11
Mixing of Powders
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11.1 BASIC CONCEPTS OF POWDER MIXING

As soon as one begins a study of powder mixing theory and practice one finds that there is considerable confusion as to what constitutes a good mixture. In fact the term good is meaningless in the context of individual powder technology and one should use the term satisfactory, with the exact meaning of this term being interpreted within the context of the industrial process. Most mixers are designed to achieve a random mixture of the ingredients. By definition a random mixture is one such that if the position in a mixture of a given fineparticle is $x_1$, $y_1$ and $z_1$ at the beginning of a mixing process, then its final position $x_2$, $y_2$, and $z_2$ is completely independent of its initial starting point. Unfortunately many people have no concept as to what constitutes a random mix. If they are shown a series of randomized mixtures of black and white fineparticles they are surprised by the amount of clustering that persists in a random mixture. Thus in Figure 11.1 a series of simulated black and white fineparticles at a richness level of 5% by volume is shown. When these were shown to people at a workshop many of the participants felt that the systems were inadequately mixed and that a better mixture could be achieved if more effort were expended on creating a mixture. The participants were surprised at the variation that can exist in a mixture of this kind. (A legal variation in a random mix is one that can arise by chance.) For some industrial purposes a randomized mixture is not sufficiently well dispersed. One then has to move to create what are known as structured mixtures by using strategies such as microencapsulation or arranging for the ingredients to be mixed under conditions in which one powder will coat another to give at least transient microencapsulation until the mixture is used in the process for which it was de-
To help appreciate the variations that can occur in a random mix Kaye has devised an expert system that can simulate and display mixtures of ingredients at various specified levels.²

In a recent review of powder mixing technology the statement was made that powder mixing is an important but academically unfashionable subject in the United States.³ In the book that was being reviewed there was a chapter by Dr. J. C. Williams, who had studied powder mixing for many years. At the beginning of that chapter Dr. Williams made the statement that during the past 30 years there has been much work done at universities in the study of solids mixing but the results of this effort have not yet been applied in industrial practice.⁴

Opinions differ as to why the industrial community is apparently unwilling to learn