Equation for Estimating Shrinkage in Binary Mixtures of Container Media

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Linear equations corrected for shrinkage have been tested for selected physical properties (Nash, 1989; Pokorny et al., 1986). A system of linear equations would permit use of linear programming techniques to facilitate selection of container media (Bures et al., 1988). Shrinkage curves have been graphically characterized for several binary mixes (Nash and Pokorny, 1990), but a mathematical model that would accurately estimate shrinkage is lacking. Objectives of this work were to devise and test a mathematical model that estimates shrinkage of binary container mixes.

The linear shrinkage pattern observed by Nash and Pokorny (1990) when preparing a two-component container medium can be expressed by an equation whereby observed shrinkage, at a given volume mixture, is a function of the maximum shrinkage of the mixture:

$$\text{Shr}_s = 2 \cdot q_s \cdot \text{Shr}_{\max} \quad [1]$$

where Shr_s = shrinkage of the mixture (%/vol), q_s = component with volume <50% (%/100), and $\text{Shr}_{\max}$ = maximum shrinkage at a 1:1 ratio (v/v) (%/vol).

Shrinkage data for 1:1 ratio (v/v) medium

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mixtures (Table 1) collected by Nash and Pokorny (1990) were used to calculate new data for each of the medium combinations and ratios. Estimated shrinkage values, calculated from Eq. [1], were paired with measured values; regression analyses and tests of equality of regression equations were performed. Regression equations (measured and estimated) did not differ statistically. Thus, Eq. [1] is a reliable estimator of shrinkage.

Development of this model to accurately estimate shrinkage in binary substrate mixes

suggests that models for n-component container mixes can be devised. These advances will permit parameterization of the shrinkage factor, a necessary step in establishing equations for computer-selected container media.

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Table 1. Regression equations (df = 28) for measured and estimated shrinkage ($\hat{Y}$ = %/vol) responses of selected container media.

Medium	Regression equation	r
Peatmoss (Pm)/perlite (Pe)		
0% to 50% Peatmoss		
Measured	$\hat{Y} = 0.64 + 0.10 (\% \text{ Pm})$	0.85
Estimated	$\hat{Y} = 0.00 + 0.11 (\% \text{ Pm})$	0.93
0% to 50% Perlite		
Measured	$\hat{Y} = 0.85 + 0.09 (\% \text{ Pe})$	0.85
Estimated	$\hat{Y} = 0.00 + 0.11 (\% \text{ Pe})$	0.93
Pine bark (B)/sand (S)		
0% to 50% Bark		
Measured	$\hat{Y} = 0.80 + 0.14 (\% \text{ B})$	0.93
Estimated	$\hat{Y} = 0.00 + 0.16 (\% \text{ B})$	0.91
0% to 50% Sand		
Measured	$\hat{Y} = 0.42 + 0.15 (\% \text{ S})$	0.94
Estimated	$\hat{Y} = 0.00 + 0.16 (\% \text{ S})$	0.91
Peatmoss/sand		
0% to 50% Peat		
Measured	$\hat{Y} = 0.72 + 0.12 (\% \text{ Pm})$	0.88
Estimated	$\hat{Y} = 0.00 + 0.13 (\% \text{ Pm})$	0.95
0% to 50% Sand		
Measured	$\hat{Y} = 0.64 + 0.12 (\% \text{ S})$	0.88
Estimated	$\hat{Y} = 0.00 + 0.13 (\% \text{ S})$	0.95