NIBA–The Belting Association
6737 W. Washington St. #1300
Milwaukee, WI 53214
Ph: 414-389-8606
www.niba.org

Technical Article

Technical Article Content Pulled from the NIBA Belt Line Newsletter

Splicing Straight Warp Conveyor Belts

Contributed by Michael Cremeens
Fenner Dunlop Americas
Member, NIBA Technical Committee
Beltline Reprint March 2003

Generally, in the past, finger splices were known and used in lightweight PVC and rubber belts of varying types. The finger splice has also seen limited use in the past on some heavy-duty conveyor straight warp construction belts.

Straight warp belts are made up of high tenacity polyester fibers in the longitudinal strength members (warp). These create low stretch characteristics in combination with proven resistance to impact and mechanical damage (important for long-haul conveyors).

The weft (lateral) reinforcement is based on a nylon composite yarn that optimizes the fatigue properties and troughing characteristics of the belt designs. These warp and weft members are held together by a nylon binder yarn in most cases.

In the past, splicing these belts required special fabrics used as a load-carrying member (scab fabric). It was these fabrics that made splicing straight warp belts time-consuming, expensive, and somewhat difficult if the covers had worn thin. With that said, a better process and material system was needed.

The first order of business was to make sample belts with as many splice types as possible and run them on the dynamic test rig. This test runs a 12-inch wide x 40 ft. long loop belt at 580 ft. per min. while applying the full PIW rated tension to the belt (i.e., a 1500 PIW belt would be tensioned to 18,000 lbs). The loop belt is flexed over four pulleys bending the splice forward and backward with the splice flexing around a pulley every second. The first level of this test is passing the 250,000- cycle goal (with once around the system being a cycle).

After the first level is passed, the tension is increased by 12.5% and the loop belt is run for 100,000 more cycles. The third level of the test increases the tension to 15% and runs for 100,000 cycles. The fourth level increases the tension to 17% and runs for 100,000 cycles or until failure.

1. 250,000 cycles full PIW tension
2. 100,000 cycles full PIW tension + 12%
3. 100,000 cycles full PIW tension + 15%
4. 100,000 cycles full PIW tension + 17%

Note: The third and fourth levels are seldom reached by any step (lap) splice type.

During this process it was found that the step (lap) splice joint using an aramid fabric load-carrying member (scab) showed signs of delamination along the load member ends. Some improvement was seen using short fingers along the load carrying scab ends, but clearly did not improve the splice service life to the new target levels.

The same step (lap) splice using a load-carrying member (scab) was tested using a nylon fabric tension member. More improvement was found, but since the gauge of nylon fabric was close to 3/32", the use of this material on thin cover or worn covers was not possible.

It should be noted that all of the scab spliced loops failed well before the 250,000-cycle benchmark of level one. Since this tester has seen splices last well past 500,000cycles and with a few types making almost 1 million cycles, this was of concern.

A new design was needed so a page was taken from splicing high-tension solid woven PVC belts and applied to the straight warp construction belt. An All Finger Construction Splice was tested and some interesting results were found.

The All Finger Splice design leaped past level one on the dynamic tester without any signs of failure. As the test loop moved into level two, small delaminations started to appear along the edges of the fingers near the tips.

These splices were removed and tested to find the cause of this delamination. After running some lab tests on the flex tester, comparisons were found between the materials that showed signs of delamination quicker than those that didn't. This delamination was determined to be caused by rubber reversion.

A great number of lab tests were preformed to pinpoint the cause and effect of this reversion. These tests found that the base polymers and their blend were the root cause. A new breed of nonreverting splice tie gum was the outcome.

The All Finger Splice was retested using these new nonreverting materials along with a new "learned" assembly method.

The loop belt spliced with the All Finger Splice jumped pass the 250,000-cycle mark (level one) without a single sign of delamination. The test moved into level two and the tension was increased by 12% (moving into the safety factor of the belt). The All Finger Splice again jumped passed this level (100,000 cycles) without any signs of failure. The All Finger Splice then moved into level three (an area were few other splice types have been) and the tension was increased to 15%, thus moving deeper into the belt safety factor and closer to the breaking strength of the belt. The loop belt then was run for 100,000 more cycles and the All Finger Splice again passed the test without any signs of failure.

At this point the All Finger Splice had seen 250,000 cycles at rated full tension and then 100,000 cycles with

NIBA–The Belting Association
6737 W. Washington St. #1300
Milwaukee, WI 53214
Ph: 414-389-8606
www.niba.org

tensions 12% past the belts rated running tension, all without failure.

The All Finger Splice made 100,000 more cycles with tensions 15% past the rated belt tension and only minor internal stranding of the fingers was noted. The splice was run for 50,000 more cycles and then removed for static break testing. The All Finger Splice made with the special nonreverting materials has proven to have a dynamic failure value more than 10 times better than the best step (lap) splice using a scab fabric tension member.

In summary, the All Finger Splice has many benefits such as doing the splice square (the finger test loops were made square—no bias angle) and using a material system that can be utilized on traditional crimp-weave (plied) belting as well. In the end, this splice type is very simple to learn but without the proper training the same service life as noted above may fall very short.