Effect of Inclines and Declines *Cont.*

Critical relationships between belt velocity, material conveyed, and conveyor setup must be maintained to avoid spillage and slip-back of the material on inclined or declined belts. Simplified relationships for the maximum belt velocities attainable before material slip or spillage occurs on inclined or declined belts are given by:

Equation 3.7
Equation For Maximum Belt Speed Before Material Slippage Occurs

$$V_{slip\text{-}max} = 60 \times \sqrt{\frac{S_i}{2\pi^2 \times Y_s}\left(g\left(\cos(\theta_{belt}) - \frac{1}{\mu_e}\sin(\theta_{belt})\right) + \frac{\sigma_0}{\rho \times h}\right)} \quad \text{(fpm)}$$

$\sigma_0 \times g$

Equation 3.8
Equation for Maximum Belt Speed Before Material Spillage Occurs

$$V_{spill\text{-}max} = 60 \times \sqrt{\frac{S_i}{2\pi^2 \times Y_s}\left(g \times \cos(\theta_{belt}) + \frac{\sigma_0}{\rho \times h}\right)} \quad \text{(fpm)}$$

$\sigma_0 \times g$

Where:

S_i (ft) = Idler spacing (Chapter5)

$Y_s = \frac{\Delta Y_s}{S_i}$ Dimensionless ratio for belt sag between idlers

g (ft/s^2) = Acceleration due to gravity 32.2ft/s^2

θ_{belt}(radians) = θ_{belt}(deg)$\frac{\pi}{180}$ radians required for Equations 3.7 & 3.8

ρ (lbm/ft^3) = Bulk density of the bulk material

μ_e = Equivalent friction between bulk material and conveyor belt

σ_0(lbf/ft^2) = Adhesive stress between bulk material and conveyor belt

h (ft) = $\left[b_{wmc} \times \sin(\beta) + \frac{(b_c + 2 \times b_{wmc} \times \cos(\beta)) \times \tan(\Phi_s)}{6}\right]\left[\frac{1}{12}\right]$

b_{wmc}(in) = .2595×BW - 1.025 Length of belt on wing roller in contact with the material

b_c(in) = .371×BW + .25 Length of belt on center roller in contact with the material

BW (in) = Belt width

β (deg) = Idler wing roll inclination

Φ_s(deg) = Surcharge angle of the bulk material