CASE HISTORIES ON THE USE OF ARAMID FIBRES IN COAL MINES AND SURFACE APPLICATIONS

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ABSTRACT

This paper contains information concerning the experiences of three manufacturers of conveyor belts using KEVLAR* high strength fibre for reinforcement: Trelleborg A.B., Sweden; H. Rost & Co. GmbH, Germany; and Compagnie Colmant Tournai, Belgium.

INTRODUCTION

You have heard in some detail of Du Pont's views on the place of "Kevlar" yarn in the conveyor belt industry. Now I would like to describe to you briefly what our customers think of it and what they consider it can do for them. I shall describe three case histories. All the information I give is from the belt makers themselves and the end-users of the belts, not from Du Pont.

Trelleborg A.B., Sweden

The first concerns the belts made by Trelleborg A.B., a leading rubber manufacturer in Southern Sweden whose more recent product development has included their "Trellamid" conveyor belt, reinforced with "Kevlar".

Trelleborg developed a process for using "Kevlar" in belting and in 1979 installed a T-3150 (N/mm) belt in a Norwegian iron ore mine. This was the strongest belt ever installed in Scandinavia, and was therefore very carefully watched. It featured a "cord" type of construction and led to the development and installation of a series of belts, now operating in the huge transshipment port belonging to EMO at the seaward end of Rotterdam docks. This site can handle ships up to 275,000 tons dead weight, has a throughput of 100,000 tons per day of coal and iron ore and a site storage capacity of 10 million tons. There are 7.5 km of conveyor belts, some half of which are already converted to "Trellamid" belts. The remainder will be changed as replacements become necessary. The very high [illegible] with the extreme harshness of conditions on flat, reclaimed land at the edge of the North Sea make this a sensitive and highly specialised place to install conveyor belting.

* Du Pont's registered trademark

Trelleborg chose to go the "cord" route after finding better material utilization and fatigue properties in their test programme in comparison with straight-warp fabrics; less belt wear in comparison with heavy cables or ropes was another positive factor. In comparison with steel, the advantages that Trelleborg identified were - low weight, less rubber cover required underneath, no rust, better energy absorption, the ability to use magnetic steel detectors, easier splicing and easier repair. The weight saving alone, with the resulting energy saving, is estimated at 43 %.

There are two areas of belting in use at EMO in Rotterdam. The first features mostly horizontal belts, up to 1470 meters long, carrying 6000 tons/hour away from the unloaders to the stackers, directly to barges, or to railway wagons. These are T-1850 (1850 N/ mm) and were installed successively during 1981 and 1982. During 1983 the site will be expanded to allow larger ships to berth; the stacking area will be increased, requiring additional and longer conveyor belts.

The second area of belting in use is in the bucket-wheel reclaimers and stackers. These are short belts of 40-50 meters length, T-1600 (1600 N/mm), carrying 6000 tons per hour at a maximum slope of 30 degrees. The slope varies and tilts while in use and the belts get exceptionally rough treatment. Steel belts at this installation need replacing normally in less than 6 months intervals. The replacement belt reinforced with "Kevlar" has now been working well over one year. The first one to be installed sustained a cut in the top cover through to the "Kevlar" cords in the first month of operation. Had this been a steel belt, immediate repair would have been necessary to stop the risk of corrosion. The belt of "Kevlar" has been damaged several more times since then, but so far no stoppage for repairs has been necessary.

Top and bottom cover wear has been found to be much less with the "Kevlar" reinforcement than with steel. Tests at EMO on comparative belts showed 0.60 and 0.80 mm per month on steel belts but only 0.18 mm per month wear on the "Trellamid" belt, indicating the possibility of a greatly increased wear life. The lower wear figure is partly due to different types of rubber used in these belts and partly to more evenly distributed tension over the belt area, better cord elasticity and lower rigidity, contributing to better energy absorption at the loading point.

The ease of repair was clearly demonstrated when a serious pulley breakdown caused a half meter hole crosswise in one belt. The downtime for repair work was 8 hours compared with at least 4 times as long for a steel belt according to EMO estimates.

Trelleborg claim that their belts are not more expensive than steel belts, and when the advantages as described are considered, the "cost per handled ton" is considerably lower with a "Trellamid" belt than with a steel belt.

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H. Rost & Co., Germany

The second case history concerns the belts made by H. Rost & Co., a belting, hose and mechanical rubber goods manufacturer in Hamburg, Fed. Rep. of Germany.

Rost started the research and development on high performance flame-resistant "Aracord" conveyor belts reinforced with "Kevlar" as early as 1973. After extensive internal and external testing at leading German mining institutes, their first "Aracord" belt was installed in 1977 in a German underground coal mine. The T-1250 belt (1250 N/mm) utilized a cord carcass made from "Kevlar" with breaker fabrics and flame resistant polychloroprene rubber on both sides. Rost claim that the cord construction allows optimum material utilization and has excellent fatigue performance. The cord construction contributes to extremely low elongation in use (ca 0.25 % at 10 % of the nominal belt strength). The breaker fabrics together with the closely spaced aramid cords provide good resistance against impact, important at the loading point, and improved resistance to splitting. They also allow the use of mechanical fasteners in emergency situations.

A 2200 m long commercial installation was made in 1978 with a T-1250 belt. This belt runs at 2.5 m/s and carries 2500 tons of coal per hour horizontally. The longest belt was installed in 1982, T-1600 (1600 N/mm), 3600 meters long, carrying 1000 tons per hour of coal up a 5 degrees slope. About 10 km of "Aracord" belting are now in operation in Germany. These are mainly in the Ruhr coal mines and ore and salt mines. Additional installations are found in Braunkohle surface mines.

Experience has shown that the belts suffer no strength loss from fatigue. A T-1600 belt was spliced and tested at the University of Hannover on their dynamic testing equipment. After 1.2 million revolutions at 32 % of nominal belt strength, no strength loss of the aramid reinforcement was observed. Belts removed after ca 2 years in actual use have also shown no strength loss. The belts are reported to keep a straight course and run more quietly than belts with a steel carcass.

"Kevlar" is five times stronger than steel on an equal weight basis, permitting savings in belt weight and in energy to drive the belts. A further saving in weight is obtained by reducing the thickness of the polychloroprene covers since there is no risk of corrosion. Depending on the installation, a 20 to 40 % weight saving over steel reinforced belts is reported. Furthermore, due to non-corrosion, lower operating costs are experienced as a result of reduced downtime and reduced maintenance costs.

The Rost "Aracord" belts successfully passed the flammability tests of the German chief mines inspectorates and are certified as suitable for use in deep coal mines and surface mines. A full range of belting reinforced with "Kevlar" from this company is today available covering the strength range of T-1250 (1250 N/mm) to T-3150 (3150 N/mm).

Compagnie Colmant Tournai, Belgium

The third case history involves Compagnie Colmant Tournai, owned by Dunlop and equipped with facilities for making solid woven conveyor belts. Colmant, as we shall call them for short, saw "Kevlar" as a way to expand their existing limits without changing radically their process. Their limit with polyester was T-2000 but the troughing flexibility had reached its limits. They realized that "Kevlar" would enable them to achieve higher strength and enter the high tension steel belt market without the fear of corrosion. Moreover they could still use metal fasteners as temporary repairs and reduce the belt thickness thus reducing the number of splices and improving the safety.

Colmant started their developments in 1976 in T-1250 belts and had installed more than 5000 m up to 1981. Based on that experience, they have been able progressively to increase their range up to T-4000 (4000 N/mm). The latter, reinforced with "Kevlar", for an equal thickness, weighs no more than a conventional T-2000. Also, the elongation of the new belt is much less than with standard textiles, being about 0.7 % over two years.

German coal mines have been major customers for Colmant for a long time and naturally they have been interested in the advantages of this new concept.

Several important belts have so far been installed in this environment and in terms of runnability have proved highly satisfactory.

In February 1978, Colmant installed a horizontal T-2000 (2000 N/mm) belt, 2800 m with a 40% troughing angle. It runs at 2.2 m/s and carries 1.5 MM tons of coal per year. The success of this encouraged a move to stronger belts and Colmant scaled up to T-4000, installing in October 1981 a 1500 m belt, running horizontally at 3.2 m/s and using 3x350 kW power units and carrying 2800 tons per hour. This belt is to be increased in 1983 from 1500 m to 3500 m.

This in turn has led to 3 more T-4000 belts, which were instal-led in early 1982. The first of these is similar to the first T-4000 belt, but the second is 1400 meters moving 1400 tons per hour up a 11 degrees slope (a rise of 136 meters). This uses 4x300 kW power units and will again be extended horizontally in 1983 to 3500 meters. The third T-4000 belt installed early in 1982 is 900 meters long, but the slope here is 14 degrees and a horizontal extension to 2400 meters is planned for this year.

Colmant see "Kevlar" as a highly important addition to their standard textile reinforcement work. Their success in the coal mines, due mainly to better runnability, reduced maintenance and improved safety has led them to develop rubber cover belts (PVG) for surface mines and quarries.