The extended Gy's formula

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Gy's formula is a formula to predict the Fundamental Sampling Error (FSE), a part of The Theory of Sampling (TOS) as developed by Pierre Gy. Gy's formula is only valid for binary materials with the same size distribution of analyte containing fragments and matrix fragments. Unfortunately, the formula has been used without regard to these limitations, and the results have often been erroneous, giving the Theory of Sampling a bad reputation. However, an extended Gy's formula for estimation of FSE without these restrictions can be derived from Gy's definition of constitutional heterogeneity. This formula is exact with no assumptions, except that the lot can be divided into classes with fragments with similar properties within each class. The extended formula allows prediction of FSE for any particulate material with any number of particle classes in contrast to Gy's formula. The extended Gy's formula is validated by model experiments sampling mixtures of 3 to 7 components with a riffle splitter. In most cases the observed sampling error was well predicted by the newly derived, extended Gy's formula. However, in some experiments the observed sampling errors were lower than FSE. This can be explained by the segregation paradox, and the effect is calculated by a new function, the Fundamental Sampling Uncertainty (FSU) proposed here. The observed results are now typically in excellent agreement with the predictions (the predicted uncertainties were on average 0.5% points lower than the observed values). The extended Gy's formula is easy to use. For a material where the analyte is only present in one class of fragments, the only parameters needed for each class are the average mass of a fragment and the mass proportion of the class in the lot. No need to estimate the liberation factor, the size and shape of the fragments and the concentration. If the analyte is present in more than one class, the concentration in each class is needed too. If fragments of a class have similar properties, but not similar size, the granulometric factor is needed though, and an exact formula for a uniform size distribution has been derived. This formula predicts that the granulometric factor *g* for a wide size distribution is 0.25 in excellent agreement with Gy's recommendation for this case. The extended Gy's formula described here is ideal for use in teaching of sampling methods because the experiments can be set up using materials with accurately known properties. The proposed new formula allows accurate prediction of FSE and FSU for complex materials that contain more than two types of particles. It is the hope that the extended Gy's formula could increase the popularity of TOS.

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