Identification of mechanical parameters of urea-formaldehyde microcapsules using finite-element method

X.F. Wang, R. Han, J. Tao, T.L. Han, G.M. Zhu, J.N. Tang, N.X. Han, F. Xing

PII: S1359-8368(18)32439-9

DOI: 10.1016/j.compositesb.2018.09.052

Reference: JCOMB 6022

To appear in: *Composites Part B*

Received Date: 3 August 2018

Revised Date: 6 September 2018

Accepted Date: 21 September 2018

Identification of mechanical parameters of urea-formaldehyde microcapsules using finite-element method

X.F. Wang[a], R. Han[a], J. Tao[a], T.L. Han[a], G.M. Zhu[b], J.N. Tang[b], N.X. Han[a], F. Xing[a,]*

[a] *College of Civil Engineering, Guangdong Provincial Key Laboratory of Durability for Marine Civil Engineering, Shenzhen University, Shenzhen 518060; PR, China.*

[b] *College of Materials Science and Engineering, Shenzhen University, Shenzhen 518060; PR, China.*

ABSTRACT

To obtain the mechanical parameters for a microcapsule, such as the Young's modulus, yield stress, and hardening coefficients using different mechanical constitutive models, parameter identification must be implemented using inverse analysis. In the present study, a new approach combining the finite-element method and an optimisation procedure is proposed for determining the constitutive parameters of urea-formaldehyde microcapsules, in which three types of elastic-plastic constitutive models are considered: the power-law hardening model, the elastic-perfectly plastic model, and the elastic-perfectly plastic model with linear hardening. A nonlinear optimisation procedure is applied to determine the minimum of the multivariable objective function, which is defined as the norm of the difference between the numerical and experimental results. The efficiency and robustness of the proposed method are verified with different initial values and numbers of elements. The force-displacement curves from a numerical simulation show good agreement with the experimental data, indicating that the proposed approach and the mechanical parameters determined are reliable.

Keywords: Parameter identification; Microcapsule; Inverse analysis; Elastic–plastic model; Finite-element method.

* Corresponding author

E-mail address: xingf@szu.edu.cn (F. Xing)