

Abstract

Despite their popularity as an inclined conveyor belt runaway preventing device, very little research into the performance of unidirectional idlers currently exists. Considering the catastrophic repercussions of a belt runaway, as well as the high cost of unidirectional idlers, the importance of correctly specifying the required quantity of these devices may be appreciated. As such, this study determined the relationship between significant belt conveying factors and the unidirectional idler resistive forces, so as to determine the proportion of idlers that are required to be unidirectional.

In order to realise this objective, a range of experiments was planned using Design of Experiment (DOE) techniques. These experiments were designed to determine the resistive forces that develop between unidirectional rollers and a conveyor belt being pulled over these rollers in the *reverse* direction (to represent a belt slipping down an incline). These experiments were executed using the unidirectional roller (UDR) Test Rig, which was used to vary the levels of inclination angle, troughing angle, idler pitch, roller type, roller diameter, belt tension and material load. Analysis of the subsequent results revealed that *material load*, *troughing angle* and *idler pitch* have the most significant effect on unidirectional idler braking. In addition, it was determined that although contact friction affects unidirectional idler performance, the presence of non-friction resistances (such as belt sag) strongly influence the resistive force at belt slip. To expand on these findings, an additional friction study of various roller and conveyor belt material pairs was conducted using a Jenike Direct Shear Tester (JDST). The findings from this study echoed those of the UDR Experiments – that HDPE rollers provide the least resistance to belt slip, and that belt wear over time results in the reduction of unidirectional idler braking ability. Based on the findings of these investigations, a conservative numerical method for specifying the required proportion of unidirectional idlers was derived.

Overall, the results indicate that the worst unidirectional idler performance case is that where a 900 mm wide empty conveyor belt is troughed to an angle of 35° and supported by idlers separated by a pitch of 1200 mm. Under these worst case conditions, it is recommended that HDPE and steel unidirectional idlers are *not specified* for inclination angles greater than 16° and 21° respectively.