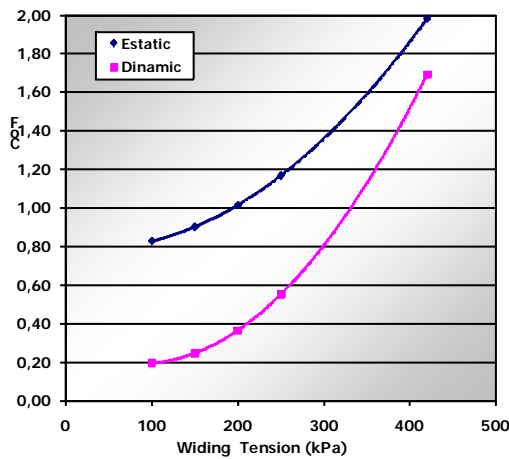


BULLETIN: WINDING TENSION EFFECT ON COF



Studies of coextruded films with LLDPE blends POP / LDPE show a strong dependence between the applied voltage during film winding and the coefficient of friction (COF). Moreover, this work reveals that the COF is independent of the extrusion temperature used.

A regression analysis of data from the study reveals that the COF has a second-order dependence with respect to winding tension, ie, the COF increases as the square of the applied winding tension (WT). The equation of regression fit is shown below:



$$\text{COF (Estatic)} = 0,80 - (5,09 \cdot 10^{-4}) \cdot \text{WT} + (7,90 \cdot 10^{-6}) \cdot \text{WT}^2$$

$$R^2 = 0,90 \quad (1)$$

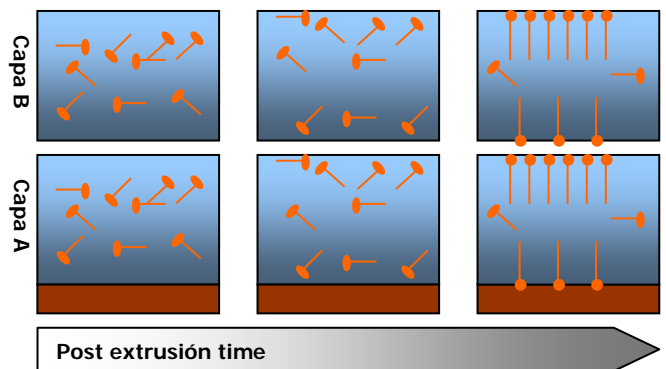
$$\text{COF (Dinamic)} = 0,30 - (2,40 \cdot 10^{-3}) \cdot \text{WT} + (1,36 \cdot 10^{-5}) \cdot \text{WT}^2$$

$$R^2 = 0,91 \quad (2)$$

As shown in both equations, both the static and the dynamic COF show dependency relationships with respect to the winding tension similar characteristics.

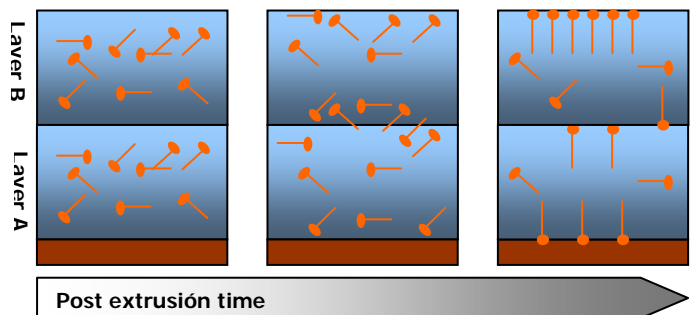
From the fitted values by the model shows that for every increase of 50 kPa in the winding tension is increased by 15% the COF Static and Dynamic COF 40%. The dynamic COF increased sensitivity to changes in voltage winding may be a common cause of faults or anomalies that occur in the post extrusion steps as cutting, printing and FF (with Formed Packaging - Filling and sealing).

The phenomenon of inhibiting the migration of slip generated by the increased tension, occurs as a result of the reduction of the free energy of exothermic separation caused by high pressure between the faces of the film. Thus molecules sliding, instead of migrating to settle on the faces of the film, migrate from one surface to another, reducing the effective concentration of sliding required to have the desired COF. The following diagram illustrate the phenomenon described.



In the representation above, the molecules move slider to the free surfaces of the film, allowing the polar group of the amide molecule incompatible with the EP, the slippery film forms.

In the second diagram shows the two faces of the film in close contact, which occurs at high winding tensions. In this case, sliding molecules move between the layers, looking for the free surface of the coil, which will result in low values of slip in the inner layers.



Based on this mechanism can also anticipate that those lines of extrusion, coextrusion, lamination, cutting, etc., Which have central voltage windings

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(Center Winders) there is a heterogeneous distribution of slip, remain the highest in the COF As it moves toward the center of the coil.

Given the evidence of landslide problems arising from the winding tension is recommended:

- Reducing the voltage applied by the winder to a value that would prevent the occurrence of defects in the coil, as the "telescope".

- Reinforcing additive resin base with a concentration of slip agent, adding small doses of 200 to 250 ppm.

- Finally, it is worth recalling that the extrusion temperature has an influence on COF extremely low, so we do not recommend altering it.

This bulletin has been elaborated by the Marketing Management of Polinter, with the support of specialists of Investigación y Desarrollo, C.A. (INDESCA), and the Technical Services Management of CORAMER. It is intended to all the users of Venelene resins and we trust that the information herein contained will be useful.

In case of comments or suggestions, please write to info@polinter.com.ve or contact our Commercial Agent at <http://www.coramer.com>

The information described in this document is, to our best knowledge, accurate and truthful. However, since the particular uses and transformation conditions are completely out of our hands, the adjustment of the parameters in order to reach the maximum performance of our products for a specific application depends on and is the responsibility of the user.

For further information on safety features and the handling and disposal of our products, please consult the Safety Data Sheet (MSDS) of Venelene Polyethylene.