Cork Tech TalkNews

Manufacturers of Waterbase, UV+EB Curable Coatings, Varnishes and Adhesives

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COF, FRICTION, SLIP, SLIDE ANGLE

Is it just me or does there always seem to be a little hesitation or extra thought that has to go into any discussion of Coefficient of Friction and slide or slip. Simply we have to remember that high COF=high slide angle=anti-skid and low COF=low slide angle=slippery.

The COF of printed/coated graphic arts materials gives us an important understanding of how the surfaces of these objects will slide across each other, or against other surfaces such as processing machinery components.

Next some further definitions.

FRICTION: resistance to the movement of one body to another in contact. The amount of friction is dependent on the type of contact surfaces and the amount of force (usually gravity) pressing the objects together, but not on the surface area of the contact surface.

COF: ratio of the frictional force and the amount of force pressing two surfaces in contact together. The coefficient is a measure of the resistance of the one surface to slide over the other.

STATIC COF (starting friction): relates to the ratio of force required to start one surface to move on another.

KINETIC COF (sliding friction): relates to the ratio of force required to continue the movement of one surface on another, at a uniform speed, once movement has started.

SLIDE (slip): lubricity of two surfaces sliding in contact with one another.

ANTI-SKID: describes the increasing of friction, raising COF and slide angle to make a surface less slippery.

Now that that's out of the way, how is COF measured?

Two types of equipment are in general use. The most expensive and more accurate, precise devices are of two designs, either stationary sled with moving plane or moving sled with a stationary plane. Either design will yield the same COF values. Less expensive are inclined plane devices either motorized or manually raised, to cause a sled to begin to slide.

Considering the horizontal sled type devices, while there are a variety of instruments available, they all work on similar principals and are capable of yielding reliable COF data. Key elements are a base mounted smooth plane and a sled. The sled is attached to a spring gage or a strain gage. After conditioning discussed below, test specimens are attached both to the sled and the plane so there is surface contact when the sled is mounted on the plane. To test, the plane driving mechanism is started, which exerts a horizontal frictional force on the test specimen contact surfaces. When the pull on the sled is equal to or exceeds the static frictional force affecting the contact surfaces, movement will take place. The gage maximum reading indicates the force component of the static COF. Next, one records the average gage reading seen as the surfaces are continuing to slide against one another. This reading indicates the kinetic force or the force necessary to continue the started sliding movement between surfaces. The capture of this force data allows the calculation of both static and kinetic COF as follows:

STATIC COF= As/B

KINETIC COF=Ak/B

As=gage reading at initial movement
Ak=gage reading during uniform sliding
B=sled weight

The inclined plane can also be effective as a test instrument. Key elements are an inclined plane and a sled. A key design consideration must be the ability to smoothly increase the inclination of the plane from horizontal to at least 45 degrees. There must also be a means to indicate angular movement with at least 0.5 degree accuracy.

Additionally, as with all COF testing, there must be an ability to level the instrument. To test, sample materials are mounted to the sled and the inclined plane after conditioning, as discussed below. Once mounted, the inclined plane is elevated at a smooth, constant rate until the sled starts to move. Desirable is an electro/mechanical switch which will stop the inclination of the plane at the first movement of the sled, denoting the angle at which movement started. The angular displacement of the inclined plane is then read indicating the angle at which movement of the sled started. The static COF is equal to the tangent of the angle at which the specimen mounted sled begins to slide.

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Kinetic COF may also be obtained by starting the sled on the inclined plane at an angle somewhat below the angle recorded for static COF. This is an estimating process, understanding that the kinetic forces required will be somewhat less than the force to initiate movement. A reading is then taken at the angle where movement is obsrved. COF properties of materials are also dependent upon surface smoothness. For this reason testing with the grain and machine or cross machine direction, is recommended.

Care should be taken to condition all test specimens, following ASTM or other test methods for temperature and humidity consistency. Further, precautions must be taken when handling the specimens to keep them free of dust, lint, finger prints, and any other foreign matter that might alter test surface characteristics.

Multiple specimens (5) should be tested for each sample with the results then averaged for a final COF value. Standard deviation may also be calculated.