Exact combinatorial approach to finite coagulating systems

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The work gives a brief introduction to coagulation systems. After revealing the shortcomings of the standard approach based on Smoluchowski's equation the need for another approach is emphasized. Thereafter, the work introduces an exact combinatorial approach to finite coalescing systems. In this formalism, cluster sizes and time are discrete, and the binary aggregation alone governs the time evolution of the systems. By considering the growth histories of all possible clusters, the exact expression for the probability of a coagulating system with an arbitrary kernel in a given cluster configuration is derived. Over the course of the work monodisperse initial conditions are applied. After stating the derived formulas, for the constant, multiplicative and additive kernel, comparisons of the theoretical predictions and simulations are performed with a very good result. At the end significant advantages and minor disadvantages of the approach are summarized.