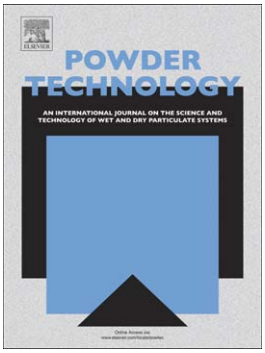

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PII: S0032-5910(16)30792-6
DOI: doi:10.1016/j.powtec.2016.11.020
Reference: PTEC 12096

To appear in: *Powder Technology*

Received date: 6 October 2016
Revised date: 11 November 2016
Accepted date: 14 November 2016

Please cite this article as: Dusan Ilic, Craig Wheeler, Measurement and simulation of the bulk solid load on a conveyor belt during transportation, *Powder Technology* (2016), doi:10.1016/j.powtec.2016.11.020

MEASUREMENT AND SIMULATION OF THE BULK SOLID LOAD ON A CONVEYOR BELT DURING TRANSPORTATION

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ABSTRACT

This article presents findings from a research program to investigate the interaction between bulk solids and a conveyor belt during transportation. The research involved measuring and simulating the loads acting on a conveyor belt during transportation for a number of bulk solid materials and belt sag ratios. Laboratory experiments and simulations on a moving belt conveyor were undertaken, where the pressure acting on the surface of the belt due to the interaction with the bulk solid was measured for the first time using Tekscan® pressure sensors. The experimental results are compared to existing theoretical methods and to simulations undertaken using the Discrete Element Method (DEM). Good correlation between the measured experimental data and the simulations was found, with the outcomes leading to improved methods to calculate loads on conveyor idler rolls and increased accuracy in predicting the energy loss due to the bulk solid flexure.

1. INTRODUCTION

Early work in the area of conveyor belt and bulk solid interactions during transportation was undertaken by Behrens[1]. This work involved measuring the reaction loads on conveyor idler rolls during transportation for a range of bulk solids and idler roll troughing angles. Behrens showed that the forces on the inclined sides of the belt are in the order of 1.2 to 1.9 times greater than gravity acting alone. Experiments showed a value of 1.2 for a 30° troughed idler roll and 1.9 times for a 45° troughed idler roll. Similarly, Behrens found the normal force acting on the centre idler roll can be approximated by the weight of the volume of the bulk solid located directly above.

Krause and Hettler[2] applied a modified version of Coulomb's earth pressure theory to calculate the normal forces acting on the side idler rolls of a three-roll idler set. Figure 1 details the force analysis developed by Krause and Hettler for the active stress state due to the opening of the conveyor belt. The theory provides an analysis of the total force acting on the idler rolls as a result of the formation of active and passive stress states within the cross-section of the bulk solid material. The active pressure factor for the opening of the conveyor belt K_{ca}, is expressed as: