It's all about the rubber

Conveyor belt specialist Leslie David looks at how Netherlands-based Fenner Dunlop Conveyor Belting make their own rubber and why they are investing some €2.4 million in much more advanced rubber mixing equipment.

Rubber represents the biggest single influence on the performance and longevity of a conveyor belt. It also represents some 70% of the mass and up to 50% or more of the cost of making a belt. Consequently, in these times of ever-increasing price competition, led and dominated by manufacturers in Southeast Asia, primarily China, rubber is also the biggest opportunity for savings. Cost-cutting practices include the use of unregulated, low-grade raw materials, the use of bulking agents such as chalk, increasingly larger proportions of recycled scrap rubber of highly questionable origin and the substitution of essential polymers such as carbon black with low-grade versions created by burning scrap vehicle tyres. Another method is reduced quantities and often the total omission of key ingredients such as the antioxidants that all good quality rubber needs to resist the premature degradation caused by exposure to ozone and ultraviolet light.

Such practices allow unscrupulous manufacturers to massively undercut the prices of the few remaining manufacturers at the quality end of the market, such as the Fenner Dunlop's of this world. Despite such competition, Fenner not only refuses to change direction, they are even more committed than ever to further widen the quality and value gap.

A SCIENCE IN ITSELF

Because of its adaptability, most conveyor belt rubber is synthetic or only contains a relatively small amount of natural rubber. The creation of rubber compounds (rubber compounding) is the process where a range of 'specific task' chemicals, reinforcements, antioxidants and anti-degradants are mixed together with rubber polymers.

Creating rubber compounds is a highly complex process

The most common polymers used in conveyor belts are Styrene- Butadiene rubber (SBR) and Nitrile rubber (NBR). The chemical agents form chains of polymers to form rubber compounds that will ultimately bze vulcanised. Vulcanisation is the process in which the compounds are chemically converted into a more durable final product

by using heat and what are termed as 'cross-linking agents' such as sulphur and accelerators. It is a highly scientific process and even more complex when you begin to consider the multitude of physical properties and characteristics that the rubber used in conveyor belts need to possess.

MEETING EVERY NEED

Every type of rubber used on conveyor belts has to meet a long list of demands, so each has to be made according to a very specific recipe. The most basic ability is to resist abrasive wear along with the need to meet specific minimum requirements in terms of tensile strength, elongation (stretch), hardness, and resistance against tearing. Every rubber compound must be able to endure temperatures of at least minus 20 or 30 °C and, at the other end of the scale, withstand continuous material temperatures as high as 80 °C. Then of course, there is the ability of the rubber to resist the seriously damaging effects of ground level ozone and ultra violet light (both sunlight and fluorescent light). Both of these last two properties require special additives to be part of the rubber compound 'recipe'.

These are just the basic requirements. There is also a need for 'specialist' rubber covers such as resistance against the effects of oil, chemicals, fire, extreme heat (up to 400 °C), extreme cold (as low as minus 60 °C), high impact, ripping & tearing and the numerous combinations of those qualities for multi-purpose belts such as oil and fire resistant for example. Last but not least, the rubber needs to be able to form strong, reliable splice joints. Being able to consistently achieve all these requirements during the mixing process so that every individual batch of rubber compound is exactly the same is unbelievably challenging.

THE MIXING PROCESS

There are literally dozens of chemicals and ingredients used to make the huge variety of rubber compounds that different conveyor applications demand. The mixing process is where all of the polymers, chemical additives, carbon black and zinc oxide are mixed together according to the specific recipe for the required rubber type. For accuracy and consistency, Fenner Dunlop use a highly advanced computerised, automated mixing carousel that places very precise measurements of each ingredient into polymer-based bags. One technician I spoke to likened it to "making cakes that have to taste precisely the same every time".

Precise measurements of each ingredient in polymer-based bags are mixed and blended together

The ingredients are then placed into a 'coarse mixer' as the first step towards blending everything into one. The total mix is then transferred into a mill, which blends the rubber until it reaches an evenly distributed consistency. Different ingredients react differently and may be sensitive to permanent damage unless the machine settings and especially the temperatures during mixing, are exactly right. For example, additives used to create the all-important self-extinguishing properties in fire resistant belts can become almost totally ineffective if not mixed in the right way.

For this reason, some compounds need to start the mixing process as separate batches of ingredients. For example, Batch A may contain 90% of all the ingredients and in a second step the remaining 10% are mixed under slightly different conditions. In all cases, regardless of type, not only must the rubber compound possess all of the requisite physical properties and characteristics, it must also be able to undergo the further processes involved in making a conveyor belt, such as calendering and vulcanization.

The calendering process

The calendering process is where the rubber compound material, which has been pre-softened by heat, is placed into the center of counter-rotating rollers. The rollers compact the rubber into a sheet as it passes through them. The thickness of the resulting product is determined by the gap between the cylinders, called the nip region. The rubber sheet can then be joined with a carcass fabric layer. After the sheet passes over cooling rollers it is then spooled into a roll with special anti-stick fabric placed in between to stop the surfaces sticking to one another. These huge rolls of unvulcanised rubber are then ready to be made into conveyor belts.

HOMEMADE

Speaking to people in their impressive production facility in Drachten, it is clear that everyone is fiercely proud of the fact that they are the only remaining European belt manufacturer that continues to make all of its own products using its own production facilities. This includes the rubber, which even fewer of their competitors now make themselves due to a growing trend to outsource the manufacturing of their rubber compounds, mostly Southeast Asia, rather than produce them in-house.

The advantage is that specialist rubber compound manufacturers are able to minimize production costs by mass-producing rubber compounds in extremely large quantities. The downsides, however, outweigh the

benefits. Firstly, outsourcing makes it almost impossible to apply the quality control disciplines needed to ensure the consistency of properties between batches of rubber produced at different times. Another downside is that some compounds have a 'best before' shelf life, so they need to be vulcanized before some important characteristics start to diminish.

Controlling the quality and the consistency –all Fenner Dunlop rubber is 'homemade'.

According to Fenner Dunlop's Innovation & Sustainability Director, Dr. Michiel Eijpe, outsourcing rubber production is not an option. "It is essential that we have total control from beginning to end, not only to consistently achieve identical high qualities and properties but also to comply with environmental regulation, which is extremely important for all concerned"

SAFE TO HANDLE, SAFE FOR THE ENVIRONMENT

It is an inescapable fact of life that to make some rubber compounds it is necessary to use chemicals that are hazardous in their own right. Fortunately, at least as far as Europe is concerned, there are very strong regulations in place to protect humans and the environment such as REACH (Registration, Evaluation and Authorisation of Chemical substances) regulation EC 1907/2006 and EU Regulation No. 2019/1021 concerning the use of persistent organic pollutants (POP's).

Sadly, most European belt suppliers continue to ignore these regulations, either completely or at least partially because doing so creates an extremely significant price advantage. Of even greater concern are manufacturers located outside of EU/EEA member states because they are not subject to REACH and POP's regulations. This provides them with an open door because they are free to use unregulated raw materials, which cost much less compared to their regulated counterparts, even though those same materials may be entirely prohibited or at least have strict usage limitations within the European community.

INVESTING IN THE FUTURE

Fenner Dunlop are certainly committed to their policy of making everything themselves. So much so that they have recently invested some €2.4 million in new machinery in their mixing department. Installation is complete and has entered the testing phase. They have also purchased an additional mill that will be installed at a later stage. "The primary reasons why such investment was needed revolves around three key factors", explains Dr. Eijpe. "Quality, safety and the environment". "Firstly, we needed better control over the processing of the more difficult materials we are now having to use. This is a result of the need to find alternatives to materials that we can no longer source from previous suppliers, for example due to the Russia – Ukraine conflict. It is, of course, essential that these alternatives have the same or higher quality properties as we have used before".

Dr. Michiel Eijpe.
Fenner Dunlop's Innovation & Sustainability Director.

"As a result of REACH and POP's regulation compliance, we also need to find alternative processing solutions for the substitute chemicals that replace those that become banned or have usage limitations placed upon them. Last but not least, there is the highly important question of safety. New ISO standards relating to operational safety of machinery are being introduced and although currently still in the draft stage, when they are implemented, our new mixing machines will instantly be compliant".

CONCLUSION

There can be no argument that the quality of the rubber has the biggest part to play in terms of performance, longevity and human and environmental safety. At the same time, it provides the greatest temptation for manufacturers to sacrifice those qualities in order to create a price-competitive edge. From what I have seen, Fenner Dunlop certainly have no intention of making such sacrifices, even in the face of such fierce competition from Asia. By surviving the onslaught, they are at least providing the end-user market with a choice. Long may that continue.

AUTHOR

Leslie David
After spending 23 years in logistics management, Leslie David has specialised 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.