Improved glass conveyor chain for higher productivity

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Higher speeds, less downtime, decreased maintenance, and reduced breakage are key factors in providing the higher productivity demanded by bottle producers. Ramsey Products Corporation has developed a high performance glass conveyor chain(UltralifeTM) especially for high speeds and enhanced productivity.

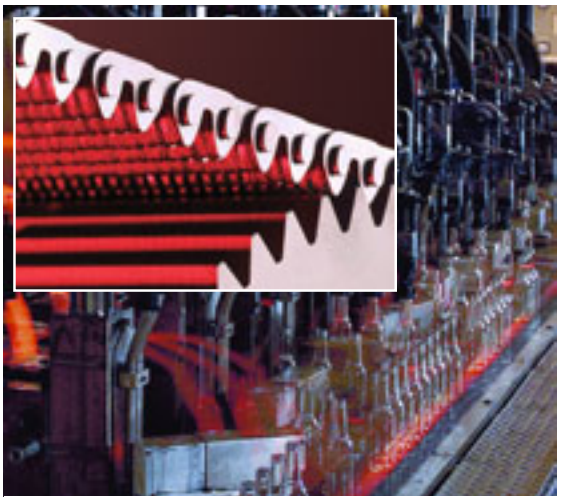
INTRODUCTION

For many years, Inverted tooth chain, also known as silent chain, has been used to transport glassware in both hot end and cold end applications. Providing a stable, flat and smooth, heat resistant surface, such chains are available in many different designs and sizes. Operators and designers of glass machinery can choose from a variety of standard chain pitches, link shapes, widths, joint styles, and materials. In most applications, particularly those involving speeds less than 0.5 M/s, standard chains perform well and will provide a satisfactory service life. However, as production speeds increase, chain wear rates also increase, resulting in more frequent maintenance and reduced service life. Also, as conveyor speeds increase, synchronization with other glass transport mechanisms becomes even more critical. Variations in chain velocity or irregular movements can lead to mishandling, tipping, breakage, and downtime. All of these problems, increased maintenance, breakage, downtime, and reduced service life, drive up production costs and reduce productivity.

Recognizing the challenges inherent in higher transport speeds, as well as the growing customer interest in improved productivity, the product designers at Ramsey Products set out to optimize a chain to meet these new demands. The goal was to design a chain that would provide longer life with less frequent maintenance and with smaller variations in surface speed.

IDENTIFYING AREAS FOR IMPROVEMENT

Analyzing customer comments and chain samples returned from the field, Ramsey engineers first identified the most common reasons that chains become unusable and the contributing factors. Chain life was found to be most often limited by two factors: elongation, commonly referred to as "stretch", and reduction in chain height due to link tip wear. Link tip wear occurs as a result of friction between the chain and the supporting wear plates. When link wear reduces the overall height sufficiently to cause the chains' riveted pins to interfere with machine guides, a chain must be replaced. Chain elongation is the result of link and pin wear within the chain joint. As a chain elongates, it will wrap an ever-increasing sprocket pitch diameter, and the chains' linear velocity will increase. Chain replacement is necessary when the velocity impairs smooth transport of glassware, the chain interferes with other machine parts, or the chain does not properly engage sprockets. In addition, a third factor limiting chain life is lateral wear or thinning of the links. Caused by links sliding against one another, thinning links can cause chain pins to project excessively, where they collide with chain guides,and crack or break.



UltraLife chain close-up, and on an IS machine

A similar review of maintenance needs revealed that chain elongation was the major reason for periodic repairs. Initially, retensioning can accommodate excess length. However, when the limits of machine adjustment are reached, it becomes necessary to

shut down the conveyor and cut out sections of chain to reduce the overall length. Customer feedback also indicated that new chains could be a problem if the pitch was inconsistent. For example, a typical conveyor that is 25 meters long will be pieced together from 8 separate chain sections. If the pitch of the individual sections is not consistent, the chain's velocity will fluctuate as the different sections engage the drive sprocket.

Analyzing all of the issues, engineers summarized that an improved chain would have the following characteristics:

1) More consistent pitch
2) More wear resistant links and chain joints
3) More consistent and reduced pin head extension

IMPROVEMENTS IN CHAIN DESIGN AND MANUFACTURING

Changes were then made in the chain design and the manufacturing processes employed. First, building on techniques developed for use in high-speed power transmission chain, specialized tooling was developed to improve the quality of the conveyor link apertures. The improved links have a smoother aperture surface and a significantly higher bearing area for pin support. Unlike standard conveyor chains, where approximately 65% of the link thickness is in contact with pins, the new links provide over 80 % of the link thickness as a bearing surface. The increased bearing area reduces bearing stresses by nearly 20% and significantly decreases the rate of link joint wear. An additional benefit of the improved link production method is better control of chain pitch. The pitch of individual links is more consistent, with less variation between manufactured lots.

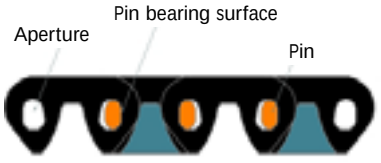


Fig. 1 Side view of conveyor chain

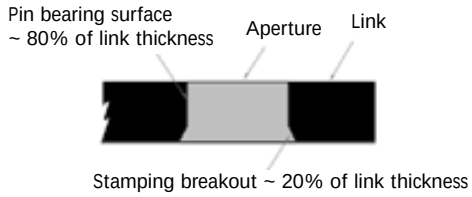


Fig. 2 Ultralife link aperture cross-section

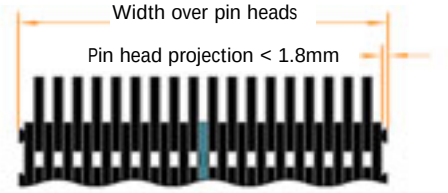


Fig. 3 Ultralife chain top view showing pin head extension

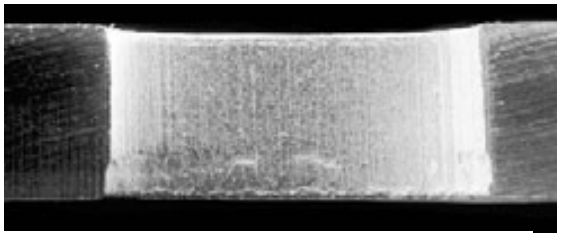


Fig. 4 Cross-section of Ultralife link aperture 20x

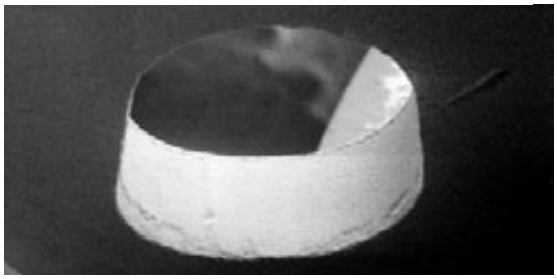


Fig. 5 Ultralife link aperture surface 15x

Other manufacturing improvements include a reduction in the amount of pinhead projection and an increase in the hardness of all chain links. The maximum pin projection was reduced by 22% and the average link hardness was increased to improve abrasion resistance. Also, additional process controls were introduced to assure component uniformity throughout production and assembly.

Initial samples of the new chain were produced for run testing at Ramsey. When the preliminary testing was successful, engineers then turned to verifying chain performance in a glass production environment.

FIELD TESTING

After consulting with a leading international bottle producer, a production plant was selected where field-testing of the new chain could be conducted. The selected plant is widely recognized for its above average productivity and the commitment of personnel to continuous process improvement. Chain life on the plant's high-speed lines was approximately twelve months and the goal was to extend life to at least two years. There was also a strong interest in reducing chain velocity variation , so the synchronized transport of glassware would be improved.

In November of 1997, the first Ultralife chain, 1/2"pitch by 175mm wide, was installed on a 10 section, triple gob, IS machine. During the installation, the machine was also fitted with two new Ramsey sprockets and the chain alignment and tension was checked. The machine was running 12 oz beer bottles, weighing 7.5 ounces each, at a rate of approximately 470 bottles per minute. The conveyor speed was about 1 M/s and operation was continuous, 24 hours per day, 365 days per year.

Initial monitoring of the test chain showed that the variation in the chain surface velocity was 60% less than that typically measured in standard chains. It was also significantly better than any chain that had been previously tested by the plant. This result confirmed that the efforts made to better control chain pitch were successful.

For the next nine months of operation, no chain maintenance was required. After a little more than nine months, the chain was re-tensioned by adjusting the drive sprocket. The magnitude of the adjustment indicated that the chain had elongated approximately

76mm. Twenty-three months later, after a cumulative run time of thirty-two months, a similar adjustment was made to take up an additional 152mm of elongation. Both of these adjustments were made while the chain was running, requiring no additional machine downtime. Finally, in September of 2000, after thirty-four months of run time, the chain was removed and replaced, even though the chain was operating satisfactorily. Bill Edmonds, the hot end engineer, explained that the chain was running fine, but we decided to replace it anyway while the machine was shutdown for other maintenance. During the entire thirty-four months of the chain test the machine was not shutdown for chain maintenance. According to Bill, "After thirty-three years in the glass business, the Ultralife chain is the finest conveyor chain I've ever worked with."

During the field test, the cost savings produced by the Ultralife chain were substantial. Because the chain lasted nearly three years, it was not necessary to purchase replacement chain at the usual 12 month intervals, or to shut down the machine for chain replacement. Over a three year period, this reduced maintenance spending on the test machine by approximately 19,000 EU. In addition, by decreasing the amount of machine downtime required for chain maintenance and replacement, the Ultralife chain produced a noticeable gain in productivity.

FOLLOW UP

Since its introduction, Ramsey's Ultralife chain has continued to demonstrate it effectiveness in production plants throughout the world. Building on this success, Ramsey engineers have developed additional chain designs employing Ultralife technology. For customers that prefer 2-pin joint styles, Ramsey now supplies Ultralife chain in 2-pin extended pitch, and 2-pin 1/2"pitch styles.

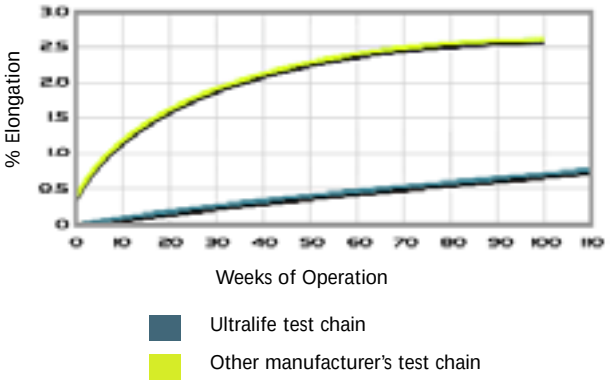


Fig. 6 Ultralife chain elongation compared to another manufacturer's published data

THE IMPORTANCE OF PROPER MAINTENANCE

While Ultralife chain can deliver improved performance, particularly in high-speed production environments, proper chain installation and maintenance is critical. If a conveyor system is incorrectly aligned, or sprockets are worn excessively, chain performance will suffer. In most cases, the single biggest factor affecting chain life is proper tensioning. A chain that is over tensioned will elongate too quickly, reducing service life and increasing replacement costs. Time spent developing maintenance procedures that assure proper chain installation and tensioning will be well rewarded with improved conveyor performance and overall cost savings. ■