

COMPARISON OF COATING EFFICIENCY BETWEEN A VECTOR  
HICOATER AND A MANESTY ACCELA COTA

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ABSTRACT

The coating efficiency of a Vector HiCoater was compared to that of a Manesty Accela Cota. Studies were conducted in 24", 52", and 67" HiCoaters, and in 24" and 60" Accela Cotas. The coating system was composed of yellow iron oxide, titanium dioxide, polyethylene glycol, and hydroxypropyl methylcellulose. Timed serial tablet samples were examined using a tri-stimulus colorimeter. The 67" HiCoater applied 300 mg of coating solution per kilogram of tablets

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(480 kg pan load) in 209 minutes, whereas the 60" Accela Cota applied a similar amount of material to a 360 kg pan load in 165 minutes. The Hunter Lab values at these times were  $58.7 \pm 0.4$ ,  $10.7 \pm 0.5$ , and  $29.8 \pm 0.3$  for the HiCoater, and  $59.9 \pm 0.2$ ,  $10.5 \pm 0.4$ , and  $30.0 \pm 0.2$  for the Accela Cota for L, a, and b respectively. Although the run time was 44 minutes longer with the HiCoater, the batch size was increased 33%.

### INTRODUCTION

The advent of film coating<sup>(1)</sup> has been accompanied by a rapid increase in the available equipment options used to apply film forming materials. Considering the international scope of many pharmaceutical organizations, the preferences in equipment can be quite varied among development, scale-up, and production functions; or among production sites. Thus, this situation requires an understanding of the coating efficiencies among types and sizes of coating equipment.

The purpose of this investigation was to more clearly define the practical coating efficiencies of the Vector HiCoater and the Manesty Accela Cota. Scale-up data in both equipment lines has been generated.

### MATERIALS AND METHODS

The tablets used in all trials except the 60" Accela Cota run were composed of 92% Lactose, USP, Hydrous (Foremost Fast-Flo, Wisconsin Dairies, Baraboo, WI), 7% Microcrystalline Cellulose, NF (Avicel PH102, F.M.C., Corp., Philadelphia, PA), and 1% Magnesium Stearate, NF (McKeeson, Hummelstown, PA). The materials were blended in a suitably sized mixer and then compressed to an average weight of 403 mg and a hardness of greater than 11 kp. Tablets used in the 60" Accela Cota run were of similar composition but prepared by a wet granulation method.

The coating formula was a dispersion of hydroxypropyl methylcellulose (6 cps, Shin-Etsu Chemical Co., Ltd., Tokyo, Japan), polyethylene glycol, and yellow Speedpaste (D. F. Anstead, Ltd., Billeriray, UK), or Chroma-Kote (Crompton and Knowles

TABLE 1: Thomas Engineering/Manesty Accela Cotas and Vector HiCoaters Sizes and Capacities

| <u>Pan</u>  | <u>Model</u> | <u>Tablet Load (kg)</u> |
|-------------|--------------|-------------------------|
| Accela Cota | 24"          | 10                      |
| Accela Cota | 60"          | 360                     |
| HiCoater    | 24"; HCT- 60 | 20                      |
| HiCoater    | 52"; HCT-130 | 150                     |
| HiCoater    | 67"; HCT-170 | 480                     |

Corp., Fairlawn, NJ). The Speedpaste and Chroma-Kote contained titanium dioxide, yellow ferrous oxide, hydroxypropyl methylcellulose, and SDA 3A alcohol. A minimum of 300 g of coating dispersion was sprayed per kilogram of tablets.

The coating pans used for the trials included in this study are given in Table 1. The respective U.S. suppliers for the Accela Cota and HiCoater systems are Thomas Engineering, Inc., Hoffman Estates, IL, and Vector Corporation, Marion, IA. The 60" Accela Cota trial was carried out in the United Kingdom, with a unit supplied by Manesty, Ltd; Liverpool. The larger pan load in a 24" HiCoater as compared to the 24" Accela Cota is due to a greater pan depth.

In general, equipment set-up was held constant. For example, 2.5 mm air caps and 1.2 mm nozzles were used in all HiCoater runs. Minor differences in equipment, such as heating type (electric versus steam), did exist. Table 2 contains information concerning spray rate, pan speed, and number of spray guns used in each run. For the most part, the inlet temperature was held at about 80°C and the outlet temperature at about 50°C. Preconditioned air sources were not used.

The efficiency of the coating process was evaluated from tri-stimulus colorimeter data. This type of equipment has been previously used to measure the opacity of tablet film coatings, and for color matching between film coating materials.<sup>(2,3)</sup> There are several coordinate systems available, including the XYZ, CIE Lab, and the Hunter Lab Systems. The Hunter Lab system was used in this study. The L coordinate characterizes the variation from black to

TABLE 2: Set-up and Operating Parameters for Coating Runs

|                 | Load<br>(kg) | Number<br>of Spray<br>Guns | Pan<br>Speed<br>(rpm) | Average<br>Spray<br>Rate<br>(g/min) |
|-----------------|--------------|----------------------------|-----------------------|-------------------------------------|
| 24" Accela Cota | 10           | 1                          | 12                    | 33.3                                |
| 60" Accela Cota | 360          | 3                          | 4-4.5                 | 654.0                               |
| 24" HiCoater    | 20           | 2                          | 8                     | 47.0                                |
| 52" HiCoater    | 150          | 3                          | 6                     | 209.0                               |
| 67" HiCoater    |              |                            |                       |                                     |
| Trial #1        | 480          | 4                          | 4                     | 689.0                               |
| Trial #2(a)     | 480          | 4                          | 4                     | 692.0                               |

(a) Crompton and Knowles Corporation Chroma-Kote;  
all other trials with D. F. Anstead, Ltd.  
Speedpaste

white and varies in numerical value from 0 to 100. The a coordinate describes the red to green component and varies from +50 to -50, and b describes blue to yellow and varies from -50 to +50.

Color measurements were made with a Model 05 Colorguard Colorimeter (Pacific Scientific, Chevy Chase, MD), through a 9 mm opening for all trials except the 60" Accela Cota trial. In that trial a Hunter Lab, D25A-9 unit equipped with a 10 mm aperture was used.

As each coating run proceeded, timed serial samples of at least 20 tablets were removed from the pan. Colorimeter readings were taken and the mean values and standard deviations (S.D.) were calculated for the L, a, and b coordinates.

### RESULTS AND DISCUSSIONS

The major difference between the Accela Cota and HiCoater equipment lines is the location of perforations in the coating pan. The HiCoater (Figure 1a) has four equally spaced perforated exhaust air panels, whereas the Accela Cota (Figure 1b) is perforated around its entire circumference. This results in a difference in the air flow through each

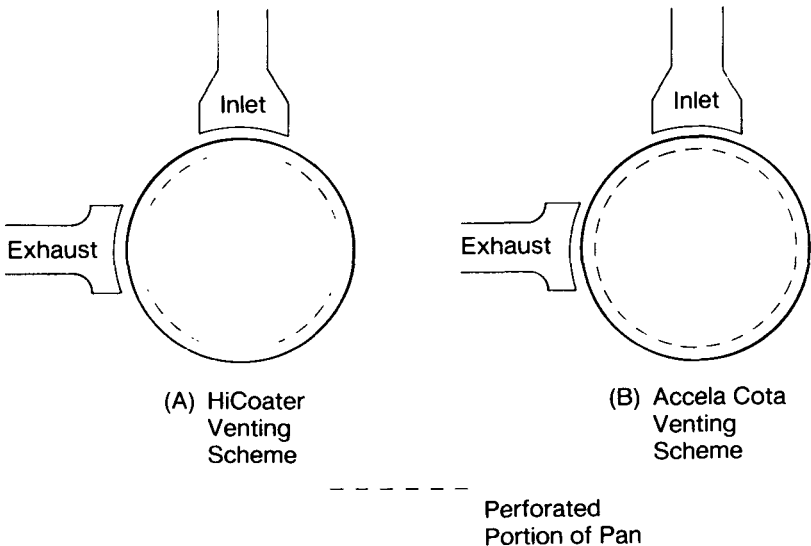


Figure 1:

- (a) Schematic of HiCoater ventilation system
- (b) Schematic of Accela Cota ventilation system

TABLE 3: Set-up in the HiCoater and Accela Cota

| <u>Pan</u>  | <u>Scaling from → to<br/>(pan diameter)</u> | <u>Increase<br/>in Tablet<br/>Load (%)</u> | <u>Increase<br/>in Spray<br/>Rate (%)</u> |
|-------------|---|--|---|
| HiCoater    | 24" → 52"                                   | 85   | 72  |
| HiCoater    | 52" → 67"                                   | 45   | 45  |
| HiCoater    |   |  |   |
| Trial #1    | 24" → 67"                                   | 96   | 92  |
| Trial #2(a) | 24" → 67"                                   | 96   | 93  |
| Accela Cota | 24" → 60"                                   | 97   | 92  |

(a) Crompton an Knowles Corporation Chroma-Kote; all other trials with D. F. Anstead, Ltd. Speedpaste.

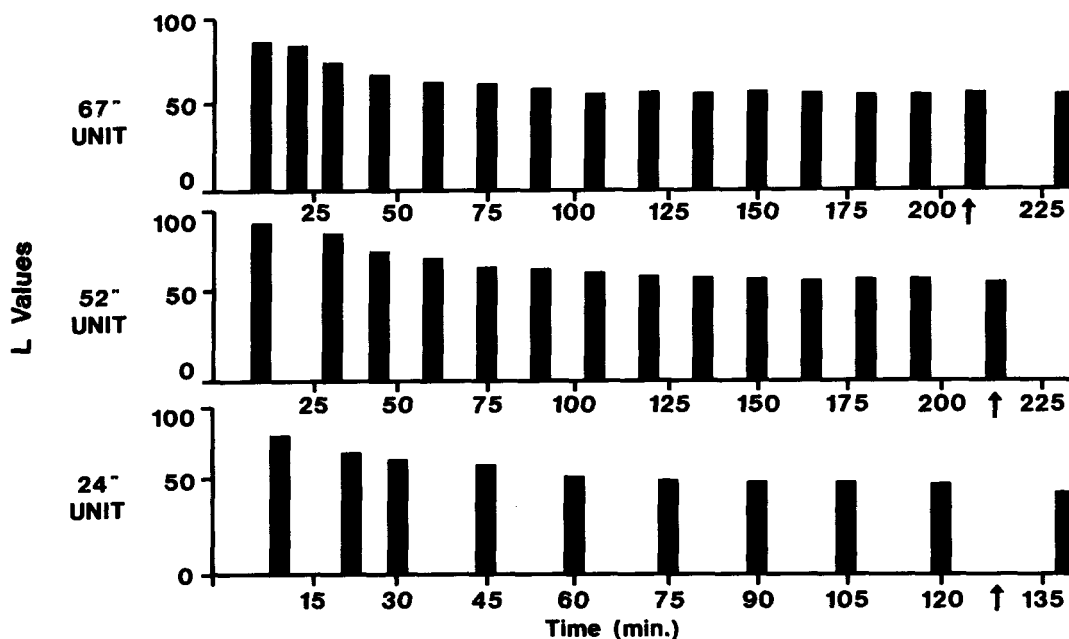


Figure 2:

Hunter L values vs time for the 67", 52", and 24" HiCoater units. The arrow indicates time point where 300 g of coating dispersion per kilogram of tablets was applied.

type of pan and, therefore, a difference in the heat transfer within each system.

A fairly linear ( $r^2 = 0.985$ ) increase in pan speed, of 0.9 rpm, was found with each 10" increase in pan diameter for the HiCoater (Table 2). The pan speed was decreased from 12 rpm to 4-4.5 rpm in scaling up from the 24" to 60" Accela Cota.

Table 3 contains information on the percentage increase in tablet load and spray rate among the different sized coating pans. It appears that in this

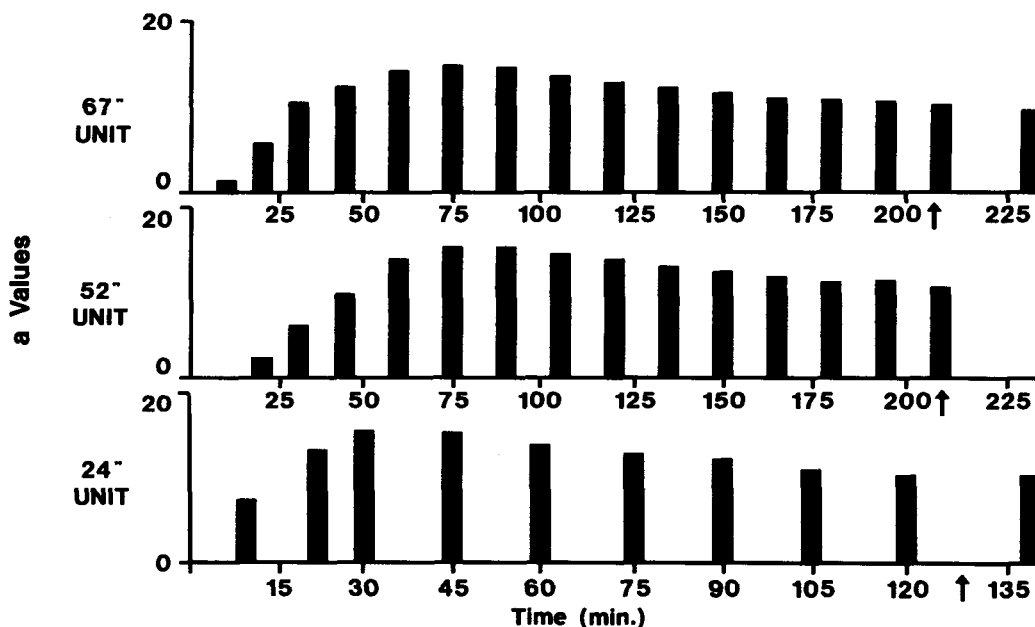


Figure 3:

Hunter a values vs time for the 67", 52", and 24" HiCoater units. The arrow indicates time point where 300 g of coating dispersion per kilogram of tablets was applied.

study, tablet load served as an accurate reference to the observed increase in mean spray rate required to efficiently and aesthetically apply a film coat to the placebo tablets.

Figures 2-7 detail the Hunter Lab values throughout the various coating trials. The time domains have been adjusted so that the duration of a group of trials occupy a similar length of abscissa. Figures 2-4 correspond to the HiCoater trials while Figures 5-7 refer to the Accela Cota runs. For the HiCoaters, 1 minute in the 24" pan gave similar Hunter Lab values as 1.67 minutes in the 52" and 67" units.

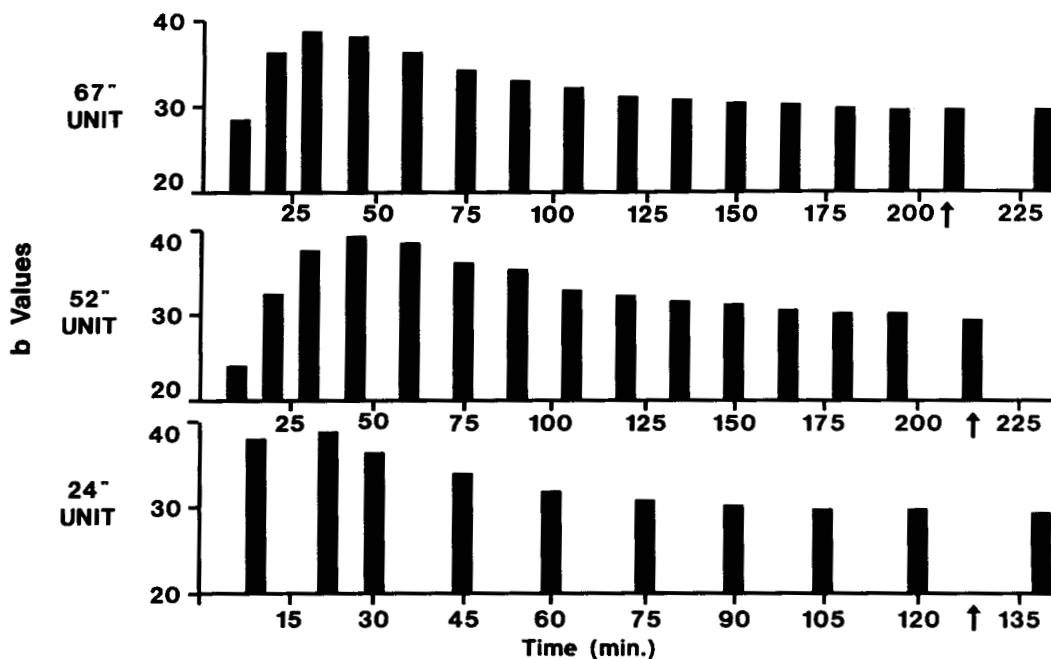


Figure 4:

Hunter b values vs time for the 67", 52", and 24" HiCoater units. The arrow indicates time point where 300 g of coating dispersion per kilogram of tablets was applied.

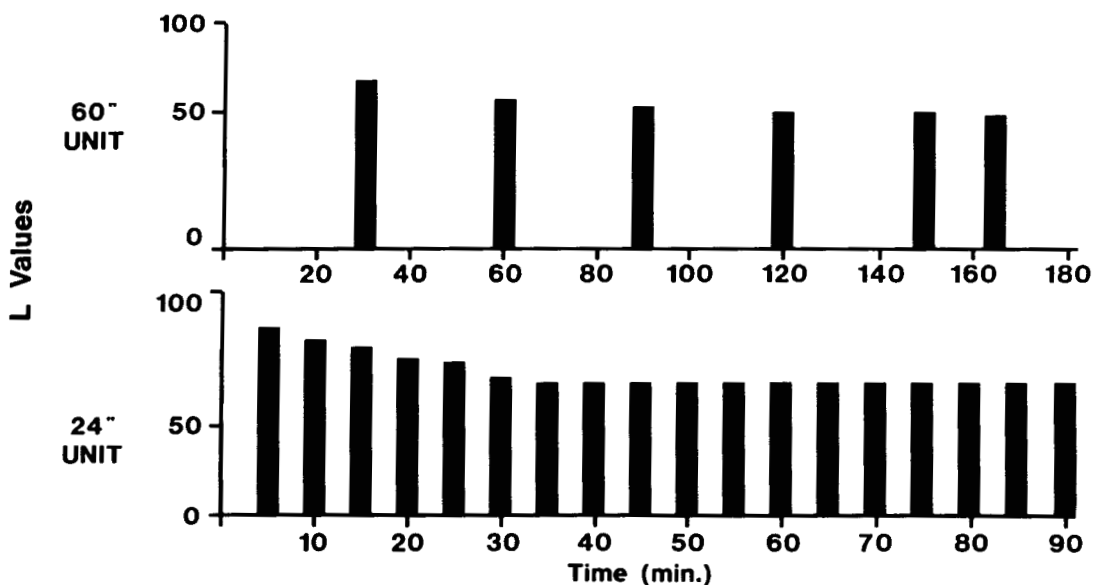


Figure 5:

Hunter L values vs time for the 60" and 24" Accela Cota units.



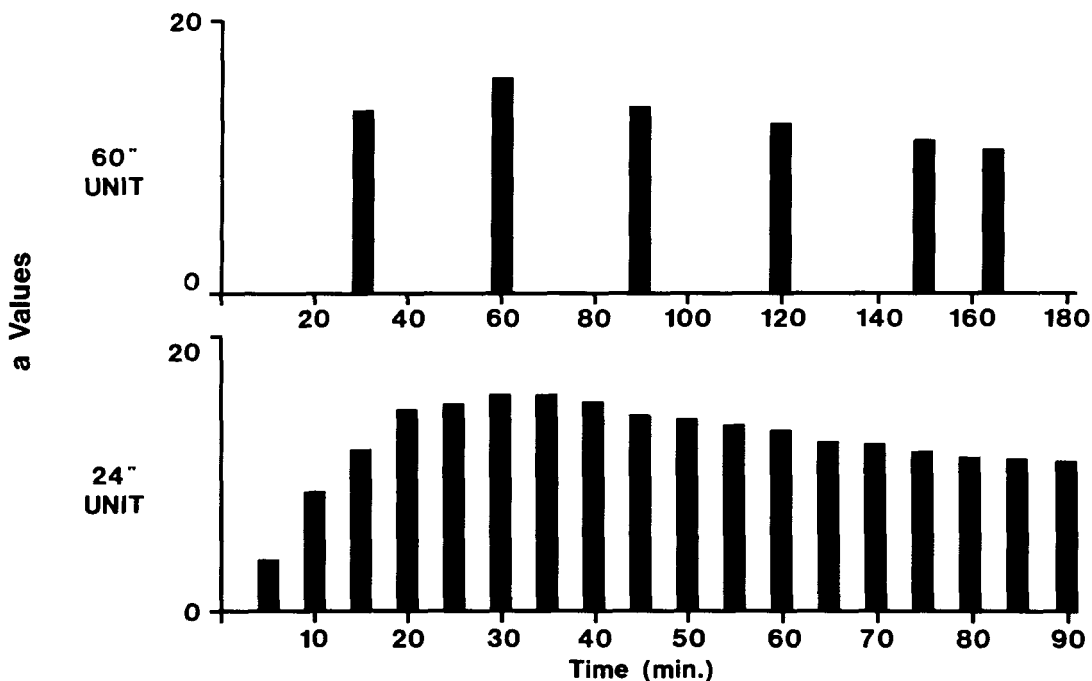


Figure 6:

Hunter a values vs time for the 60" and 24" Accela Cota units.

Hunter Lab values in the Accela Cotas were comparable, with 1 minute in the 24" pan scaling to 2 minutes in the 60" pan. In this sense, the Accela Cota took a slightly greater time scale adjustment.

A comparison of the coating efficiencies of the 60" Accela Cota and 67" HiCoater are presented in Table 4. Comparable Hunter Lab values were found after applying about 300 g of coating dispersion/kg of placebo tablet cores. With the difference in pan load and the equivalency in coating as determined by the Hunter Lab results, the only true difference is the time required to coat the tablets. Dividing the time required to apply 300 g of coating dispersion/kg of tablets by the tablet load gives a coating time of 0.458 min/kg of tablets for the Accela Cota and 0.435

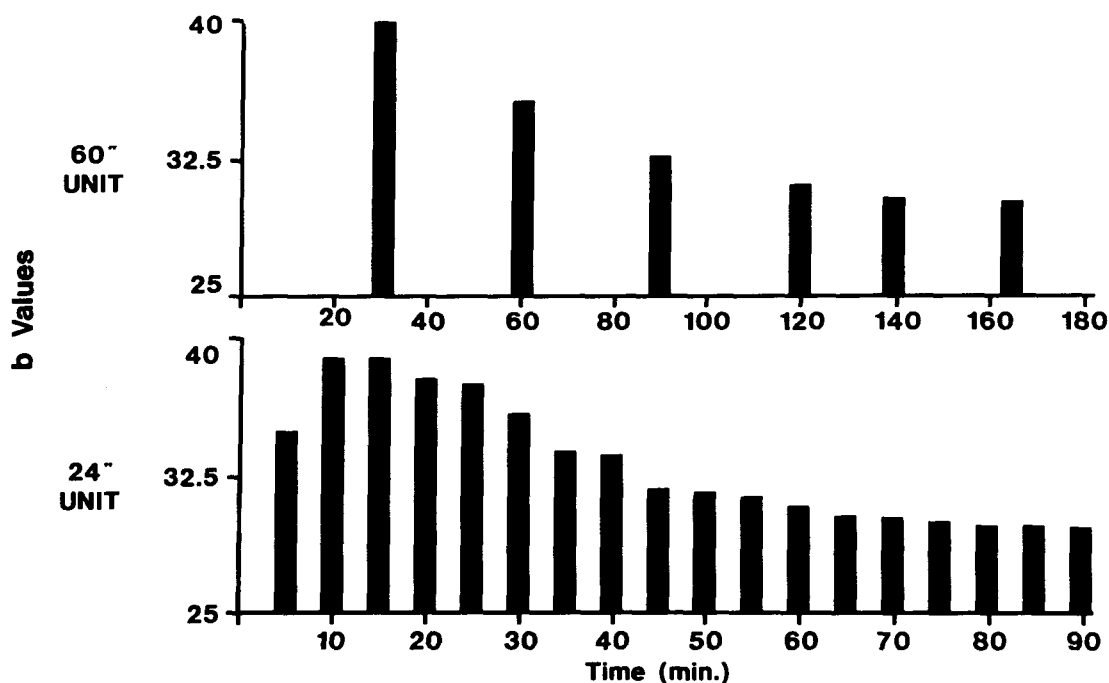


Figure 7:

Hunter b values vs time for the 60" and 24" Accela Cota units.

TABLE 4: Hunter Lab Values For 67" HiCoater and the 60" Accela Cota Runs with D. F. Anstead, Ltd. Speedpaste

| Time (min) | L value<br>HiCoater <sup>(1)</sup> | Accela<br>Cota | a value    |                | b value    |                |
|------------|------------------------------------|----------------|------------|----------------|------------|----------------|
|            |                                    |                | HiCoater   | Accela<br>Cota | HiCoater   | Accela<br>Cota |
| 10         | 88.3 ± 3.5 <sup>(2)</sup>          |                | 1.6 ± 1.9  |                | 28.7 ± 7.1 |                |
| 20         | 82.0 ± 5.3                         |                | 5.9 ± 4.2  |                | 36.5 ± 4.5 |                |
| 30         | 75.9 ± 4.4                         | 73.7 ± 4.2     | 10.5 ± 3.4 | 13.3 ± 2.9     | 39.3 ± 1.2 | 39.8 ± 1.6     |
| 45         | 71.7 ± 4.8                         |                | 13.0 ± 2.8 |                | 38.4 ± 2.0 |                |
| 60         | 67.7 ± 3.3                         | 66.4 ± 1.8     | 14.9 ± 1.0 | 15.6 ± 0.5     | 36.7 ± 2.1 | 35.6 ± 1.4     |
| 75         | 64.9 ± 2.5                         |                | 15.1 ± 0.6 |                | 34.7 ± 1.9 |                |
| 90         | 63.4 ± 2.0                         | 62.7 ± 1.5     | 14.8 ± 0.9 | 13.8 ± 1.2     | 33.7 ± 1.6 | 32.4 ± 1.3     |
| 105        | 62.1 ± 1.2                         |                | 14.3 ± 0.7 |                | 32.6 ± 1.0 |                |
| 120        | 60.9 ± 1.2                         | 61.1 ± 0.7     | 13.2 ± 1.0 | 12.3 ± 0.9     | 31.6 ± 1.0 | 31.0 ± 0.6     |
| 135        | 60.3 ± 0.8                         |                | 12.8 ± 0.8 |                | 31.2 ± 0.6 |                |
| 150        | 59.7 ± 0.6                         | 60.1 ± 0.4     | 12.0 ± 0.8 | 11.0 ± 0.7     | 30.6 ± 0.5 | 30.3 ± 0.4     |
| 165        | 59.2 ± 0.5                         | 59.9 ± 0.2     | 11.4 ± 0.7 | 10.5 ± 0.4     | 30.2 ± 0.4 | 30.0 ± 0.2     |
| 180        | 58.9 ± 0.3                         |                | 11.2 ± 0.5 |                | 30.1 ± 0.3 |                |
| 195        | 58.8 ± 0.5                         |                | 11.0 ± 0.6 |                | 30.0 ± 0.4 |                |
| 210        | 58.7 ± 0.4                         |                | 10.7 ± 0.5 |                | 29.8 ± 0.3 |                |
| 230        | 58.6 ± 0.3                         |                | 10.1 ± 0.3 |                | 29.6 ± 0.2 |                |

TABLE 5: Summary

|     |             | Time<br>to Apply<br>300 g<br>Coating |                 | Mean<br>Hunter Lab<br>Values<br>(n = 20)  |      |           |
|-----|-------------|--------------------------------------|-----------------|---|------|-----------|
|     |             | Average<br>Spray<br>Load<br>(kg)     | Rate<br>(g/min) | Material<br>per kg of<br>Tablets<br>(min) | L    | a b       |
| 24" | Accela Cota | 10                                   | 33              | 90  | 58.8 | 11.0 29.5 |
| 60" | Accela Cota | 360                                  | 654             | 165                                       | 59.9 | 10.5 30.0 |
| 24" | HiCoater    | 20                                   | 47              | 128                                       | 58.5 | 10.8 29.7 |
| 52" | HiCoater    | 150                                  | 209             | 215                                       | 59.3 | 11.2 30.0 |
| 67" | HiCoater    |                                      |                 |   |      |           |
|     | Trial #1    | 480                                  | 689             | 209                                       | 58.7 | 10.7 29.8 |
|     | Trial #2(a) | 480                                  | 692             | 208                                       | 61.0 | 8.7 30.0  |

(a) Crompton & Knowles Corporation Chroma-Kote; all other trials with D. F. Anstead, Ltd Speedpaste

min/kg for the HiCoater. These results are emphasized in Table 5 which summarizes all the discussed trials. As shown, Hunter Lab parameters are a sensitive measure of the efficiency of the dynamics occurring throughout the coating process. This technique may also be of benefit in the evaluation of coating system modifications. For example, equipment variables such as baffle design or formulation composition can be examined.

The Crompton and Knowles Chroma-Kote was only used in the 67" HiCoater. This material was examined as a possible alternate supply. Hunter Lab values for this material were  $61.0 \pm 0.2$ ,  $8.9 \pm 0.4$ , and  $30.1 \pm 0.2$ , for L, a, and b respectively. The Anstead Speedpaste had  $58.7 \pm 0.$ ,  $10.7 \pm 0.5$ , and  $29.8 \pm 0.3$  for L, a, and b respectively.

The pattern of changing Lab values measured throughout the coating runs was nearly identical for both sources of materials, as can be seen in the L value curves in Figure 8. The Chroma-Kote was subsequently fine tuned for a nearly perfect color match.

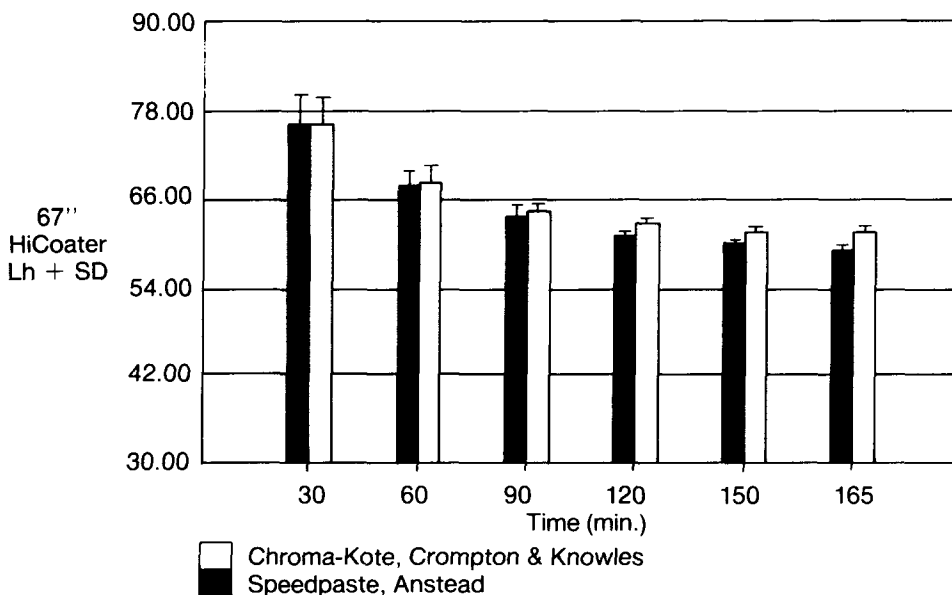


Figure 8:

Hunter L values vs time for the 67" HiCoater unit comparing pigment sources.

The final standard deviations of all Lab values were less than 0.5 for all runs included in this report. Therefore, the color variability within each batch was minimal. The usefulness of the Hunter Lab values in evaluating alternate sources of color was also demonstrated.

For the equipment configurations and coating systems examined in this study the color efficiencies, as evaluated by Hunter Lab data, of the Thomas Engineering/Manesty Accela Cota and a Vector HiCoater are similar. However the batch size in the 67" Vector HiCoater was about 33% larger than in the 60" Accela Cota. Also, the HiCoater required slightly less time per kilogram of tablets to accomplish the same process. Where cost accounting factors are important variables in selection of manufacturing equipment or processes, the latter mentioned items may become extremely important.

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