 70, 120 and 180 minutes were selected for this study. After coating individual seeds were examined for chips, then dissolved in 5.0 ml distilled water and the absorbance read on a UV/VIS spectrophotometer at 630 nm. Absorbance values were compared statistically and are presented below.

Standard deviations determined for individual beads are 19.6%, 17.8% and 12.1% at 70. 120, and 180 minutes. This pattern of improved uniformity as a function of coating time is similar to that observed for larger pieces, although there is clearly a difference in observed uniformity as a function of particle size.

FIGURE 2



In order to see what effect this variability has on a larger scale, such as a quantity of beads in a gelatin capsule, we also compared the uniformity of 100 mg. samples of beads to see how the small scale variability effects a larger scale product or dosage form. As expected, the observed uniformity improves with sample size.(See Figure 2)

In all cases tested to date it has been observed that coating uniformity increases as a function of time if other factors are controlled. This is reasonable because more time means more cycles of the pieces through the spray zone and more droplets to be distributed over the available surface area. It is recognized that time is expensive and there are practical limits to how much time can be extended, however more uniform coating distribution may permit use of less coating material which will help offset the cost of time.

The degree of uniformity required will vary for different products. For slow release applications it may be desirable to have a somewhat uneven coating to provide both an early burst effect and a later extended release effects as well. For other applications such as taste masking or enteric coating it is desirable to minimize premature release while avoiding very slow release after a certain point. This more precise control can be achieved by applying a highly uniform coating onto all the particles.

In this paper we are not claiming that more uniform is better, indeed there are numerous cases in which particles of different coating levels are blended to achieve a desired release profile. It is, however, necessary to understand those factors, which alter coating uniformity so that we may better control it to make more consistent products.

1. "Coating Uniformity in 46" Unit", CPI Publication 73-3, 1973.