# Conveying biomass


Conveyor belts that carry biomass face the perfect storm. They operate in highly explosive, combustible environments, so they need to be completely anti-static and self-extinguish very quickly if ignited. Biomass contains oils and resins that seriously damage rubber plus they are constantly exposed to the damaging effects of ozone pollution and ultraviolet light and to be cost-effective, they need to provide the longest possible operational life. Here, *conveyor belt specialist Leslie David* explains the four key qualities and the consequences of not having them.

## 1. Risk of explosion (anti-static properties)

In the production process of biomass wood pellets, wood chip and similar renewable resources, the materials are continually broken down, resulting in high levels of combustible dust. This can be easily ignited by static electricity created within the conveyor system because the source only requires ignition energy as low as 17mJ for the ultimate ignition to take place. Biomass dust is also prone to self-ignition, especially if the material has become damp because a chemical reaction can take place that causes self-heating and the emission of carbon dioxide, carbon monoxide and methane emissions, which is referred to as 'off-gassing'.

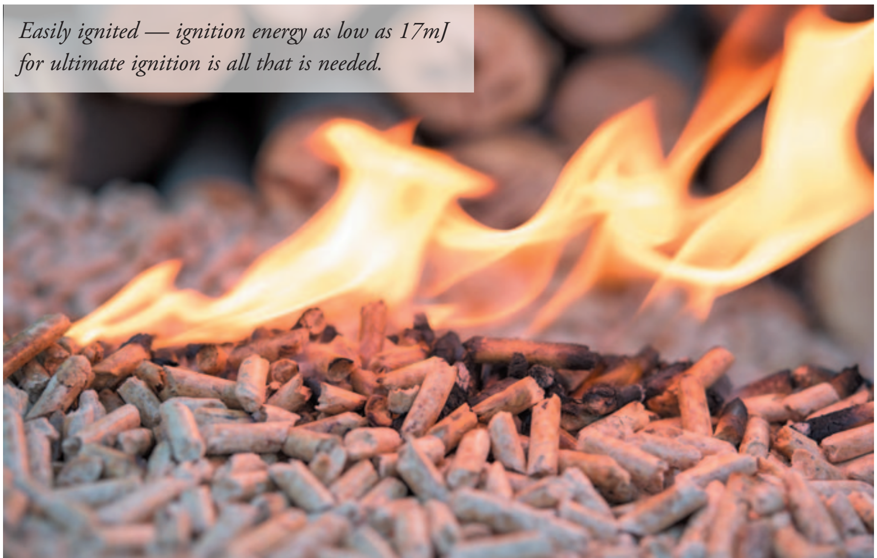
Strict conformity to Directive 94/9/EC (applicable to potentially explosive atmospheres of zones 20, 21 and 22 where combustible dust is present) should be a pre-requisite. It is absolutely essential that the electrostatic dischargeability (anti-static) properties of the conveyor belt cover rubber (according to DIN EN ISO 284 test methods) do not exceed the maximum resistance value of 300MΩ

## 2. Fire safety (self-extinguishing properties)

Factual evidence gained from laboratory testing as well as anecdotal evidence indicates that even some of Europe's biggest ports and terminals are using belts that do not achieve their claimed standard classification. Only the best quality fire resistant belts for conveyors carrying biomass should be considered.

The majority of conveyor belts used in dry bulk handling are rubber multi-ply

*Easily ignited — ignition energy as low as 17mJ for ultimate ignition is all that is needed.*



construction. The first thing to bear in mind is that they can never be totally fireproof. Rubber is flammable and the fabrics used in the carcass of multi-ply belts are mostly polyester and nylon, which have virtually no resistance to fire. Once alight, they can be remarkably efficient at conveying flames at a frightening speed. Fortunately, they can be engineered so that the risk is dramatically reduced.

### What is meant by 'fire-resistant'?

A more accurate description rather than 'fire resistant' is 'self-extinguishing'. This is because the ability of a rubber conveyor belt to 'resist' fire is achieved by adding special chemicals and additives such as antimony trioxide, decabromodiphenyl, alumina trihydrate and magnesium hydroxide to the rubber compound during the mixing process. The actual amounts depend on the level (international standard) of fire resistance required. Once fire-resistant rubber has been vulcanized and is ignited it emits gases that effectively suffocate (extinguish) the fire by starving the flames of oxygen.

### Prioritizing a competitive price.

The special additives are costly so if low grade or insufficient quantities are used in order to keep the selling price sufficiently attractive to win orders then the ability of the belt to self-extinguish will be slower (and sometimes non-existent) and therefore much less safe. Especially in the past twenty years or so, the conveyor belt market, particularly in Europe, has been inundated by 'cheap' imports from South East Asia, primarily China. Performance, longevity and ultimately safety, have all become sacrificial lambs in the effort to win

*Rubber conveyor belts can never be totally fireproof.*

*Low-price fire-resistant belts can prove deadly.*

*EN ISO 340 testing.*

greater market share and force out the competition.

The reality is that 'economy' versions of high-quality fire-resistant belts simply do not exist. The biggest single influence on the ability to resist fire is the fire-resistant properties of the rubber. Unfortunately, because rubber constitutes around 50% of the material cost of a conveyor belt, it is the prime cost saving target for manufacturers who want to compete on price, even though they will happily claim to meet the same safety specification as the premium brand versions, safe in the knowledge that their deception is unlikely to be discovered.

### EN ISO 340 testing

The tests involve exposing six individual samples of belt to a naked flame causing them to burn. The source of the flame is then removed, and the combustion time (duration of flame) recorded. A current of air is applied to the test piece for a specified time after the removal of the flame. The flame should not re-ignite.

The time it takes for the belt sample to self-extinguish after the flame has been removed is a maximum of 15 seconds for any individual sample with a maximum cumulative duration for each group of six samples of 45 seconds. This means that the maximum allowable average time per sample is 7.5 seconds. This factor is of paramount importance because it effectively determines the distance that the fire can be carried by belt when in motion.

Even if a manufacturer states that their fire-resistant belt has passed the ISO 340 test, caution must still be exercised. A typical conveyor belt will easily travel several metres within the 15 seconds allowed for a belt sample to pass the test, which is a potentially very dangerous distance. For this reason, one major European manufacturer (Fenner Dunlop in the Netherlands) applies an average maximum time limit standard of less than one second, which is more than six times faster than the required standard and decidedly safer as a consequence.

Given the highly flammable nature of biomass, EN 12882 Class 2B (S' grade) should be regarded as the minimum standard. For enclosed conveyors the higher standard, Class 4A of EN 12882, which includes an additional fire test, is recommended.

*Oil-resistance ASTM 'D' 1460 testing.*

## 3. Resistance to oils and resins

Biomass, especially the wood and wood waste content, can contain vegetable oils and resins that can have a very detrimental effect on the performance and life expectancy of a conveyor belt. When the oils and resins penetrate rubber it causes the rubber to swell and distort, resulting in serious tracking and steering problems as well as premature wear. The oils, resins, fats and greases that have these damaging effects can be divided into two distinct sources — mineral and vegetable/animal.

The level of oil and resin present depends very much on the type (origin) of the wood itself.

For most wood from Scandinavia for example, good resistance to oil is necessary as these trees are mostly pine trees, which have high turpentine content. In South-European countries and in Latin America, Eucalyptus trees are commonly used. The wood from these trees contains little or no turpentine so oil resistance is not so essential. This is generally valid for non-pine wood such as poplar and birch. If the origin of the wood used for the biomass can be from variable sources then the use of conveyor belts that have a combined resistance to fire and oil is recommended.

*The first signs — small cracks appear in the surface of the rubber.*

There are two recognized test methods for oil resistance, both of which involve almost identical test procedures. These are ISO 1817 and the comparable, slightly less elaborate but very stringent American ASTM 'D' 1460. Samples of rubber are immersed in the relevant test liquid for a specific period of time and then measured for absorption and expansion. ISO or DIN international performance standards for oil & grease resistance do not yet exist. Manufacturers can use whichever test method they deem most suitable. However, there is a sting in the tail concerning the matter of test methods.

## DIN 22102 G — not what it seems

Some of the largest manufacturers of belting in the world, primarily those in Asia and in Europe use the DIN reference number 22102 G when referring to oil-resistant belting. This can be very misleading because the letter 'G' is simply used to denote oil (or grease) resistant belting. In truth, there are no firm requirements, test methods or limits specific to oil resistant belting associated with DIN 22102 G. This is a classic example of how simply indicating a test method reference number on the technical datasheet is designed to create a false sense of security, but which is actually meaningless in respect to actual performance.

## 4. Ozone & UV resistance

The fourth essential characteristic of belting used to carry biomass is the ability to resist the damaging effects of ground-level ozone and UV rays. At low altitude ozone ($O_3$) becomes a pollutant that attacks the molecular structure of rubber. Ground level ozone increases the acidity of carbon black surfaces with natural rubber,

*90% of belts tested for ozone resistance test are <u>NOT</u> resistant.*

polybutadiene, styrene-butadiene rubber and nitrile rubber being the most sensitive to degradation. The reaction that occurs is known as ozonolysis.

The first visible sign is when cracks start to appear on the surface of the rubber. Further attacks then occur inside the freshly exposed cracks, which continue to grow steadily until they complete a 'circuit' and the product separates or fails.

Ultraviolet light from sunlight and fluorescent lighting also has a similar, seriously detrimental effect on rubber because it accelerates rubber deterioration by producing photochemical reactions that promote the oxidation of the rubber surface resulting in a loss in mechanical strength and wear resistance. This is known as 'UV degradation'. The combination of ozone and UV has a seriously limiting effect on the operational lifetime of a rubber belt, regardless of geography or type of climate.

Although ozone and ultraviolet damage is easy to prevent, extensive laboratory testing shows that some 90% of belts tested according to EN ISO 1431/1 procedure B static ozone resistance test are not resistant. In fact, the vast majority typically start to crack within the first six to eight hours of the 96-hour test duration. This translates into cracking occurring within a few months, and possibly weeks, from installation. This is because the anti-ozonants needed to protect the rubber have been omitted from the rubber compound mix because of cost. The best advice is to make ozone & UV resistance a constant requirement when selecting any rubber conveyor belt.

## Not worth the risk.

Conveyor belt manufacturers and suppliers will naturally claim that their belts possess all the essential characteristics in abundance but operators need to be as sure as possible that what is promised is actually delivered. Belts that convey biomass that are not of the highest standard are a very dangerous and expensive liability.

## About the author

After spending 23 years in logistics management, Leslie David has specialized in conveyor belting for over 19 years and is one of the most published authors on conveyor belt technology in the world.

*Leslie David.*