Calculating the Friction of Seized Wheels on Take-Up Trolleys

This article is based on the experience of On-Site Servicing by Iptron Technology personnel over a period of 30 years and hundreds of installations.

Assume the average Take-Up Trolley has a mass of about 1000kg. The trolley has 4 Wheels running on a Rail with 90 deg contact. Assume the weight is equally distributed between the 4 wheels, one of which is seized. The coefficient of dry sliding friction for Mild Steel on Mild Steel is given as 0.62.

Frictional force can be expressed as:-

$$F = \mu N$$

Where:

F = frictional force in Newtons

μ = coefficient of friction

N = force in Newtons

Each wheel will exert a force of (1000/4) / 0.10197 Newtons = 2.45 kN (Kilonewtons)

The Inverted Angle Iron will cause the friction to be increased by √2

Thus the friction per seized wheel will be 2.45kN x √2 = 3.47 kN per 1000kg trolley mass

The friction per seized wheel must be divided by 2 for each conveyor pulley on the Take-Up Trolley.

Thus the effective frictional effect on the Take-Up Trolley with a single Pulley will be 1.73kN. Note that this operates in each direction.

For a Conveyor Belt running at 20kN Belt Tension, the typical Dead Band for the Control System would be +/- 3kN.

With just a single seized pulley, this is usually workable but with 2 seized wheels, clearly it is not. Bear in mind also that the average Take-Up Trolley has dry bronze bushes because lubrication was present only at installation so the minimum Trolley Wheel friction is already significant. Our experience shows that the system is already marginal with 1 seized pulley. In a survey of 9 systems in use for 5 years, we found that all but one has one or more seized pulleys.

The effect of Trolley Wheel Friction on Tension Control.

The total trolley friction has to overcome when adjusting tension in each direction. When increasing tension, the Rope Tension represents the force applied to it. However the Belt tension will be 1.73kN lower than the measured tension. Thus the tension will be chronically under-adjusted by the effective total friction. When the under adjustment exceeds the 'Dead Band, the control will continually attempt to re-adjust; this will raise

the number of winch motor starts and put the motor at risk of failure. This effect is always present due to residual friction in all systems; however, the residual is constant and can be routinely compensated for by having a small amount of Time Lag set to match the under-adjustment.

Note that Sheave Wheel Friction, which has a very dramatic effect on Tension Control, does not usually occur as soon as Trolley Wheel Friction does. Also the Sheave Wheels that have the highest stresses are those with 180 deg of rope wrap; these are the ones that will fail first. I.e. those operating in line with the Take-up Trolley.