THE BEST OF BOTH WORLDS

Fertilizers, and the processes used to manufacture them, place some of the very toughest demands on rubber conveyor belts. Strangely, despite the serious damage that can be inflicted on them, the continued use of low-grade conveyor belts (that have inadequate resistance to these demands) is widespread, often in an effort to minimise costs. The same applies to heat resistance which is a very short-term and costly mistake. Without adequate heat-resistant properties, high temperatures cause a rapid acceleration in the ageing process of the rubber.

Most conveyor operators in the fertilizer industry could and should be using belts that provide at least twice the length of working life compared to what is currently being achieved. In a surprising number of cases, it can be substantially more than twice the life. The mathematics regarding costs are simple. Belts that last appreciably longer and require less intervention cost much less. To achieve cost-effective longevity, fertilizer conveyor belts need to possess a range of essential properties.

Basic properties

To provide cost-effective longevity, the rubber covers that protect the inner carcass of the belt must have a good standard of at least two basic properties – abrasion (wear) resistance and ozone and ultraviolet resistance. Insufficient resistance to abrasion is one of the biggest reasons why belts need to be replaced much sooner than should be necessary.

Rob van Oijen, Fenner Dunlop, the Netherlands, explains how fertilizer producers can increase the working lifetime of conveyor belts, whilst decreasing their cost.

When conveying material that does not contain oils or chemicals, with a continuous ambient temperature of less than 80°C, then a straightforward abrasion resistant compound should suffice. The DIN Y grade or its closest equivalent, ISO 14890 grade L, is usually perfectly suitable for 'normal' service conditions. When comparing figures relating to abrasion resistance, it is important to remember that lower figures represent a higher level of resistance against abrasive wear. The second, and most commonly overlooked basic property, is resistance to the seriously damaging effects of ozone and ultraviolet light. At low altitude, ozone becomes a pollutant and is created by the photolysis of nitrogen dioxide (NO_2) from sources such as automobile exhaust and industrial discharges. This is known as ozonolysis.

Exposure is inescapable because even tiny traces of ozone in the air will attack the molecular structure of rubber. It increases the acidity of carbon black surfaces with natural rubber, polybutadiene, styrenebutadiene rubber and nitrile rubber being the most sensitive to degradation. Unless the manufacturer has included sufficient amounts of good quality antiozonants when creating the rubber compound, small cracks will begin to appear in the surface of the rubber at a surprisingly early stage. This is because the process of ozonolysis effectively begins when the conveyor belt leaves the production line.

While this process is taking place, ultraviolet light from sunlight and artificial (fluorescent) lighting is also accelerating the deterioration of the rubber covers. Known as 'UV degradation', it produces photochemical reactions that promote the oxidation of the rubber surface, resulting in a loss in mechanical strength. One of the many unwanted side effects of rubber degradation caused by ozone and ultraviolet radiation is that the ability of the rubber to resist wear and surface cutting is steadily reduced, thereby significantly reducing the operational lifetime of the belt. A good standard of abrasion resistance, and ozone and UV resistance, should therefore be absolute prerequisites when buying any type of rubber conveyor belt.

Oils and chemicals

Just as there are several different types of fertilizer, there are even more varieties of oils and chemicals, including acids, that are contained within them or which are used as part of the production process. Many have a seriously damaging effect on the outer covers of conveyor belts and consequently on both their day-to-day performance and life expectancy. When oil penetrates rubber it causes it to soften, swell and distort. The process is relatively gradual but it leads to all kinds of problems.

As with ozone and ultraviolet, the first problem is a dramatic decrease in the ability of the rubber to withstand abrasive wear, although unlike ozone and ultraviolet, the signs are not so visually obvious. As the rubber continues to soften, it also steadily loses its tensile strength while at the same time becoming much more prone to ripping and tearing. The next stage is that the rubber begins to swell and distort. This causes steering and handling problems along with a serious reduction in the amount a belt can stretch before it snaps. The technical phrase for this is 'elongation at break'. A common symptom of this is recurring splice joint problems.

There are two distinct sources of oils that damage rubber: mineral and vegetable/animal, each of which has its own particular effects. Despite the difference in effect, most conveyor belt manufacturers only offer one oil resistant rubber cover quality compound, which is usually referred to as 'MOR' (moderate oil resistance).

Although probably a safe option when dealing with vegetable/animal oil, such a level of oil resistance usually proves inadequate when conveying fertilizers such as phosphates and urea that have been treated with an oil-based coating to prevent the granules sticking together. Experience has shown that rubber covers that contain a higher level of nitrile have superior resistance to mineral oil and provide the best protection when urea formaldehyde (UF) is used as an anti-caking and de-dusting agent. At the same time, rubber that has good resistance to mineral oil usually proves to have good resistance to aggressive chemicals such as nitric acid, ammonia and so forth.

Figures 1 & 2. Insufficient resistance to abrasion is a prime cause of premature belt replacement (left) and the seriously damaging effects of ozone and ultraviolet light (right).

Figure 3. Serious distortion – the effect of oil on a flat rubber belt.

Figure 4. Heat is the ultimate belt killer.

Heat – the ultimate belt killer

The high temperature materials and working environments found in the fertilizer industry create arguably the most destructive forces of all. Heat causes a rapid acceleration in the ageing process of the rubber, causing it to harden and crack. Tensile strength and elongation can be reduced by as much as 80%, effectively destroying the operational strength and flexibility of the belt and seriously weakening splice joints.

The covers of the belt wear much faster because the resistance to abrasive wear diminishes considerably. Worse still, if the core of the carcass becomes too hot, then the bond between the covers and fabric layers can separate (delaminate) and the belt will quite literally fall apart. However, as with inadequate resistance to the other life-shortening factors previously described (abrasion, ozone, ultraviolet, oils and chemicals), the quality of resistance to high temperatures is often sacrificed in the pursuit of 'economy'.

The two most critical considerations when choosing the level of heat resistance required are both the temperature range and the granularity of the materials being conveyed. The temperature limits that a belt can withstand are viewed in two ways – the maximum continuous temperature of the conveyed material, and the maximum temporary peak temperature. The combination of temperature and size of the material dictates the amount of energy exposed to the belt cover. The two main classifications of heat resistance recognised in the

Figure 5. Delamination – if the inner carcass becomes too hot, the belt will literally fall apart.

Figure 6. Cheaper in the long run – quality belts help maximise productivity.

market are T150, which relates to a maximum continuous temperature of 150°C, and T200, which is for more extreme heat conditions up to 200°C.

Combined solutions and cost savings

There are probably more situations within the fertilizer industry that involve combinations of abrasion, oil, chemical and heat resistance than any other. In addition to that, of course, is the question of fire safety, which is a separate subject altogether and not directly related to day-to-day performance and longevity of use. Fortunately, in terms of performance and longevity properties, belts equipped with specialist rubber compounds are available, which are proven not only to withstand multiple demands but also provide amazing levels of life expectancy. For example, there are belts available such as Fenner Dunlop's BVGT, that have a combined resistance to heat, oil, fire, abrasion, ozone and UV. They may not be available 'off the shelf' and they come at a higher buying price. However, selecting a conveyor belt because it is 'competitively priced' rather than considering its 'whole life cost' is almost invariably a very expensive mistake. Experience shows that the bigger the difference in price, the bigger the difference will be in performance and longevity.

Thanks to technological advances, the effectiveness and value of modern-day conveyor belts should be measured over several years rather than just a year or two. In the fertilizer industry, there are more and more examples of belts that only last a few months and, in some extreme cases, only a matter of weeks. It is important to never accept that it is not possible for a belt to last many times longer than is currently being achieved. It really is possible to get the best of both worlds. WF