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The Correct Alignment and Profiling of High Speed Conveyors

P D H Comley
Conveyor Contracts Director
Anderson Mavor (SA) (Pty) Ltd

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1 Current Practice

The need to align troughed belt conveyors is nothing new, and is undertaken to greater or lesser degree on every installation. The usual procedure is to put a string line through to centre the conveyor structure, put the idler sets on at approximately 90° to the line of the conveyor, align the structure to the string line, and complete assembly.

After the belt has been put on to the conveyor, and the joints spliced, the conveyor is commissioned. This involves running the belt with men located at various points along the conveyor to observe where the belt is off-tracking, or other problems are occurring. The normal practice is then to adjust one or more of the idler sets in the areas where the belt is off-tracking, and to steer the belt back towards the centre.

The conveyor may even be fitted with so called training idler sets, which are pivotably mounted so that the whole set can pivot about the centre point. Vertical side rollers are located, on the ends of the sets, so that when the belt off-tracks the edge of the belt comes into hard contact with the side roller thus creating a side force on the idler set and pivoting the set so that the idler rolls become off-set to the belt and the scrubbing action between belt and rolls causes a force that tends to make the belt move back towards the centre line of the conveyor.

Most troughing idler sets and 'V' returns have the ends of the wing rollers set forward so that the side rolls are at 1 or 2° to the line across the set. The purpose of this is to create a scrubbing action between belt and side roll to keep the belt centralised.

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1 **Current Practice** (Continued)

This type of design and installation procedure has worked fairly well over the years, and been generally acceptable due to the relatively slow speed of belts. However, it is very unusual to see a conveyor installation of any length when the belt runs true and central, the norm being to see some belt wander from side to side.

2 **Effects Of Current Practice**

It can be easily seen that if all side rolls have a forward tilt that scrubbing between belt and roll takes place. The effect of this is continual wear on the belt cover and idler roll, and the absorbtion of power to overcome the resistance set up. This power loss is recognised at International Standard level and ISO 5048 singles this out as a significant part of the calculations in determining the power required to run the conveyor.

As described above the conveyor structure is normally string aligned, and approximately levelled, and idler sets set approximately square to the belt line, but many adjusted during the commissioning stage.

It is therefore safe to say that the profile of the belt across the conveyor varies from one idler set to another. This continuously changing shape again causes wear and tear to belt and idlers, and absorbs more power. It will also cause changes in the shape of the bed of material on the belt, causing movement of the material both within the bed of material and that in contact with the belt surface. Again power is being absorbed as well as further wear on the belt.

It is reasonable then to assume that on many conveyor installations unnecessary power is being absorbed to overcome these deficiencies, and that the lives of both belts and idlers are being affected. This however, has been generally accepted over

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2 Effects Of Current Practice (Continued)

the years with belt speeds only increasing gradually, and the affects of these anomolies not being a significant factor. However, the picture changes quite dramatically when we enter the region of high speed belt conveying, from some 5,0 m/sec and upwards.

3 Effect Of High Belt Speeds

High belt speeds have been introduced as conveyors have become longer and more costly, as it is possible to convey the same tonnage on a narrower belt but at a higher speed. Since the belt accounts for the major part of the initial capital and replacement costs, the use of a narrower belt brings considerable cost savings.

However, one of the results of running at high speeds is to greatly magnify the problems highlighted in section 2 of this paper. Belt and idler roll wear increases significantly, as does the power consumption, and the results of a high speed belt off-tracking would be disastrous as far as belt edge is concerned.

Troughed belt conveyors are one of the most cost effective ways of transporting loose bulk material over considerable distances, and high speed applications require special considerations to ensure the best cost effectiveness. One important way of making such a conveyor cost effective is to design and install the conveyor so that the belt runs with the minimum of resistance, and careful alignment and tracking of the belt can achieve significant gains in this area.

An average overland conveyor, installed and aligned with care to the normally accepted practices will have a resistance of about 0,022. However, it has been demonstrated by a number of installations overseas, where special design and installation

3 Effect Of High Belt Speeds

procedures have been adopted, that considerable power consumption savings can be made, and the resistance factor can be reduced to as little as 0,016.

To demonstrate the size of this saving let us consider an overland conveyor of some 7 kilometre in length, 1050mm belt (Steel cord), running at 6,0 m/sec and conveying 2000 TPH of Coal.

With a resistance of 0,022 the power required to run the belt and move the material horizontally is 1813 Kw. However, with a resistance factor of 0,016 the power reduces to 1195 Kw. For an installation running an average of 4000 hours a year, and with a 20 year life, the saving in power consumption at today's prices of 3,73 cents per kilowatt hour is some R1 844 112,00.

This takes no account of the improved belt and idler life that will result by having a conveyor that is very accurately aligned and profiled.

4 Correct Alignment And Profiling

4.1 The Equipment

First of all, if we are now going to ensure that the conveyor is correctly aligned and profiled there is no longer any need to have idler sets with wing rollers having a forward tilt. The idler rolls can now be parallel to one another.

One criterion for a well aligned high speed conveyor, is for the idler sets to be made to a consistent standard, so that the idler profiles are maintained to a good degree of accuracy. Current methods of manufacture can achieve this without any major problems.

4 Correct Alignment And Profiling (Continued)

4.1 The Equipment (Continued)

Conveyor Structure and idler sets must be designed to allow a degree of adjustment of the idler set both across the structure as well as sideways.

The conveyor structure should be set out to centre line pegs that have been set to a surveyed line, with the grading of the run of the conveyor having been previously completed.

The troughing and 'V' return idler sets can now be installed with their nuts and bolts, to the structure, but not tightened down.

The author now proposes a system that can effectively be employed to align and profile the idler sets.

This comprises two alignment frames, one for the trough set and one for the 'V' return set. In both cases the frame spans the set, and projects beyond the width of the conveyor on one side. The frame sits on the wing rolls by means of two 'V' plates, so that they contact each side roll like a 'V' block, and are set at right angles to the wing rolls. A suitable leg is provided on the frame to rest against either the structure or the idler base, to prevent the frame tippling over. An adjusting screw with lock nuts is provided at one end of the frame so that the end of the screw contacts the outer face of the wing roller, and can be adjusted so that the frame is central to the idler set.

A "Slow" spirit level is set in the top of the frame, so that it levels across the frame. On the side of

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4 Correct Alignment And Profiling (Continued)

4.1 The Equipment (Continued)

the frame that projects beyond the conveyor structure is mounted an optical sighting device, and capable of being rotated in a vertical plane. This optical device is designed to be absolutely at right angles to the alignment frame and its 'V' plates.

A laser beam is now set up alongside the conveyor, at the head end, so that it can be viewed from along the conveyor, and set to a surveyed mark for the correct alignment.

4.2 Procedure

The alignment frame is set on the first idler set, and the set checked for being level. If necessary shims can be fitted under one foot to achieve a level situation.

Then with one operator viewing through the optical sight to the laser beam, the complete idler set is moved across the conveyor structure, and adjusted side ways until the laser beam can be seen centrally through the optical sight, and aligned with the front and rear sighting marks.

The idler set is now correctly aligned and profiled, and the bolts can be tightened.

The same procedure applies to the alignment frame for the 'V' return set, and is repeated at each top and bottom set.

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4 Correct Alignment And Profiling (Continued)

4.2 Procedure (Continued)

Due to undulations in the Conveyor, it may be necessary to re-set the laser beam after a section of conveyor has been aligned, to undertake the next section with the laser in sight for that section.

We first used this system when the Author was responsible for the installation of the Steel cord Shaft belt at the Selby Coal field in the UK, in 1982. This conveyor was planned to be some 15 kilometres long, and being located in a tunnel under the coal seam, and dipping with the coal seam.

The conveyor was designed to run at up to 8,4 m/sec belt speed, and we aimed for an overall resistance factor of no more that 0,015 to stay within the operating belt safety factor of 5 to 1 with an ST 7100 Steel cord belt.

In addition to the need for accurate alignment and profiling of the idler sets, all idler rolls were machined on the O/D for maximum concentricity to eliminate any possibility of belt hammer at this high speed.

However, the system we had to adopt for alignment was different in as much as we could not make use of a laser beam. The conveyor was initially commissioned at a length of 5 kilometres, and then extended in stages as the tunnel was driven by the tunnelling machine. A haulage roadway was located alongside the conveyor to take men and materials to the tunnelling machine, and we had to keep the roadway clear, so a laser beam could not be used.

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4 Correct Alignment And Profiling (Continued)

4.2 Procedure (Continued)

The system we adopted was to survey a line parallel to the conveyor, marking this line on the underside of the roadway rings. From these points we set a tight string line, and from this string line hung two plumb lines, ring mounted so they could be easily moved along.

Instead of the optical device on the alignment frame, we had a machined metal alignment bar running at right angles to the frame.

The procedure was the same in as much as we shimmed the idler sets to a horizontal position, and then moved the set sideways and aligned it until the alignment bar was just touching the two plumb lines.

One advantage of this system using a string line and plumb lines, was that we could use two teams with two sets of alignment frames, working at the same time on different sections of the conveyor.

When the conveyor was initially run, the advantage of using the system were clearly seen. During the whole of the commissioning we did not have to adjust a single idler set in the whole 5 kilometres, and initial readings of power consumption showed an overall resistance factor of only 0,017 before any part of the equipment had been "run-in".

One important point to remember is the alignment of the pulleys as well as the idlers. This is best achieved by mounting the pulley on machined sole plates, and with vertical adjusting screws. The pulleys can then be both shimmed and levelled to bring them square to the line of the conveyor.

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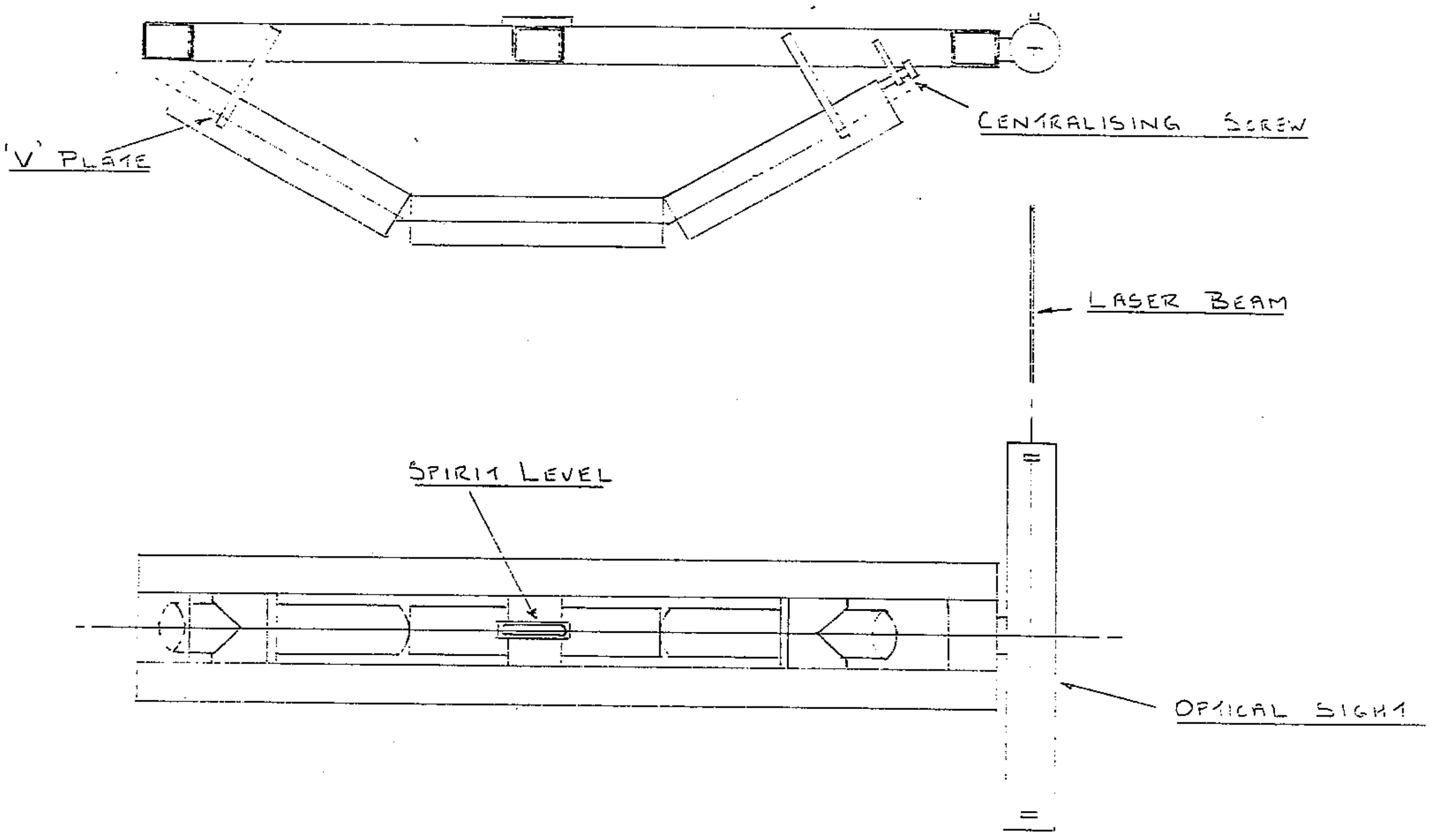
5 Conclusion

To align and profile each idler set is time consuming, and will therefore add to the installation costs. However, the savings in power consumption, and the increased lives of both belt and idlers will more than offset this initial cost, and will reap the User considerable benefits over the life of the system.

The Author recommends that the alignment frames become the property of the User, and form part of his maintenance equipment.

Two final very important points - a lot of the gains to be made by adopting these procedures will be lost if the belt supplied is not straight, and that the belt joints are not made straight and to a tightly controlled specification. The belting can be monitored with the supplier to ensure the required straightness, but it must be stressed that first class belt splicers are used and that joints are made in areas where adequate centre line lengths can be set out and where the splicing operations can be closely supervised.

Finally, the grading of the run of the conveyor is important to ensure smooth and adequate radii, and avoid any dips or steps in the line of the conveyor. Proper surveying and grading at the start will be the firm basis to ensure satisfactory installation.



ALIGNMENT FRAME FOR TROUGH IDLERS

Idler Alignment System Used At Selby