Technical Article
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Elongation Properties of Heavyweight Conveyor Belting

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Conveyor belt elongation properties are critical in determining how heavyweight belts will react when subjected to varying stress levels. These stresses change along the length of the conveyor and across the width of the belt due to system influences such as tension, transitions, vertical and horizontal curves, turnovers, and crowned pulleys.

Elongation can be defined as the change in length (stretch) of a belt subjected to tensile stress. A distinction is made between elongation at break, permanent elongation, and elastic elongation. The elongation at break is the elongation at the moment the belt breaks. With each tensile stress below break load, the belt is subject to an elongation which, upon stress relief, partly recovers (elastic elongation) and partly remains (permanent elongation).

A tensile stress-strain curve (Figure 1) is a plot of stress on the y-axis versus strain on the x-axis. In the plot, strain is expressed as elongation. Stress-strain curves are measured with an instrument designed for tensile testing. We see that as the strain (length) of the belt increases, a larger amount of stress (force) is required. As the elongation is increased the belt eventually breaks.

In order to measure a belt's elastic and permanent elongation characteristics, the industry has adopted international standard ISO 9856. The standard specifies a 50mm (1.97 in.) wide sample with a length of at least 300mm (11.8 in.) plus clamping length. The belt is subjected to a sinusoidal cyclic stress that varies from 2% to 10% of the belt's minimum ultimate breaking strength. This is equivalent to the normal working range the belt sees while in operation. The frequency for cycling is .1 hertz, or six cycles per minute. An extensometer is used to measure elongation during the test.

The test is concluded after 200 cycles have been completed. A graph (Figure 2) is generated that shows the recorded load/elongation curve after the 1st and 200th cycles. The elastic modulus is given by the following formula,

Elastic Modulus = $\Delta F / \in$

ΔF is the variation of the amplitude of the load between 2% and 10% of the minimum breaking strength of the test piece, expressed in pounds per inch of width.

The relative elongation, $\in$, is given by the formula

$\in = \Delta l / l_o$

Δl is the elastic elongation, expressed in inches l_o is the initial length of the extensometer, expressed in inches.

In simplified terms, the load required to elongate the belt 1% is calculated by dividing the elastic modulus by 100. Because of the relationship of modulus to load (stress) and elongation (strain), the higher the modulus the lower the elastic elongation per unit stress.

Example:
Belt Modulus = 60,000 piw

Load required to elongate belt
1% = 60,000/100 = 600 piw

Permanent elongation can be determined from the chart after 200 cycles as shown in Figure 2.