Thoughts on recovering particle size distributions from the moment form of the population balance

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Abstract: The moment form of the population balance is a very popular method of modeling the evolution of particle size in many particulate systems. In many cases the moments of the particle size distribution are sufficient to characterize the system for engineering purposes, however in some cases an approximation to the particle size distribution itself is desired. The traditional method to achieve this approximation is to write the set of (known) moments in matrix form, $\mu = A \cdot n$, and then solve this equation, via matrix inversion, to obtain the population density, n, in a finite number of size classes. The method of matrix inversion may result in a poor approximation, particularly if the distribution is too complex to be represented by a small set of finite width pulses. Several alternative methods are discussed including a similar method based on the central moments, and fitting the moments to known types of distribution functions, the gamma distribution in particular. The inversion method involving central moments improves the conditioning of the matrix. This did not improve the result when small numbers of moments (six or less) were used, because accurate inverses of the matrix for the moments about the origin could be achieved. Fitting moments to known distributions is computationally more difficult than the inversion technique because of the optimization required, but this is not a significant drawback due to the widespread availability of computation mathematical programs. This method was particularly successful in reproducing accurate distributions.

Ei controlled terms: Particle size analysis - Crystallization - Approximation theory - Inverse problems - Matrix algebra - Optimization - Differential equations - Mathematical models