Show of strength

Bernd Küsel comments on conveyor belt design and manufacturing improvements

There are tens of thousands of km of conveyor belts in use in all regions of the globe, with the most demanding applications usually found in underground and open pit mines. Recent technological advances have allowed the most spectacular conveyor belts, with conveying paths that were not even conceivable a few decades ago, which are now helping mines to become more efficient and reduce costs drastically.

The world’s strongest underground conveyor belt was commissioned at RAG’s Prosper Haniel mine in Germany as long ago as 1986. This unique installation features an ST 7500 belt that conveys 2000 tonnes/hour of coal on the top run from 800 m underground to the surface, and simultaneously, 1000 tonnes of scalings back underground on its bottom run. Since the stones on the return run are more aggressive, a higher cover thickness was chosen for the bottom cover. Both belt sides are protected by a special transverse reinforcement and this is a self-extinguishing conveyor belt in compliance with strictest safety
requirements for underground use in Germany. This belt offers a minimum breaking strength of 7500 N/mm and its actual breaking strength is a colossal 8200 N/mm.

Meanwhile the highest capacity conveyor belts are being used with huge bucket-wheel excavators operating at Rhenbraun's lignite mines in Germany. These machines have a capacity of 240,000 m³/day and the conveyor belts used on these giants are 3,200 mm wide. The belts carry up to 40,000 tonnes/hour of overburden and lignite and no other belt on earth moves such a heavy load. Rhenbraun is using St 4500 types with special transverse reinforcements in top and bottom covers and the total minimum breaking strength of the entire St 4500 belt is 14,400 kN or 1,470 tonnes.

However, the strongest conveyor belt worldwide has got a minimum breaking strength of 7,800 N/mm and its actual breaking strength is 8,500 N/mm as stipulated by DIN 22131. The total weight of the 24 km long St 7800 conveyor belt is 3,500 tonnes. These enormous conveyor belts are being used on two long distance conveyors in South America and are conveying 8,700 tons of copper ore/hour. The installation is more impressive still as it descends 1,070 m over its length and because of the downhill-conveying, the system is regenerative and provides electrical power to the mine rather than consuming it. When it is fully loaded with ore and running at full capacity this system can generate up to 25 MW, which is utilised for the copper-ore concentrator. Because of the extreme conditions due to the altitude, these super belts operate in tunnels for most of their length as this provides weather protection and reduces the risk of damage or shut-downs that would otherwise result from avalanches.

High performance, long distance steel cord conveyor belts like these will usually achieve operating lives of more than 20 years. It is obvious that to deliver this kind of performance, conveyor belt manufacturers must utilise sophisticated production processes. Crucial factors in belt design, manufacture and construction include the use of open construction steel cords with the optimum quantity of pure zinc coating, equal tensioning of all cables during vulcanisation and the right rubber bonding system. Careful mixing of the right components at the right time for the right duration at the right temperature is equally important. And manufacturers also have to maintain the optimum core rubber viscosity at the right time and 40 bar vulcanising pressure throughout. All of these factors are crucial in providing an optimum interplay of all components and actions.

Open type steel cords are constructed such that gaps emerge between the different wires. These gaps are filled with rubber, increasing the steel-to-rubber bond as well as corrosion protection, while reducing internal friction. It is also important to protect high performance conveyor belts against damage caused by high impact energies or tearing. Manufacturers use impact test benches for checking performance in the former instance. Drop weights featuring impact bodies fall onto tensioned belt sample in these test facilities, with the impact forces measured by transducers when the impact head impinges on the belt. Meanwhile, in exceptional cases foreign bodies can become stuck in the conveyor structure after these have penetrated the conveyor belt and in such instances, the belts will be slit. Manufacturers use rip testing machines to measure resistance, with cutting tools being pulled through the samples at speeds up to 2.5 m/s. The slitting resistance can then be measured using transducers. Excellent protection against impact and rip damage can be provided by highly elastic high-strength synthetic cords embedded in the rubber covers of the conveyor belt. And it is worth noting that all the record-breaking conveyor belts mentioned here are equipped with such an active protection system.

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