THE CARE AND MAINTENANCE OF CONVEYOR BELTS

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Introduction

Mechanical handling of materials is fully justified only where the handling system will operate reliably without the posting of labour to ensure that it continues functioning. Efficient mechanisation must combine good housekeeping with sound design. The incorporation of one or more of the cleaning devices described in this paper may determine the ultimate success of a conveyor system. The correct application of these cleaning devices will ensure a belt conveyor system which functions efficiently and can be relied upon to operate with a minimum of attention.

In the operation of any belt conveyor system, good housekeeping is essential to ensure reliable service. Attention to lubrication and cleanliness is normal preventive maintenance, but it is very necessary in order to ensure that the belt and its rolling equipment will give the years of service for which they are designed.

Inspection

The manufacturer of the equipment lays down a recommended programme of lubrication and inspection, which, when carried out correctly, will safeguard the conveyor system. Ignoring this maintenance can easily damage not only the individual component, but the belt as well.

A build-up of material on the structure can bear against the running gear with resultant abrasion, and a build-up on the idlers can cause the belt to run off to one side, foul the structure and often suffer severe damage, usually at the edges.

Lubrication

All troughing and return idlers, also the snubbing pulley behind the head drum, should be inspected periodically to ensure that they are revolving freely. A jammed idler, whether from an under-lubricated damaged bearing, or from build-up of material, will wear through its outer shell where the belt rubs over it, especially where the conveyor is handling abrasive loading. The sharp edge of the shell can then cut the belt.

Oil and grease are natural enemies of rubber belts, and over-lubrication will force excess grease to escape past the bearing seals of the idlers, and permit this grease to be thrown on to the belt, especially at the point where the horizontal and inclined troughing idlers meet. In time this grease will cause the rubber to swell along this line, the swollen rubber will tend to pinch between the rollers, and eventually
the belt can be irreparably damaged along its entire length at the two points where the pulley side cover of the belt passes over the junction of the troughing rollers.

Another habit to be guarded against is that of the greasing crew who, finding that they have waste grease either due to a leak between the grease gun and the nipple or from handling the gun, tend to wipe this grease on to the belt as a means of disposing of it.

Cleaning

Cleanliness of the belt in operation can best be brought about by a combination of sound design incorporating efficient cleaning devices for the material to be handled and periodic inspection to ensure that no build-up of material is occurring at any point in the system.

Belt conveyor systems are called upon to carry all manner of materials, many of which, such as raw sugar, wet coal, boiler ash and moist earth, are very sticky, and it is with materials such as these that special attention must be given to the design of cleaning devices.

This problem can be tackled from two aspects, one being to remove all the material at the discharge point, the other being to accept a certain amount of the material being carried around on the return run of the belt, and to ensure that it does not accumulate on either the idlers or the structure.

Devices for Cleaning Conveyor Belts

Bar Types.—The simplest device for the removal of material at the head pulley is a steel bar fixed to the structure and situated under the head pulley, just clearing the belt and acting as a scraper. This arrangement has the disadvantage of being liable to damage the belt. A build-up on the head pulley itself can force the belt against this bar, or a large piece of material can wedge between the belt and the bar; in either case the belt can be cut extensively along its carrying side. Further, this bar must not quite bear on the belt, otherwise excessive belt wear will occur; consequently, its effectiveness is limited. Also, it is obviously unsuitable for belts joined by metal fasteners.

Another device suitable for vulcanised endless belts is a stretched piano wire mounted in the same position as that of the steel bar except that the former may just touch the surface of the belt and is effective for lifting cake-like deposits. Its limitation is the risk of breakage by a large particle forcing its way through and subsequent failure of the cleaning protection.

As a modification of the bar device, the bar is set back $\frac{3}{4}$ in. to $\frac{1}{4}$ in. from the belt, and a piece of abrasion resistant rubber $\frac{1}{4}$ in. to $\frac{3}{4}$ in. thick is affixed to the bar, so that this rubber bears on and gives a positive wipe to the belt. Furthermore the bar, instead of being fixed, can be pivoted and spring loaded, so that the pressure of the wiper on the belt can be varied. This spring will allow the unit to be forced back to permit large pieces of material to pass through without damaging the belt. This arrangement, shown in Fig. 1, is frequently used on reasonably sticky materials, but it is only partially successful on the more adhesive materials such as raw sugar. These devices must be checked
periodically to ensure that worn or damaged rubber scrapers are replaced. Extra life can be achieved from these rubbers by having them made wider and slotting the mounting bolt holes so that they can be moved further out to compensate for wear. It should be noted that the use of conveyor belting in place of the rubber scraper is not wise, as belting is too rigid and abrasive particles can lodge in the exposed scraper belt duck and gouge the conveyor belt cover.

This method of cleaning is also sometimes used to remove material from the pulley side cover of the belt, thereby preventing a build-up on the head and tail pulleys. In this application the scraper is usually fitted just behind the head pulley and is set at an angle to the run of the belt or fabricated in a chevron shape so that dislodged material is fed to the outside of the belt where its disposal must be provided for.
Blade Type.—For this purpose, the scraper may consist of a series of spring mounted flexible steel bars, which bear lightly on the belt and are arranged stepped back in chevron shape so that each serves a portion of the belt and feeds its removed material on to the adjacent scraper, gradually working this material to the outside of the belt for disposal. This type of scraper cleaner is illustrated in Fig. 2.

Beater Type.—A more effective approach to the removal of adherent material is by the use of the more elaborate rotating beater, which can be operated on the carrying side cover of the belt either where it passes over the lower half on the head pulley or on the return run of the belt. This type is depicted in Fig. 3 and can be driven either by a vee belt from the head pulley or from a separate motor.

![Fig. 3—Rotating beater type of belt cleaner.](image)

It consists essentially of three or four pieces of 3 ply transmission belting mounted tangentially on a boss fitted on the driven shaft and is driven at a peripheral speed of 1000 feet per minute or four times the speed of the conveyor, whichever is the greater. This device is mounted so that the beaters may be adjusted to flick the conveyor belt cover for approximately 25 degrees of the circumference of the beater in the case of the four blade unit and 35 degrees in the case of the three blade unit.

Brush Type.—A somewhat similar principle is involved in the rotary brush belt cleaning device, which consists essentially of a brush bearing against the belt on the lower section of the head pulley and rotating in a contrary direction to the direction of travel of the belt. It may be driven by a separate motor or from the head pulley through a counter shaft, as shown in Fig. 4.

The brush is mounted on a counterbalanced sub-chassis, with an adjustment to vary the bearing pressure. In practice it is found that a
light pressure is more effective, the bristles then flicking the material free rather than wiping it off which action would occur when the brush bears heavily. The brush itself consists of rows of bristles mounted in a hardwood base. This base has a square hole running through it and is split lengthwise to be clamped on to the shaft. The bristles are normally of heavy gauge bassein, which gives good service; however, being vegetable, in the presence of moisture they gradually rot. Probably one season on raw sugar would be a fair indication of reasonable service. It is likely that in the future further experiments will be carried out with nylon, whalebone and even fibre glass bristles, to develop a longer lasting brush.

Fig. 4—A rotary brush cleaner driven from the head pulley.

Suitable brush speeds are indicated in Table I.

<table>
<thead>
<tr>
<th>Type of Material</th>
<th>Peripheral speed of brush—f.p.m.</th>
<th>Brush speed—r.p.m.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8 in. 10 in. 12 in.</td>
<td>8 in. 10 in. 12 in.</td>
</tr>
<tr>
<td>Dry, dusty</td>
<td>800 870 1000</td>
<td>380 330 320</td>
</tr>
<tr>
<td>Damp</td>
<td>960 1100 1200</td>
<td>455 420 380</td>
</tr>
<tr>
<td>Wet, sticky</td>
<td>1200 1380 1500</td>
<td>525 475</td>
</tr>
</tbody>
</table>

Idler Cleaning

Accepting the fact that with sticky materials it is virtually impossible to clean completely the belt at the head pulley, it is necessary to ensure that material carried on the return run of the belt does not affect the performance of the conveyor. This is achieved by designing the return idlers, snubber pulley and, in extremes, the head and tail pulley so that they will not accumulate material.
The fitting of spaced round rubber rings to return idlers is normally adequate to prevent build-up at these points. These rings are 3/8in. to 3/4in. diameter in section and are made approximately 1/4in. less in internal diameter than the outside diameter of the return idler and are spaced at 3in. to 4in. across the idler, so that stretch fitting permanently locates them; however, where the belt tends to drift on the return run, it may be necessary to fix these rings with a suitable rubber adhesive.

Where larger quantities of material are carried on the return run of the belt, it may be desirable to have a greater clearance between the belt and the idler, in which case specially designed rubber discs are available to stretch fit over the idlers. These tough flexible discs are spaced at 4 to 5in. and allow the belt to sag slightly between discs, this flexing helping to clear the belt.

**Pulley Cleaning**

Self clearing snubber pulleys of the so-called "squirrel cage" construction (Fig. 5) consist of two or three discs mounted on the shaft, with 3/8in. or 3/4in. mild steel bars welded to the circumference of the discs parallel to the shaft at 1 1/2in. to 2in. spacing. Any material tending to build up passes between the bars and falls clear. The vibration imparted to the belt by the bars tends to clear the conveyor further, a heap of material will form under a squirrel cage snubber, and its disposal needs to be allowed for.

![Fig. 5—Squirrel cage snub pulley.](image)

Squirrel cage tail pulleys ensure no build-up at this point; however, to be self clearing, the bars need to be chevron shaped to enable material to work to the outside of the pulley as it revolves.

**Loading Points**

At this stage a note on loading points may be appropriate. Practically all the wear of a conveyor belt cover takes place at the loading point, as it is here that the material moves on the cover, whereas during the carrying cycle the material reposes motionless on the belt. The ideal loading point is that where the material being loaded meets the belt at the same speed and in the same direction as the belt is travelling; under these conditions the material settles on the belt without moving over the rubber cover or abrading. At the same time the material bed is spread across the belt to ensure balanced loading.

In practice the ideal is almost never achieved; however, the closer the practice approaches the ideal, the greater will be the life of the
belt, and the following aspects in the design of loading points should be considered:—

Where particles of a mixed lump size are being loaded, an inclined grizzly bar arrangement to allow the fines to form a mat on the belt before the large lumps are accepted will lessen impact damage to the belt carcass.

Where mainly heavy lump sizes are being loaded, it should be arranged that they do not drop any further than necessary on to the belt to minimise impact damage. Also, shock absorbing rubber impact idlers should be fitted under the loading point. Special shock absorbing rubber discs are manufactured for this purpose. In extreme cases consideration should be given to the fitting of rubber semi-pneumatic or even pneumatic impact idlers.

Loading at an angle to the run of the belt should be avoided. This type of loading will give an uneven sectional loading. Also, impact forces of the loading material will tend to force the belt sideways, thereby giving the belt a different running position when loaded or unloaded.

Adequate skirts must be mounted at the loading point to prevent spillage. These skirts should extend along the run of the belt as far as any movement of the load is experienced, and normally consist of steel or wood side plates with abrasion resistant rubber strips bridging the gap between the side plates and the belt. For the reasons mentioned earlier in connection with rubber scrapers, conveyor or transmission belting should not be used in this application. Every precaution should be taken to ensure that large pieces are not wedged between the side plates and the belt, as serious damage to the belt can result.

Conclusion

The user must remember that the selection of the correct belt for the job is of paramount importance. The manufacturer of conveyor belts can "build in" resistance to the conditions experienced in practically all environments and, by incorporating special ducks manufactured from cotton, rayon, nylon and other fibres, can accommodate the tensions imposed by the hauling of heavy loads up steep inclines for indefinite periods.

The rubber covers protecting the duck carcass can be compounded to resist most specific environments—chemicals, high temperatures, severe abrasion, weathering, oils, fats, greases, etc. One example in sugar mills is the specially compounded rubber required to resist the attack of cane waxes and resins in filter mud and hot bagasse. Conveyor belts handling these substances often gave poor service and investigation revealed that, in a certain temperature range, precipitation of solidifying waxes and resins occurred due to cooling in the carrying cycle of these conveyors. Consequently, a normally fractional percentage of matter injurious to rubber formed, a highly concentrated layer
on the surface of the belt. Having isolated the environment, compounding rubber covers for resistance became a routine matter.

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