A guide to conveying fertilizer

Fertilizer continues to be a major cargo for the bulk handling industry with Europe alone importing more than nine million metric tonnes of nitrogen-based, phosphate and potash fertilizers annually. Every bulk cargo presents its own challenges, but perhaps none more so than fertilizer. For example, some unbagged fertilizers can seriously damage rubber conveyor belts. Added to this is the constant challenge of safety. Here, *conveyor specialist Leslie David* explains the challenges and provides a useful insight into the most important attributes of conveyor belts needed to handle fertilizers over prolonged periods.

Serious distortion — the effect of oil on a flat rubber belt.

A range of challenges

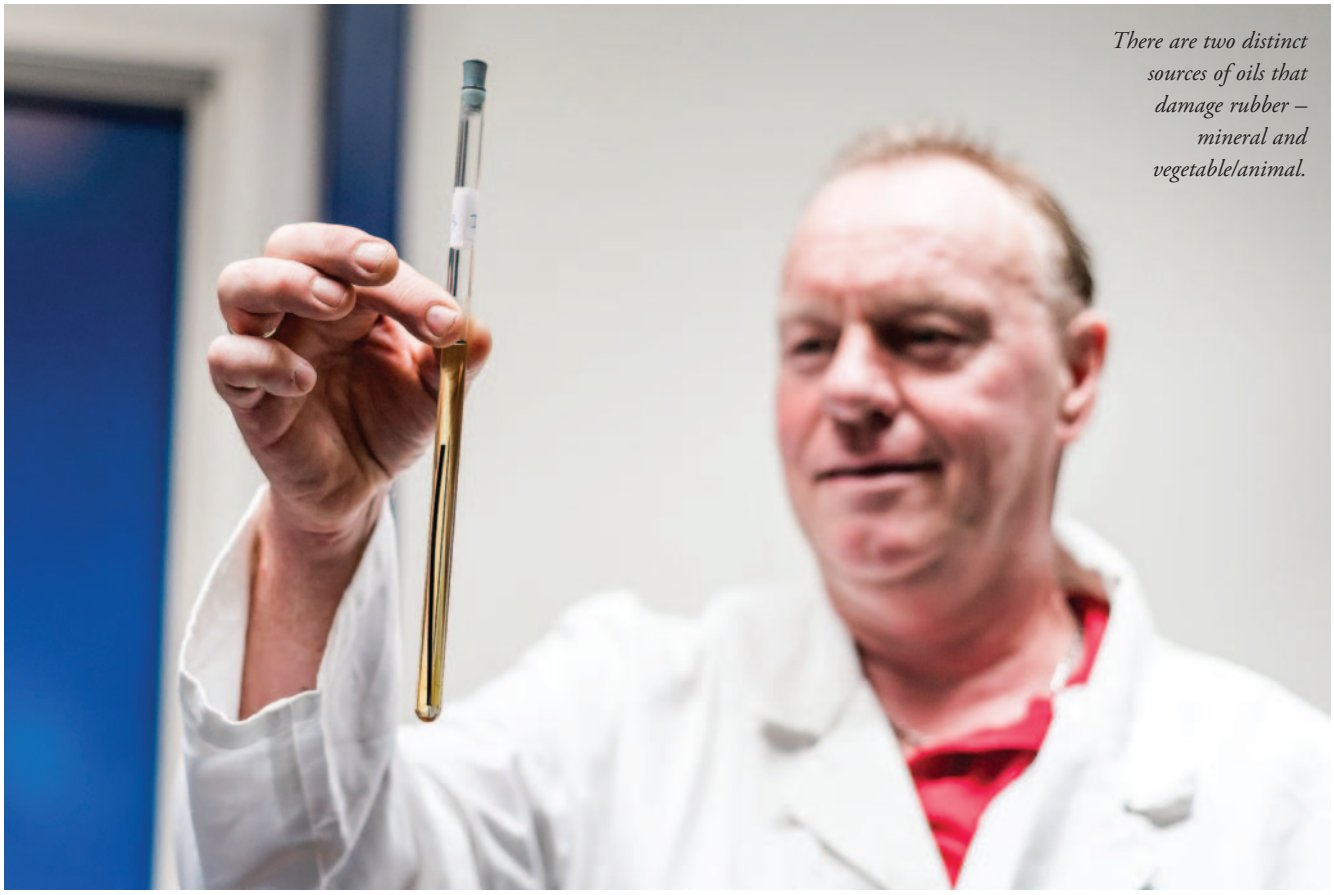
In terms of their effect on the day-to-day operational reliability of conveyor belts, the wide variety of oils and chemicals, including acids, that are contained within the different types of fertilizer, as well as those used in its production processes, pose the single biggest challenge. When oil penetrates rubber it causes it to soften, swell and distort. The time it takes to have a noticeable effect depends on the oil-resistant properties of the belt but ultimately it can lead to all kinds of problems.

The first problem caused by insufficient oil resistance is a dramatic decrease in the ability of the rubber to withstand abrasive wear. As the rubber continues to soften, it also steadily loses its tensile strength while at the same time becoming prone to ripping and tearing under the slightest provocation. 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. A common and expensive symptom of this is recurring splice joint reliability problems.

Vegetable-based oils

There are two distinct sources of oils that damage rubber — mineral and vegetable/animal, each of which has its own particular effects on rubber. Most modern-day conveyor belts are made of synthetic rubber rather than natural rubber because it is appreciably less expensive and much more adaptable. To be suitable for conveying products containing vegetable oil, oil resistant belts should have outer covers that are based on a combination of SBR (Styrene Butadiene Rubber) and NBR (Nitrile butadiene rubber). Good quality SBR has excellent resistance to abrasion combined with very good tensile strength. Those two characteristics help to ensure that the rubber is durable and long lasting and better than natural rubber when it comes to ageing and better able to cope with a combination of demands.

The inclusion of nitrile rubber within



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the compound mix provides the essential resistance to the damaging effects of oils, fats and greases. However, because of the high cost of nitrile butadiene, manufacturers who engineer their belts based on the principle of lowest cost rather than performance and longevity, prefer not only to use lower-grade nitrile but also in the lowest possible quantities. As laboratory tests consistently confirm, sometimes its use is avoided altogether, resulting in a belt that is claimed to be oil resistant but in truth has only nominal resistance at best.

Mineral oils and chemicals

Compared to most vegetable oils, mineral oil tends to be much more aggressive. For this reason, a full Nitrile butadiene rubber (NBR) based synthetic rubber is required. The greater the concentration of nitrile within the polymer, then the greater resistance there is to oil. This is especially relevant to the conveying of fertilizer because nitrile also provides protection against other aggressive chemical elements such as sodium hydroxide and potassium hydroxide, nitric acid and ammonia and Urea Formaldehyde (UF), which is used as an anti-caking and de-dusting agent.

One type does NOT suit all

Despite the difference in effect, most conveyor belt manufacturers only offer one type of oil-resistant rubber cover, which is usually referred to as 'MOR' (moderate oil resistance). Although probably a fairly safe option when dealing with vegetable oil in cargoes such as grain, such a level of oil resistance often proves inadequate when conveying product that has a high concentration of mineral oil and fertilizers such as phosphates and urea that have been treated with an oil-based coating to prevent the granules sticking together. As referred to earlier, the reason why most manufacturers only offer a 'MOR' oil resistant option is the higher cost of a rubber compound that contains sufficient levels of good quality nitrile.

Buyer beware: *some manufacturers create a false sense of security by using the DIN reference number 22102 G when referring to oil resistant belting, even though there are no firm requirements, test methods or limits specific to oil resistant belting associated with DIN 22102 G.*

Handle with care

Granulated fertilizers are generally easier to handle than blended fertilizers, which can separate and 'cake' when moved. Blended fertilizers can also create dust, which can be explosive if ignited. Fertilizer handling systems should minimize the risk of fire and explosion and be able to deal with these events without putting personnel, ships, or terminal infrastructure at risk. Fire detectors can be installed along the conveying line to automatically start the fire-extinguishing system and stop the conveyors. All such safety considerations should always include the conveyor belts themselves.

In environments where fertilizer, coal dust, grain or other potentially combustible materials such as biomass are present, it is essential that the conveyor belt cannot create static electricity that could ignite the atmosphere. Belts need to be able to allow static electricity to pass through the metal frame of the conveyor structure down to earth rather than allow static to build up. The safest approach is for all belts to meet EN 12882 Category 1, which contains the standards for electrical and flammability safety requirements for general purpose conveyors used above ground. Category 1 is the most basic classification and simply demands that the belt is anti-static. This means that the belt meets the primary requirement for use in ATEX 114 (Directive 2014/34/EU) classified zones if necessary.

Fire-resistant conveyor belts (self-extinguishing properties)

All rubber belts used to convey potentially inflammable and/or combustible materials should be able to resist fire. Rubber conveyor belts can never be totally fireproof. Rubber is flammable and the

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synthetic fabrics used in the carcass have virtually no resistance to fire so all belts will be damaged or destroyed by fire. Therefore, the true essence of fire-resistant belting is that it will not continue to burn without a continuous external source of ignition and therefore not contribute to the spreading of a fire.

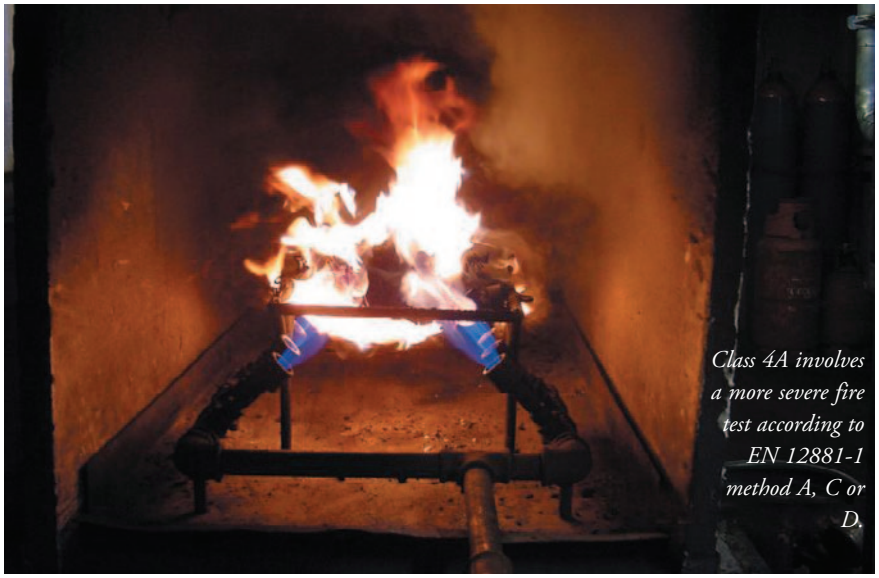
A more accurate description of fire-resistant belting would be "self-extinguishing". The ability of a rubber conveyor belt to 'resist' fire is achieved by adding special chemicals and additives to the rubber compound during the mixing process. Once the vulcanized rubber is ignited, the additives emit gases that effectively suffocate (extinguish) the fire by starving the flames of oxygen.

Different recipes or 'cocktails' of rubber compound are necessary depending on the level (standard) of fire resistance required. These additives can be very costly so if poor quality or insufficient quantities of the additives are used in order to keep the selling price artificially low then the ability of the belt to self-extinguish will be slower and less effective than it could and should be. The time it takes for a belt to self-extinguish is enormously important. Firstly, conveyors are frighteningly effective when it comes to conveying fire. Secondly, burning rubber and synthetic materials such as polyester and nylon release a dangerous thick smoke that contains cyanide, carbon monoxide, sulphur dioxide and products of butadiene and styrene. The time it takes to self-extinguish therefore needs to be kept to an absolute minimum.

Standards and test methods

The EN12882 standard is for safety requirements for conveyor belts for

Every second counts — conveyors spread fire extremely quickly.



Class 4A involves a more severe fire test according to EN 12881-1 method A, C or D.

general-purpose, above ground applications and describes a range of classes from '1', '2A", '2B' up to '5C'. As most transshipment conveyors are used to convey a variety of bulk materials and which vary in their degree of flammability, 'S' grade (EN 12882 Class 2B) should be regarded as the default standard. The test method used for all classes up to and including Class 5C* is EN ISO 340, which involves exposing six individual samples of belt to a naked flame causing them to ignite. The source of the flame is then removed and the time it takes for the belt sample to self-extinguish is then measured. (*Class 3A and above require tests in addition to EN ISO 340).

The duration of continued burning (visible flame) should be less than 15 seconds for each sample with a maximum cumulative duration of 45 seconds for each group of six tests. This means that the average allowable time per sample is 7.5 seconds. This factor is of paramount importance because a belt can easily travel more than 40 metres within the 15 seconds that is allowable for a belt sample to pass the test, which is a potentially very dangerous distance. For this reason, Fenner Dunlop in the Netherlands, considered by many to be a world expert in fire-resistant conveyor belting, apply an average maximum time limit standard of only one second, which is more than six times faster than the required standard and therefore decidedly safer.

EN ISO 340 testing.

Covered conveyors

Precautionary measures for preserving fertiliser bulk quality include keeping the product dry. For this reason, covered conveyors are required. The same applies if the conveyor is also used for handling biomass, although in this case the reason is that biomass dust is prone to self-ignition if it becomes damp.

Although the use of covered conveyors is therefore very necessary, the risk to human life is higher in enclosed environments because burning rubber belts release thick toxic smoke that contains cyanide, carbon monoxide, sulphur dioxide, and products of butadiene and styrene. EN 12882 Class 4A is therefore usually the best choice for conveyors operating in closed or covered conditions because it involves a more severe fire test according to EN 12881-1 method A, C or D in addition to EN ISO 340 testing.

Exposing a weakness

To many, fertilizers may seem to be quite an undemanding cargo but for rubber conveyor belts, the wide range of oils and often aggressive chemicals they can contain are more than capable of exposing the slightest weakness in the quality of the rubber. As a result, life expectancy is much less while the whole life cost is much higher, so my best advice is always to opt for premium quality brands. Anything less is invariably a false economy.

About the author

After spending 23 years in logistics management, Leslie David has specialized in conveyor belting for over 17 years. During that time, he has become one of the most published authors on conveyor belt technology in the world.