Correction to “Analysis of the Dynamics of the FT4 Powder Rheometer”

C. Hare^{*1}, U. Zafar¹, M. Ghadiri¹, T. Freeman², J. Clayton², M. Murtagh¹

¹ *Institute of Particle Science and Engineering, School of Chemical and Process Engineering, University of Leeds, Leeds, LS2 9JT, UK*

² *Freeman Technology, Tewkesbury, GL20 8DN, UK*

* Corresponding author

Dr Colin Hare

Tel: +44 (0) 1483 68 9472

Fax: +44 (0) 1483 68 6581

Email address: c.hare@surrey.ac.uk

Abstract

The paper entitled “Analysis of the Dynamics of the FT4 Powder Rheometer” contains calculation errors that lead to an underestimate of deviatoric stresses by a factor of ten and average compressive stresses by a factor of approximately three. The trends remain unchanged from those shown in the paper, with compressive stress and deviatoric stress both increasing approximately linearly with blade penetration depth. Here, the corrected values of compressive and deviatoric stress are given.

1. Introduction

It has come to our attention that the paper entitled “Analysis of the Dynamics of the FT4 Powder Rheometer” contains two calculation errors in the stress calculations (Hare *et al.*,

2015). The volume of the measured cell used to calculate the stresses in Eq 2 was incorrectly input to be ten times larger than it should be, thus resulting in principal stresses ten times smaller than they should be. Secondly, in calculating the average compressive stresses, the sum of principal stresses should have been divided by three. These errors lead to incorrect values being given in Figures 10 and 11 of the paper, with the deviatoric stress underestimated by a factor of ten, and the average compressive stress underestimated by a factor of three and a third. Here, we provide the correct values of hydrostatic and deviatoric stresses in Figures 1 and 2, respectively. The trends are unchanged from the original paper, with hydrostatic and deviatoric stresses increasing almost linearly with blade penetration depth, and remaining approximately constant across the length of the blade. A notable consequence is that the average compressive stress now exceeds the hydrostatic head. In the original paper it was suggested that the average compressive stress should be lower than the hydrostatic head since a portion of the stress is transferred laterally to the walls; however this is only true in the absence of the impeller blades. Considering the blade angle with respect to the horizontal plane, the anticlockwise and downward impeller movement causes compression, the magnitude of which depends not only on the hydrostatic stress as well as particle properties. Since the stress measurement is taken directly in front of the impeller which is driven through the bed, the average compressive stress is increased due to the action of the impeller, and hence exceeds the hydrostatic head as shown in Figure 1.

Fig. 1. Average compressive stresses during the simulated FT4 test.

Fig. 2. Deviatoric stresses during the simulated FT4 test.

Future work should aim to develop a relationship between the measured flow energy and the shear stresses existing in the powder bed. To develop such a relationship it is essential that the corrected values shown here are considered.

References

C. Hare, U. Zafar, M. Ghadiri, T. Freeman, J. Clayton, M.J. Murtagh, Analysis of the Dynamics of the FT4 Powder Rheometer, Powder Technol. 285 (2015) 123-127.