

〈技術資料〉

フィラー分散技術の基礎 第 I 報 —スラリーやポリマー中でのフィラー分散技術とその展望—

Filler Dispersion Technology in Slurries and Polymers Part I : Fundamentals and Future Perspectives

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Abstract

Fillers are widely used to improve the mechanical, thermal, electrical, optical, and economic performance of polymer materials, coatings, inks, adhesives, ceramics, and other industrial products. However, the functions of fillers can be fully realized only when their dispersion and aggregation states are appropriately controlled in slurries or polymer matrices. This article reviews the fundamentals of filler dispersion technology from both theoretical and practical viewpoints. First, the diversity of filler materials, particle size, particle shape, particle-size distribution, composition, and surface properties is outlined. The basic factors governing dispersion and aggregation are then discussed, including Brownian motion, sedimentation based on Stokes' law, DLVO theory, van der Waals attraction, electrostatic repulsion, steric stabilization, and compatibility between filler surfaces and dispersion media, including consideration of solubility parameters. Practical approaches for stabilizing dispersion, such as surface modification, dispersant addition, viscosity control, pH adjustment, and optimization of mechanical dispersion processes, are also summarized. Furthermore, representative dispersion equipment and evaluation methods for slurry and polymer systems, including image analysis and statistical evaluation, are introduced. Finally, industrial applications, environmental considerations, safety management, regulatory requirements, recycling, and future perspectives are discussed in relation to dispersion and aggregation control. The review emphasizes that appropriate control of filler dispersion and aggregation is essential for achieving stable quality, high functionality, process reliability, and sustainable material design.

キーワード：フィラー分散、分散安定性、表面処理、分散剤、複合材料

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