Using Larger Rollers to Improve Energy Efficiency in Belt Conveyor Systems

Project Scope:

Equipment: Idler Rollers for Long Distance Belt Conveyor Applications

Objective: TUNRA Bulk Solids, in collaboration with Big Roller™ and ContiTech Australia, assesses the influence of larger diameter idler rollers on energy savings for overland belt conveying systems.

Belt conveying systems are effective solutions for transporting bulk materials over long distances. The indentation rolling resistance in belt conveying systems, caused by the viscoelastic contact between the conveyor belt and an idler roll, can account for up to 60% of total drive power for overland conveying systems [1]. Typically, the indentation rolling resistance is known to be a function of idler roll diameter, belt loading profile, belt cover thickness, cord diameter and pitch for steel cord belts and the viscoelastic material properties of the bottom belt cover, which are also dependent on the operating conditions of the system including temperature, belt speed and belt load.

Big Roller™ Overland Conveying Company engaged TUNRA Bulk Solids to conduct indentation rolling resistance measurements with idler roll diameters of 152.4 mm, 219 mm, 316 mm, and 400 mm, to quantify the impact of larger idler rolls on the energy efficiency of conveyor belts.

Test Procedure and Analytical Model

Testing was conducted on the large indentation rolling resistance test facility operated by TUNRA Bulk Solids at The University of Newcastle, Australia, using an ST1000 belt supplied by ContiTech Australia Pty Ltd, manufactured with Continental Eco Plus cover compounds.

Pictures of the test facility set up with the 152.4 mm and 400 mm test idler rollers are shown in Figure 1:

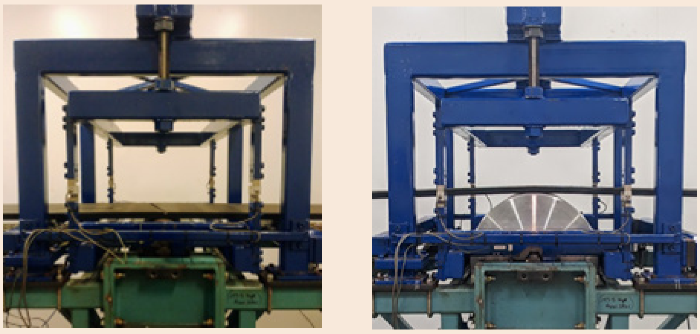

Figure 1:Test facility set up with the (a) 152.4 mm diameter test idler and (b) 400 mm diameter test idler [2].

In addition to the experimental data, the QC-N analytical model [3] was utilised to predict the indentation rolling resistance for a generic low rolling resistance compoud for a range of idler diameters.

The percentage decrease in indentation rolling resistance compared to an idler roller diameter of 152.4 mm is shown in Figure 2 for belt loads of 5 kN/m and 8 kN/m, for the idler roll diameters tested. Included in the comparison is the relative decrease predicted from the QC-N model at 20°, with a belt speed of 5 m/s. These results show an improvement in indentation rolling resistance performance of over 45% when comparing a 400 mm diameter roller to a 152.4 mm roller for this system, representing a saving in energy. Extrapolating this data based on the QC-N model would yield a 55% reduction for a 508 mm idler roll.

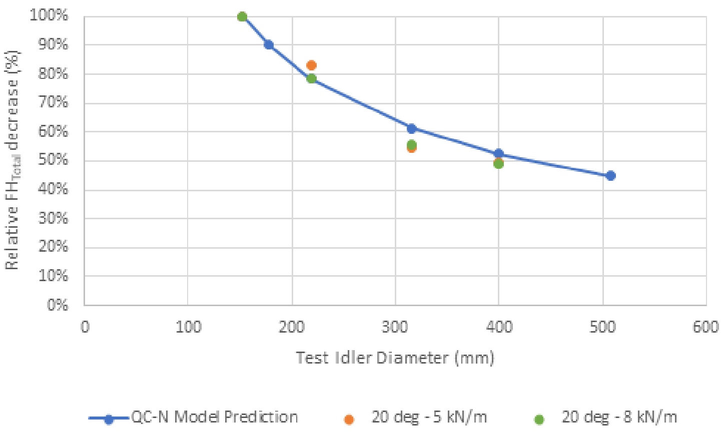

Figure 2: Decrease in indentation rolling resistance (IRR) compared to 152.4 mm diameter idler roller[2].

Trade-offs arise between increasing roll diameters and spans to achieve optimal efficiency versus adhering to material strengths and weights for roller components. Considerations such as shell wall thickness, abrasion design allowances, and component design life expectations also play a crucial role in determining practical limits for roller diameters. The practicality and cost-effectiveness of employing larger-diameter idler rollers may be more suitable for specific applications.

In summary, the use of larger diameter idler rollers reduces the indentation rolling resistance, which can lead to significant energy savings, particularly in long overland conveyors.

Figure3: Large indentation rolling resistance test facility at TUNRA Bulk Solids

References

1. Hager, M. and A. Hintz, The energy-saving design of belts for long conveyor systems. Bulk Solids Handling, 1993. 13(4): p. 749-758.

2. O'Shea, J., Robinson, P., Badat, Y., Wheeler, C., The Effect of Large Diameter Idler Rollers on the Indentation Rolling Resistance of Belt Conveying Systems, in The 14th International Conference on Bulk Materials Storage, Handling and Transportation, ICBMH. 2023: Wollongong, Australia.

3. Qiu, X. and C. Chai, Estimation of Energy Loss in Conveyor Systems due to Idler Indentation. Journal of Energy Engineering, 2011. 137: p. 36-43.

Why TUNRA Bulk Solids?

Experience and Expertise

We have provided expert solutions to industry for over 45 years and are the leading organisation for materials handling research and consulting in Australia and internationally

Research and Development

We have a proven track record in research and development through the close association with The University of Newcastle

Quality Service

We have highly qualified, well-trained and specialist staff that are committed to delivering excellence

First Class Facilities

Our laboratory is a state of the art facility located within the Newcastle Institute of Energy and Resources (NIER) at The University of Newcastle

Industry Standards

We are accredited to ISO 9001, ISO 45001 and ISO 14001

Independent

We are independent and not for profit

Advancing the Bulk Materials Handling Discipline Globally

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