A uniform measurement expression for cross method comparison of nanoparticle aggregate size distributions

Abstract:
The European Commission’s recent recommendation for a definition nanomaterials (2011/696/EU) will require characterisation of materials used in regulated consumer products in terms of number based particle concentration and size distribution. When adopted under food regulations, the definition will be applicable to those food additives that contain a fraction of the particles that are smaller than 100 nm at or above the threshold of 50% in terms of particle number based size distribution. In the view of this we have performed a comparative evaluation of the different analytical methods for the measurement of number based particle size distributions. This study has used synthetic amorphous silica as a an example nano-structured material already widely applied in food processing, and provides a comparison of the six methods deemed suitable for the purpose: scanning electron microscopy in both high vacuum and liquid cell setup; gas-phase electrophoretic mobility molecular analyser; centrifugal liquid sedimentation; nanoparticle tracking analysis; and asymmetric flow field fractionation on-line combined with plasma mass spectrometry. The results have highlighted an important question in relation to the effects that the particle shape, chemical composition and agglomeration/aggregation state may have on the size measurement accuracy of the different methods. We propose mass equivalent diameter (MED) as a uniform expression of particle size distribution measurements for aggregated particulate materials allowing comparison of the measurements from different analytical methods. We have detailed how the MED for aggregated materials, such as synthetic amorphous silica, can be derived from measurements by the six methods. This approach enables unambiguous interpretation and comparison of the results between different research studies on nanoparticles and reference materials, and is our best suggestion for a common measure of particle size distributions.

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