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Effects of Colored Pigments on Opacity of Film Coating Systems

PURPOSE

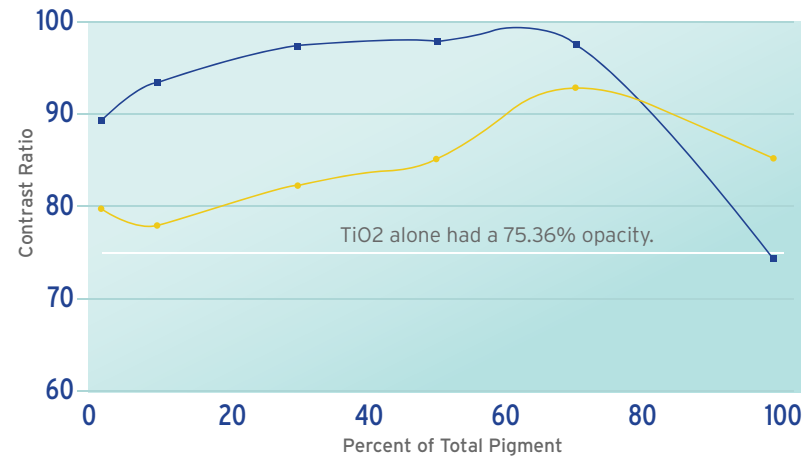
To evaluate the function of Titanium Dioxide (TiO₂) as the chief supplier of opacity in aesthetic film coating systems that use TiO₂ in combination with other pigments. Traditionally, the assumption has been that the opacity of a film is directly proportional to TiO₂ content, and that the introduction of colorants lowers the film's hiding power.

METHODS

An aqueous film coating system was formulated using the following: Hypromellose 6cps (HPMC); Polyethylene Glycol (PEG) at 20% of the polymer; total pigment content at 30% of the polymer. The coating system was made with varying ratios of TiO₂ and colorant within the total pigment content. The following six levels were evaluated each for FD&C Blue 1 Aluminum Lake and Yellow Iron Oxide (See figure below):

2% colorant/98% TiO ₂
10% colorant/ 90% TiO ₂
30% colorant/ 70% TiO ₂
50% colorant/50% TiO ₂
70% colorant/30% TiO ₂
98% colorant/2% TiO ₂

An additional blend was made with TiO₂ at 100% of the pigment. The figure at left is a visual representation of the change in color with increased pigment from left to right. The blends were reconstituted at 28% solids and cast as films on black and white Lenetta cards (form 5DX) using a 160 micron drawdown bar. The films were read over both sections of the cards (represented by the top and bottom sections of the figure at left) using a spectrophotometer. The resulting spectral data was used to calculate a contrast ratio for each pigment level.



CONCLUSION

Rather than lowering the hiding power of a film, the presence of colorants actually enhances opacity. The results of the study at higher colorant levels indicate that a combination of colorants and TiO₂ provide robust hiding power, even when the colorant exceeds the TiO₂ in the formulation. This challenges the current understanding of the function of TiO₂ as an opacifier and allows a film coating system to provide a broad spectrum of colored products without sacrificing opacity.

Blue 1 at 30% of Total Pigment

Material Description	%w/w
Hypromellose	66.67
Polyethylene Glycol 400	13.33
Titanium Dioxide	14.00
FD&C Blue 1 Aluminum Lake	6.00
Total Coating Suspension	100

TiO₂ at 100% of Total Pigment

Material Description	%w/w
Hypromellose	66.67
Polyethylene Glycol 400	13.33
Titanium Dioxide	20.00
Total Coating Suspension	100

RESULTS

At 2% of the pigment, Yellow Iron Oxide and Blue 1 gave opacity of 79.96% and 89.42% respectively. At 70% of the total pigment, Blue 1 had a contrast ratio of 97.53% and Yellow Iron Oxide showed 92.95% coverage, both significantly higher than TiO₂ alone.



Films with added colorants showed greater hiding power at colorant levels between 2-70%. Pictured below are the contrast ratios of several pigments at 10% of the total pigment.

