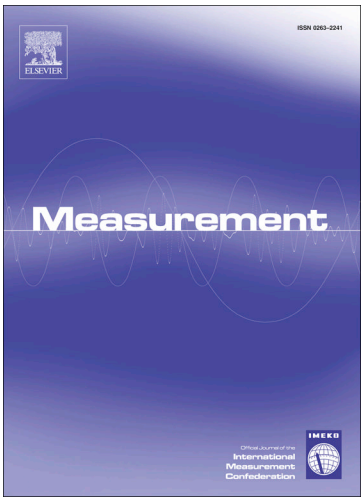

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INVESTIGATION OF THE DYNAMIC DEFLECTION OF CONVEYOR BELTS VIA EXPERIMENTAL AND MODELLING METHODS

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ABSTRACT

In a belt conveyor system the belt and conveyed bulk material experience cyclic movement due to the presence of the belt sag during operation. This dynamic belt deflection results in the trampling resistance of the belt conveyor. Dynamic belt deflection is complicated as it depends on the properties of the belt and bulk material, belt and material interaction and the configuration of the belt conveyor such as the idler spacing, belt tension and speed. To investigate belt deflection for variable dynamic conditions, a specially designed test facility has been constructed, which replicates the relative movement of a belt and idlers by moving several idler roll sets underneath a fixed belt. The main components of the test facility are described in this paper. A new experimental approach based on a photogrammetry technique is proposed for dynamic belt deflection measurements. Moreover, a coupled Finite Element Method (FEM) and Discrete Element Method (DEM) model is developed to predict the dynamic belt deflection. Experimental results were presented and compared to the results from the theoretical calculations and simulations. Comparisons showed a good correlation between simulation and experimental results.

KEYWORDS

Conveyor belt; Trampling resistance; Dynamic belt deflection measurement; Coupled FEM and DEM model

1. INTRODUCTION

Typical belt conveyors transport bulk materials using an endless belt supported by successive troughed idler roll sets. Belt deflection occurs between the idler roll sets due to the self-weight of the belt and the forces from the bulk solid material. During transportation, both the belt and material experience cyclic sagging and rising longitudinally and opening and closing transversely. The two components collectively make up the trampling resistance of the belt conveyor. While Spaans [1] predicted that longitudinal flexure dominates, the influence of transverse flexure becomes more significant with an increase in the distance between idler roll sets. Therefore, the belt conveyor trampling resistance heavily relies on the belt deflection during operating or dynamic conditions. The focus of this paper is dynamic belt deflection in the longitudinal direction.

A variety of theoretical and numerical methods have been developed to investigate belt deflection. The fundamental theoretical calculation for longitudinal belt deflection considers