Conveyor Idler Noise

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Abstract

Conveyor systems are sometimes located near populated areas and can have a negative impact on people living in the vicinity due to the noise that they create. The conveyor idlers that the conveyor belt rolls upon are one of the main noise sources of a conveyor system. This article discusses ways that conveyor idler noise is measured and how materials, finishing processes and conveyor idler shell surface quality can affect conveyor idler noise production.

1. Introduction

Conveyor systems are used widely in mining and material handling applications to efficiently move large amounts of bulk materials from one location or process to another. Often, conveyors are operating near populated areas where their noise emissions need to be managed; this is especially true at ports which are often sited near to densely populated residential suburbs. Conveyor noise is generated by bulk material impacts at loading points, conveyor drive units, vibrating conveyor structures, ancillary equipment and from conveyor idlers. In the past, conveyor idler noise was evaluated with experiments that measured the self-noise produced by a conveyor idler. More recently, conveyor idler noise experiments have changed to measure their operating-noise which is created by the interaction of the conveyor belt rolling on the conveyor idler as shown in Figure 1. These later experiments have shown that the surface finish of a conveyor idler is the main contributor to conveyor idler noise generation.

Figure 1 Conveyor idlers supporting a conveyor belt.

2. Conveyor Idler Self-noise

It is widely thought that the primary source of conveyor idler noise is the idler itself. This noise source is termed conveyor idler *self-noise*. Testing for conveyor idler self-noise is conducted by using a sound meter to measure the noise produced by one or more conveyor idlers mounted in a frame while they are rotating at operating speeds. The test idlers are driven with a light – low tension – belt that is powered by a small electric motor. The drive motor is positioned in a sound insulated cabinet so that the noise it makes is not added to the conveyor idler noise. Conveyor idlers that undergo a self-noise test are usually in brand new condition and do not produce any adverse noises. The typical noise level of a conveyor idler self-noise test is about 45 – 50dBA, which is less than the noise level of a "normal conversation" [1].

The conveyor idler self-noise test is of limited usefulness in determining conveyor noise production due to the low levels of noise that are measured by the test. However, this is not to say that conveyor idler self-noise can always be ignored as they are able to produce prominent humming or high pitch squealing noises which are both self-noise generators. Idlers that produce a lot of self-noise have generally been in service for some time and have developed some fault that will cause them to be quickly replaced in areas where noise minimization is important. The noise produced at this stage in an idler's life will bear no resemblance to the results from its self-noise test and self-noise testing on such an idler would only be of academic interest since it would not be used again.

3. Conveyor Idler Operating-Noise

The main source of conveyor idler noise production is through its interaction with the conveyor belt that it supports rather than the self-noise that it generates. Thus, any useful test that measures conveyor idler noise levels will involve a tensioned conveyor belt rotating the test idlers under a reasonable load. This alternative test is known as a conveyor idler *operating-noise* test as it measures the noise of an "operating" idler that is in contact with a conveyor belt.

The conveyor idler operating-noise test has the advantage of measuring the louder idler and belt interaction noise while also measuring the much quieter self-noise of the rotating idlers. Also, the surface of a new conveyor idler's shell is typically rougher than a used idler's surface and the idler's operating-noise will quieten down as its shell surface is used and polished smooth by the conveyor belt rather than get louder as with conveyor idler self-noise.

A conveyor idler operating-noise test is conducted by first tensioning a flat, light weight fabric conveyor belt between a drive pully and a tension pully. Five conveyor idlers, that are wider than the belt, are arranged with three above one of the strands and two below the same strand, as shown in Figure 2. The two groups of idlers are brought together such that the belt forms a zig-zag path between them with about 10 degrees of wrap on the middle three idlers. Noise levels are measured, while the conveyor belt is rotating the conveyor idlers, over a range of velocities which includes the intended operating speed. The typical noise level of an operating-noise test is between 70dBA and 100dBA.

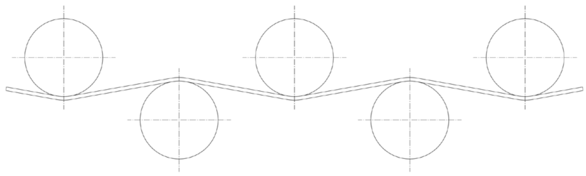

Figure 2 Conveyor idler operating-noise test idler and belt arrangement.

It is thought that a useful way to compare measurements between different test equipment would be to calibrate the equipment with a set of machined steel conveyor idlers and make tension adjustments until a sound pressure level of 74dBA is recorded for a belt speed of four metres per second. Calibration would be done for each different conveyor idler size. It is recognized that the calibration noise level is arbitrary and that the test is only useful for the relative comparison of operating-noise. More research is required to determine a correlation between the conveyor idler operating-noise test and an actual conveyor.

4. Conveyor Idler Shell Material and Noise Production

Different materials are used to manufacture conveyor idler shells. In a general order of increasing operating-noise *mass-produced* idler shells are made from polymers, aluminium and steel. The actual shell material seems to have little bearing on the relative noise output of a conveyor idler with noise production being more closely related to the finishing processes of each material. Mass-produced polymer conveyor idlers are relatively quiet due to their shell nearly always being machined during their manufacture. Mass-produced steel conveyor idlers have a weld seam on their shell which increases their noise output and mass-produced aluminium conveyor idlers are extruded which gives them a noise output between polymer and steel conveyors due to the lack of a weld seam on one hand and the lack of machining on the other. The addition of polymer endcaps to metallic shell materials will reduce the operating-noise as this removes the weld distortion at each end of the shell. Machining of any conveyor idler is the best option to reduce conveyor idler operating-noise and it has been found that finely machined steel idlers are the quietest overall. It is noted however, that quieter conveyor idlers are possible, but they require very fine machining and balancing processes and careful assembly procedures that are uneconomical for mass-production and the effort will only yield a conveyor idler that is a few tenths of a decibel quieter than a machined steel conveyor idler.

As an aside, over a decade of testing conveyor idler operating-noise, it has been found that once a conveyor idler has been well machined, it is the conveyor belt surface that becomes responsible for the minimum attainable operating-noise levels and this finding suggests that a modified version of the operating-noise test could be used to determine the relative operating-noise of conveyor belt.

5. Shell Measurements

The forging hints that it is the surface quality of the conveyor idler's shell that is responsible for much of the operating-noise. There are two tests commonly used to assess idler shell quality, these are: total indicated runout (TIR) and maximum indicated slope (MIS). The TIR test gives a measure of the eccentricity of the idler shell and the MIS test gives a measure that is roughly proportional to the radial surface velocity of a conveyor idler as it rotates. For MIR and TIR tests, the change in radius of the conveyor idler is measured for every six degrees of rotation at the idler's ends and centre. The TIR is reported as the difference between the highest and lowest readings and the MIS is the largest difference between consecutive readings as shown in the graph presented in Figure 3.

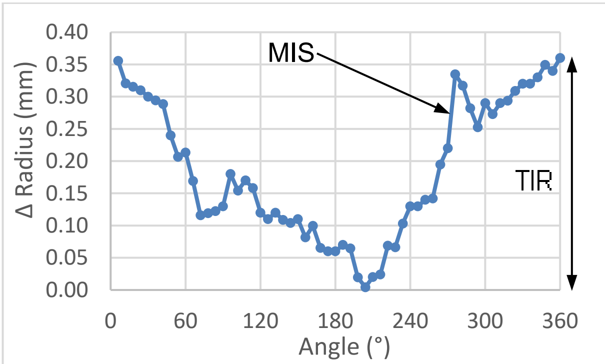

Figure 3 TIR and MIS relative conveyor idler radius measurements.

Operating-noise research was conducted by Munzenberger and Wheeler [2] for which a set of perfectly round but eccentric conveyor idlers were produced along with another set of perfectly round and concentric conveyor idlers that possessed a small flat machined along the shell to mimic the presence of a weld seam. The former group was designed to have a large TIR and practically zero MIS and the second set was designed to have practically zero TIR but a large MIS. Noise levels were measured for several sets of each group of conveyor idlers with progressively worse measurements. It was found that operating-noise did not increase with increasing eccentricity – Figure 4 – and that operating-noise increased with increasing MIS – Figure 5. The research corresponded well with mass produced conveyor idlers and showed that only the MIS properties of a conveyor idler shell influenced operating-noise. That is not to say that TIR can be ignored as far as conveyor noise production is concerned because the TIR measurement gives an indication of idler balance and idlers with large TIR measurements, and correspondingly poor balance, will vibrate a conveyor structure loose over time and cause vibration related noises especially from corrugated steel conveyor enclosures.

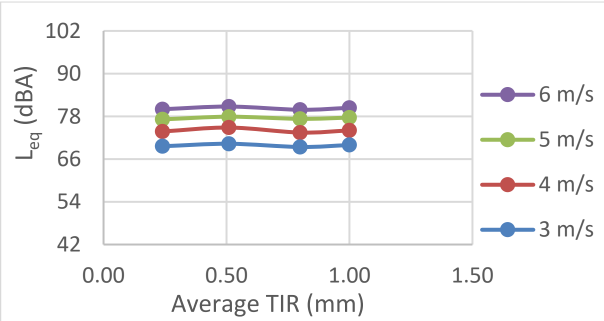

Figure 4 Conveyor idler operating-noise for increasing TIR.

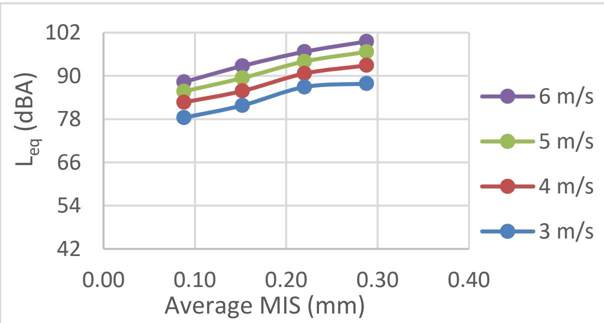

Figure 5 Conveyor idler operating-noise for increasing MIS.

6. Conclusion

When designing a conveyor system for a noise sensitive area or retrofitting a conveyor system to reduce its noise levels, it is important to consider the contribution of the conveyor idlers. The conveyor idlers are not the noisiest item on a conveyor, but their noise output is present along the entire length of the conveyor. When considering the noise production of conveyor idlers, it is safe to ignore the self-noise of the idler, but it is important to consider its operating-noise. When specifying the low noise idler type, not only should the conveyor idler's TIR and MIS measurements be checked, the shell material, construction method and construction accuracy should also be considered alongside the idler's finishing process and balancing. Ultimately, however, conveyor idlers are cheap mass produced and disposable items and the effort that is expended to produce low noise versions needs to be balanced with the level of noise reduction that is required.

7. References

[1] Safe Work Australia, "Noise," [Online]. Available: https://www.safeworkaustralia.gov.au/noise. [Accessed 12th May 2021].

[2] Munzenberger, P. J.; Wheeler, C. A., *The influence of Maximum Indicated Slope and Total Indicated Runout on the Noise Caused by the Interaction of Conveyor Idler Rolls and Conveyor Belt,* Johannesburg: IMHC Beltcon, 2011.