Conveying coal – no soft options

A common generalization within the dry bulk handling industry is that coal is not particularly abrasive or destructive, *writes Jan Willems*. Indeed, this view is shared by most in the conveyor belt industry itself. As a consequence, insufficient attention (and investment) is often paid to the type and quality of rubber conveyor belts needed to handle it. Generalizations also seem to exist regarding fire safety and the level of risk posed by coal. In both cases, the reality is that the level of wear and the level of fire risk very much depend on the type of coal being conveyed.

Wear and tear

Different types of coal vary significantly in how abrasive they are. Each type of coal causes distinct wear and damage patterns on rubber conveyor belts. The primary damage mechanisms include surface abrasion, cutting, gouging, and chemical degradation.

The abrasiveness of coal is largely determined not by the carbon itself, but by the hard impurities and mineral matter trapped within the coal, specifically quartz and pyrite, which can both be harder than steel. The main factors that make a specific type of coal more abrasive include:

- **Quartz and pyrite content:** these are the primary minerals that cause the most aggressive abrasive wear on conveyor belts and conveyor equipment.
- **Ash content:** higher-ash coals typically display a higher Abrasivity Index (AI), as more ash generally corresponds to a higher concentration of abrasive minerals.
- **Excluded minerals:** minerals that are released and exposed during the pulverization process cause significantly more abrasive damage than 'included' minerals that remain locked safely inside the carbon matrix.
- **Coal rank (anthracite vs. bituminous):** although higher-ranking coals such as anthracite are harder, coal rank alone is not a reliable indicator of abrasiveness. Lower-rank coals such as bituminous and lignite can cause equal or greater wear depending on their mineral content.

Belt surface wear is caused by fine, abrasive particles that scour the belt cover, especially at the loading and unloading stations when the particles are effectively accelerated across the belt surface. creating a steady thinning of the rubber over time. It is important to bear in mind that the ability of a belt cover to withstand wear is not due to its 'abrasion resistance' alone because much also depends on the cover rubber's overall strength and its resistance to cutting and gouging caused by sharp lumps of hard coal (such as anthracite*) strike the belt surface at transfer points, puncturing and slicing into the rubber surface. In belts made using low-grade, 'cheap' rubber, this damage will quickly spread and link up with other areas of damage. Consequently, small pieces of rubber are effectively cut out from the surface rather than being simply worn thinner.

Scraper wear occurs when highly abrasive coal fines become trapped under belt cleaners and scrapers, acting like sandpaper, scoring grooves in the center of the belt. Chemical degradation of the conveyor belt is caused by high-sulphur coals** that create acidic runoff when under moist and oxidising conditions. This chemically attacks the rubber compound, causing it to harden, crack, or soften. This reaction is even more pronounced in belts with low grade rubber that is not resistant to the effects of ground level ozone and ultraviolet light. Finally, tracking issues can also be influenced by coal type such as lignite*** for example.

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**Anthracite: high hardness and sharp fractures cause severe gouging, cutting, and rapid wear.*

***Bituminous: moderate abrasiveness causes standard surface wear, but high sulphur content risks chemical cover degradation.*

**** Lignite: typical low physical abrasion due to softness, but high moisture and clay content cause material buildup, leading to belt tracking issues and edge wear.*

Price — avoid the soft option

Wear and tear takes place over time but yet again, the actual length of time depends on the quality and durability of the rubber covers. Imported belts can be as much as 50% lower in price compared to the leading quality brands in Europe, such as Netherlands-based Fenner Dunlop. Field surveys and laboratory testing consistently confirm that their belts will outlast as many as five lower quality 'competitively priced' belts, which compensates the difference in price many times over.

ISO 340 measures the time taken to self-extinguish.

Different coal types = different fire risks

Different types of coal also have vastly different levels of fire risk, primarily driven by their propensity for spontaneous combustion during storage and transport. Contrary to logical expectation, lower-quality, lower-rank coals such as lignite and sub-bituminous often present a higher risk of spontaneous combustion and therefore pose a significantly higher immediate fire risk than higher quality coals such as bituminous and anthracite.

Key factors determining fire risk

- **Coal rank and carbon content:** lower-rank coals (lignite) have less fixed carbon and are highly chemically reactive. They absorb oxygen rapidly at ambient temperatures, initiating an exothermic (heat-generating) oxidation reaction that can quickly accelerate into an open fire
- **Moisture and volatiles:** low-rank coals contain high inherent moisture and volatile matter. When stored in large stockpiles, the evaporation and condensation of this internal moisture can trigger an exothermic (energy transfer) chemical response.
- **Friability (breakability):** softer coals create dust more easily, causing an enormous cumulative surface area for oxygen interaction, while simultaneously acting as an insulation blanket that traps heat inside the pile.
- **Pyrite content:** the presence of iron pyrites (FeS_2) significantly amplifies fire hazards. Pyrite oxidizes rapidly in the presence of air and moisture, releasing a large amount of localized heat that serves as an ignition trigger for the surrounding coal.

Coals such as lignite pose a significantly higher fire risk.

A brief guide to fire-resistant belts.

The basic definition of fire-resistant belting is that it will not continue to burn without an external fire source. The ability to 'resist' fire is achieved by using special chemicals and additives within the rubber compound. Once vulcanized rubber has been ignited it emits gases that effectively suffocate (extinguish) the fire by starving the flames of oxygen.

EN 12882 Category 1. EN 12882 is the most basic classification and 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, such as those that may contain coal dust.

EN 12882 Class 2A and Class 2B

The basis of most tests within EN 12882 for belting fire resistance is EN ISO 340, which measures the amount of time which a sample of belt takes to self-extinguish when the source of ignition is removed. These standards make the distinction between fire resistance with covers, which is Class 2A (also referred to as K grade) and fire resistance with and without covers, which is Class 2B (also referred to as S grade). The relevance of 'with and without covers' is primarily because the rubber skim layers between the synthetic plies protect what is essentially the most

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

flammable part of the belt. The rubber skim material therefore needs to be equally fire resistant as the outer covers. Unfortunately, manufacturers who want to achieve a more competitive price often use rubber skims that are not sufficiently fire resistant.

For the majority of bulk material handling 'open air' applications, EN 12882 Class 2A (K grade) or Class 2B (S grade) levels of fire resistance would be perfectly adequate. The best way to decide between Class 2A and Class 2B is to consider the type of coal being carried. If the type is unknown or unpredictable then the safest option is to choose Class 2B.

EN 12882 Class 4A

Class 4A involves a more severe fire test according to EN 12881-1 method A, C or D in addition to EN ISO 340 testing. This increased level of fire safety is necessary when conveying coal with a particularly high level of flammable dust found in biomass can be ignited by static electricity created by abrasion within the conveyor system because the source only requires ignition energy as low as 17mJ for ignition to take place.

Although the use of covered conveyors minimizes this risk, the risk to human life is heightened 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 also the best choice for conveyors operating in closed or covered conditions.