Conveyor Belt Cleaning

Maximizing efficiency and cost-effectiveness

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Today, efficient belt cleaning devices are indispensable in most conveyor installations. At a time when the number of operatives employed on such installations is being reduced, even greater demands are being placed on the cleaning efficiency of these systems. Yet this is only possible if the scrapers employed operate in harmony with the other plant components.

After a brief introduction to belt cleaning technology, this article will consider the integration of such systems as an important component in any conveyor installation, and examine the savings that can be achieved by efficient belt cleaning.

Basic belt cleaning methods and equipment

Belt conveyors tend to accumulate dirt on the return strand, as the conveyed material is constantly being scraped by other parts of the installation and therefore enters the conveyor line. To prevent the accumulation of dirt, or to reduce it to acceptable levels, each belt must be cleaned after the discharge point. A variety of procedures and methods is available to perform this task, as shown in figure 1, while figure 2 shows the most commonly used belt cleaning systems.

In practice, most companies employ scrapers fitted with blocks, blades or modules to clean their conveyor belts. These scrapers can be classified according to various characteristics:

- The cleaning tip material: Cleaning tips can be made of rubber, plastic, ceramics, steel or tungsten carbide. Tungsten carbide, especially, is characterized by a long service life.
- The position of the blades against the belt: The market today offers numerous scraper systems with a great variety of different designs: i.e. paint scraper principle, bar principle or negative-angle principle (fig. 3). All types of scrapers are used but the best cleaning results are said to be achieved with scrapers utilizing the paint scraper principle.
- The design of the cleaning blades: Single-row scrapers with a strip-type cleaning blade made of rubber, plastic or steel show a so-called continuous-line layout. Modern high-efficiency belt scrapers, however, offer a split-line layout, i.e. individual spring-loaded cleaning elements pressed against the belt. The latter are available in either single-row configuration, with ➤
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**Integration of belt cleaning systems into the conveyor structure**

Effective cleaning is dependent upon the principle behind the scraper system, although the underlying technical conditions encountered in the facility as a whole and the properties of the conveyed material are also important. A scraper is in permanent interaction with the other belt conveyor components and is therefore only as good as the conveyor allows.

When discussing the use of scrapers, it is normal to distinguish between the pulley and the return strand (fig. 6). The boundary between these two areas is marked by the discharge point. Cleaning is highly effective in both areas.

On a reversible belt each discharge point must be equipped with a cleaning system. In this case, scrapers are generally installed at 90° to the conveyor belt. Where a high level of cleaning efficiency is required on the drum, cleaning systems using the paint scraper principle can also be installed. Depending on the direction of belt travel, these scrapers must be disengaged and re-engaged. The necessary disengaging devices can be operated electrically, pneumatically or hydraulically.

To obtain the best possible results, the following principles should be followed:

— sufficient space should be available for arrangement of the scrapers according to the installation and operating instructions
— where conveyed material sticks to the belt in thick layers there should be enough space for a pre- and a main scraper
— after the scraper there should be sufficient space up to the rear wall of the chute to prevent caking of conveyed material on the chute
— the rear wall of the chute should exhibit an angle appropriate for the discharge behaviour of the material
— the rear wall of the chute should be closed at as high a point as possible to prevent scrapings being thrown behind the chute
— the scraper should be easily accessible for ease of mounting, maintenance and cleaning.

Chutes that are extremely small and narrow can prevent optimal cleaning for the entire life of the plant, thereby creating extra costs. Each cleaning facility should, therefore, be carefully selected at an early stage in consultation with the plant manufacturer, the plant operators and the scraper manufacturer, in order to achieve the best possible cleaning efficiency.

The surface quality of the conveyor belt also has a considerable influence on the cleaning effect. For example:

— a furrowed or worn belt does not permit efficient cleaning, as the scraper cannot fully contact the conveyed material
— a cover-plate hardness of 60° to 75° Shore-A is favourable
— joins and patched areas in the belt must be level and ➤
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does deviate from the undisturbed section, the junction must feature a gradual, terrace-like edge 
— the edge of a textile belt junction should be gradual and terrace-like, so that the scraper hits the undisturbed section of the belt after passing the junction and does not run against the overlap
— it is vital to check the compatibility of mechanical belt splices with the scraper. In some cases it may be necessary to use special cleaning elements with a reduced cleaning efficiency. This is also the case with highly damaged belt surfaces, patches and grooves
— excessive belt mis-tracking in the scraper area may cause the pre-tensioned cleaning elements to lose contact with the belt and damage the belt edges
— in order to stabilize the belt in the scraper area, the installation of support idlers on the return strand may be required.

The head pulley is also very important, for example:
— where a scraper is to be installed on the head pulley, it is crucial to check the scraper’s compatibility with the drum lagging and the drum design
— the conveyor design should ensure that no material is caught between the belt and the drum, as this could damage the belt
— during the winter, ice should be prevented from forming on the drum
— scrapers increase the energy requirement of a conveyor belt. For short belt conveyors it may be necessary to check the power requirement.

It is clear, therefore, that a variety of factors must be taken into account when selecting equipment and designing the plant. Unfortunately, in practice it is often the case that too little attention is paid to the belt cleaning systems, thus preventing optimum selection and arrangement.

By investing slightly more in the configuration of material-transfer facilities, for example, plant owners are guaranteed satisfactory operation for the entire life of the plant. Each cleaning device should therefore be carefully selected at an early stage in consultation with the plant constructors and operators, taking into account the conditions of service as well as relevant standards and directives.

Scraper system components are situated in the product flow and are therefore exposed to high dynamic and static stresses. These operating conditions, combined with the need for high and steady levels of cleaning efficiency, necessitate regular maintenance of the scraper devices. This involves:
— regular inspections of the scrapers and control of their operating efficiency
— regular cleaning and functional checks of all scraper components
— replacement of worn out or damaged components with OEM parts.

In order to schedule maintenance intervals and requirements for spare parts, it is recommended that operational statistics are maintained. The intervals for follow-up inspections can vary from once a month to once a week and mainly depend on the material conveyed and the operating conditions of the scraper.

<table>
<thead>
<tr>
<th>Costs of investment</th>
<th>Operating costs</th>
</tr>
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<tbody>
<tr>
<td>Belt cleaning system</td>
<td>Spare parts for cleaning system</td>
</tr>
<tr>
<td>Installation of cleaning system and modification of conveyor structure</td>
<td>Maintenance of the cleaning system</td>
</tr>
<tr>
<td>Costs for cleaning up carryback</td>
<td>Costs of material loss</td>
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<tr>
<td>Costs of increased wear of other conveyor components</td>
<td>Costs owing to conveyor failure</td>
</tr>
<tr>
<td>Costs of energy, air, water etc.</td>
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Economy of belt cleaning

Conveyed material sticking to the belt can lead to substantial plant operating costs (fig. 7).

For example, personnel costs may be incurred due to the cleaning work required; the loss of conveyed material (depending on the material) can result in unsubstantial costs; and material sticking to the belt can impact on the plant, eg the idlers carrying the return strand, and lead to increased wear. If the material becomes clogged on the return idlers or builds up underneath the return strand the belt can start to skew dangerously. This can lead to damage to the belt, the steel structure and, in the worst case, total failure of the plant.

When considering the economic viability of a belt cleaning system it is necessary to compare investment and operating costs. A model cost statement gives an even clearer picture (see tables 1 and 2).

Table 2 clearly shows that by halving total contamination levels by duplication of the efficiency of the cleaning system, significant cost savings can be achieved. The economic consequences of inadequate belt cleaning are still underestimated by many companies (fig. 8).

HOSCH have therefore developed a practical assessment method and can offer operators an analysis of the effectiveness of existing or newly installed belt cleaning systems (fig. 9).

To carry out such an assessment, a carryback gauge consisting of a steel blade and a collecting vessel for the removed material is installed behind a belt cleaning system for a limited period of time to measure the quantity of carryback. The quantity of carryback can be measured either volumetrically, in litres, or by weighing the collected material. Afterwards, the data ascertained is extrapolated to one year, taking into consideration respective operating hours, and the economic viability of the system is evaluated.

Compared with the cost of investing in a complete conveyor system, the cost of the scraper systems is of only minor importance. But when considering the overall cost of running a plant over time, then they become of much greater significance. Scraper systems should therefore be taken into consideration and specified when planning a new installation and belt cleaning concepts should be developed in accordance with the plant as a whole.

Summary

At a time of high cost pressures and reduced personnel capacity, belt cleaning systems have become increasingly important. The integration of cleaning systems into the conveyor structure requires a considerable technical understanding and a detailed knowledge of the entire installation. Optimal scraper system configuration significantly reduces the operating costs of belt conveyors.

References

Table 2. Belt cleaning feasibility analysis for two scrapers of different efficiency

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Unit</th>
<th>Cleaner Type - A</th>
<th>Cleaner Type - B</th>
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<tbody>
<tr>
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<td>4.</td>
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Fig. 8. Operating cost of belt cleaning depending on cleaning efficiency

Fig. 9. Method of gauging the effectiveness of belt cleaning facilities