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A Better Measure.

Coefficient of Friction of Plastic Medical Tube

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INTRO

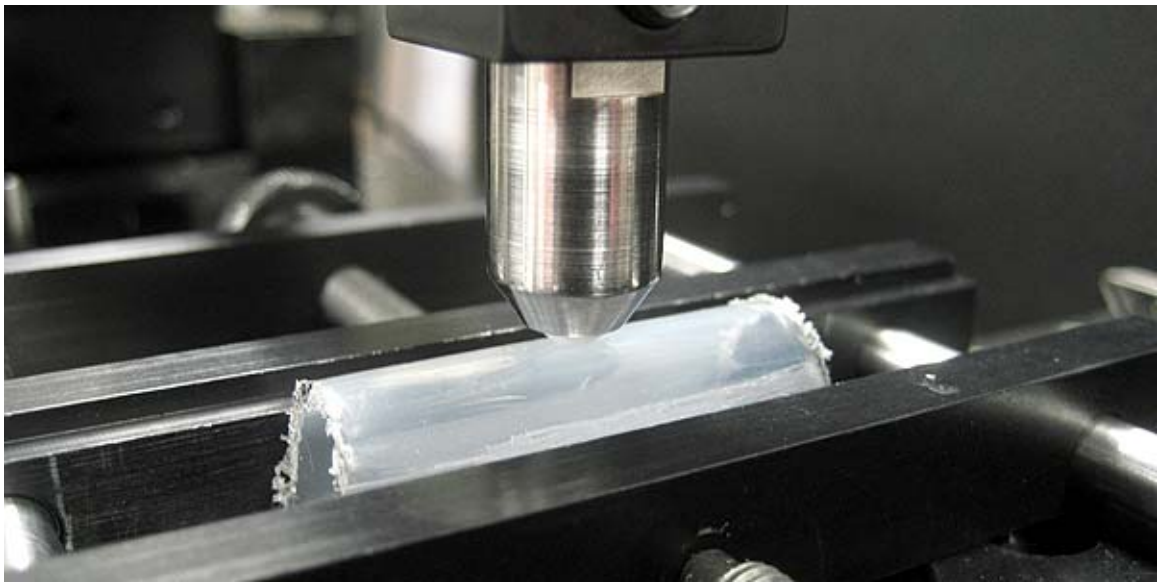
Plastic is highly used within the medical industry. Its use within the industry ranges from containers and syringes to medical tubing such as catheters. Catheters are inserted into a body cavity or vessel and are used to allow drainage, fluid injections or to allow the insertion of medical devices. The flexibility of plastic allows the medical industry to make various important and different uses of it. The quality of the plastic has to be considered for the various types of uses and forms it will take.

IMPORTANCE OF COFFICIENT OF FRICTION FOR QUALITY CONTROL

A major concern for plastic used within the medical industry is the Coefficient of Friction (COF) value. Since plastic tubing is used for inserting medical or surgical devices into the body, the frictional value must be as low as possible in order to allow for a smooth travel into its destination. Also, in cases where medical devices, such as stents, are inserted in the body through a plastic tube, the COF value must be low in order to avoid removing any of the medicine that often stents are coated with. Some plastics may have the best flexibility for a specific application but may not have the best COF value; therefore, it is very common to add a lubricant, either as a coating to the plastic or in liquid form during the use of the tube. Adding a lubricant may reduce the friction found in the plastic tube and ease the travel of whatever is being inserted through it.

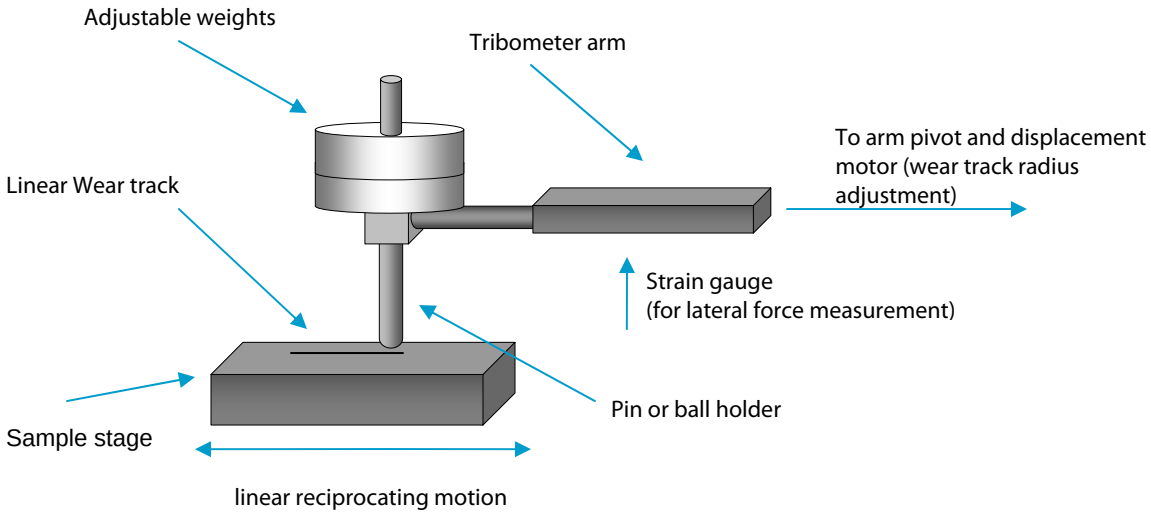
MEASUREMENT OBJECTIVE

In this application, the Nanovea Tribometer (seen below) is used to measure the coefficient of friction between a 6mm teflon ball (typically of low COF value) and a plastic tube. Two different tests are recorded, one without any lubricant and one with the use of lubricant, in order to show the changes in COF within the same tube. This technique uses the Linear Tribometer method to determine coefficient of friction. This test will show how the COF values of plastic may vary by using a lubrication and not using lubrication on the same plastic tube.



MEASUREMENT PRINCIPLE:

A flat or a sphere shaped indenter is loaded on to the test sample with a precisely known force. The indenter (a pin or a ball) is mounted on a stiff lever, designed as a frictionless force transducer. As the plate slides in a linear reciprocating motion the resulting frictional forces acting between the pin and the plate are measured by very small deflections of the arm using a strain gage sensor. Wear rate values for both the pin and sample may also be calculated from the volume of material lost during a specific friction run. This simple method facilitates the determination and study of friction and wear behavior of almost every solid state material combination, with varying time, contact pressure, velocity, temperature, humidity, lubrication, etc.



TEST PROCEDURE

The instrument base is first leveled in the horizontal position by screwing or unscrewing the adjustable rubber pads at each corner. A ball-holder containing a 3 or 6 mm diameter ball is held in the load arm and placed at a height that allow the tribometer arm to be leveled horizontally when resting on the sample to ensure that normal load will be applied vertically. The arm is then balanced with counter weights to ensure that the arm and ball holder initially apply no force on the sample surface. Finally, weights corresponding to the load required for the test are finely placed on the arm over the ball holder. Through software, the test is then launched and the test is performed at a specified speed for a specified duration, and the frictional force is recorded over time.

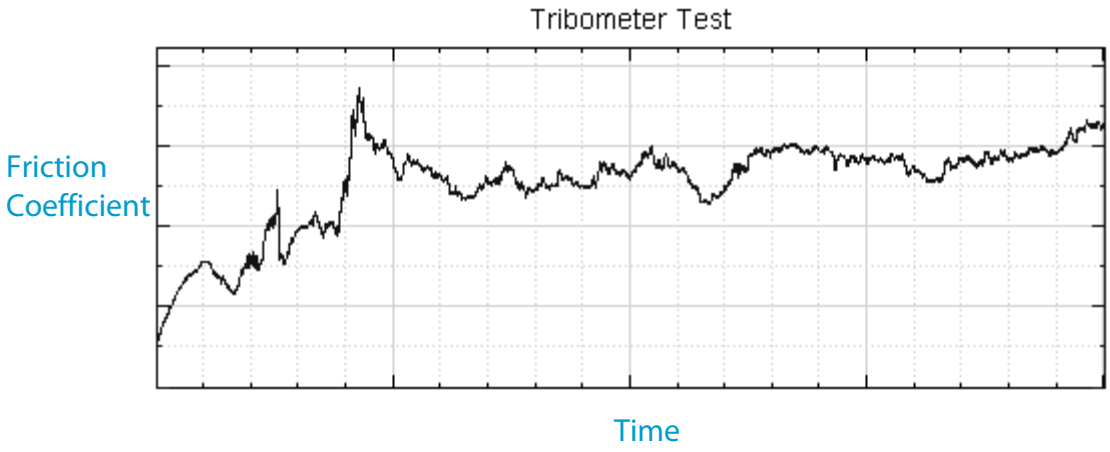


Figure 1 : Example of a friction curve in during a tribometer test

TEST CONDITIONS

Test parameters

Load	**1 N**
Duration of test	**20 min**
Sliding rate	**100 rpm**
Amplitude of track	**6 mm**
Révolutions	**2000**
Ball Diameter	**6 mm**
Ball Material	**Teflon**

Environmental conditions

Lubricant	**Saline**
Atmosphere	**Air**
Temperature	**23°C (room)**
Humidity	**35%**

Results

This section includes the following results:

• Summary table of the main numerical results • Graphs of coefficient of friction over time

Wear rate and coefficient of friction summary table

Sample	Average COF
Plastic Tube WITHOUT Lubrication	0.116 ± 0.002
Plastic Tube WITH Lubrication	0.096 ± 0.001

(See following pages for individual sample summary)

Full results tables

Plastic Tube WITHOUT Lubrication	
	Average COF
1	0.116
2	0.118
3	0.115
Average	**0.116**
Standard deviation	**0.002**

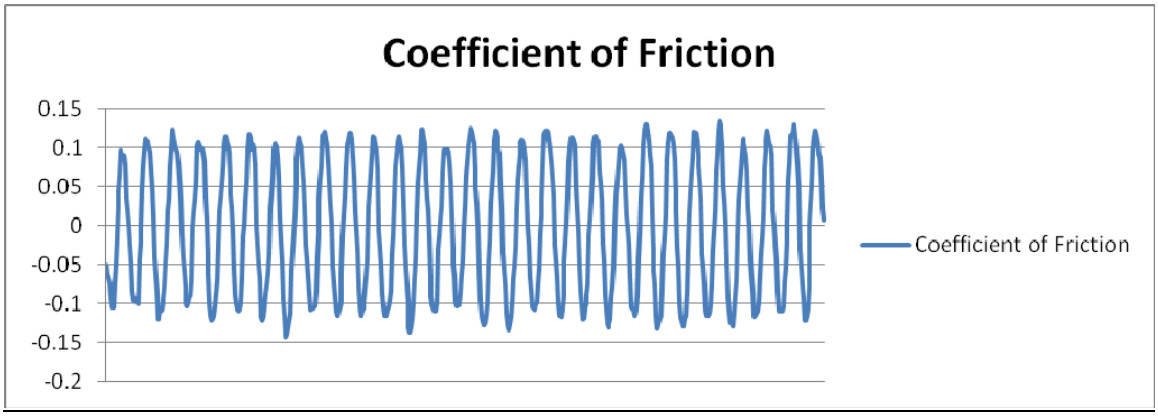


Figure 2 : Graph of coefficient of friction (ZOOMED) – Plastic Tube WITHOUT Lubrication

Plastic Tube WITH Lubrication	
	Average COF
1 2 3	0.097 0.095 0.096
Average	**0.096**
Standard deviation	**0.001**

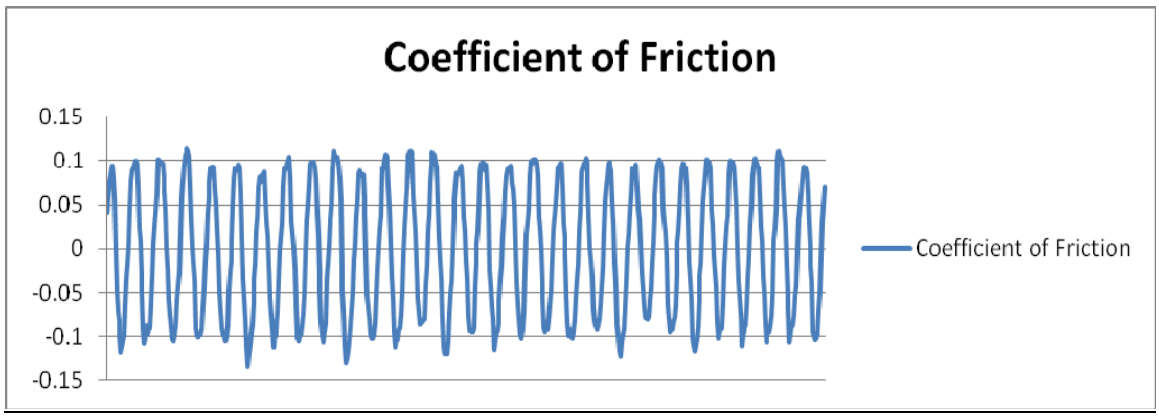


Figure 3 : Graph of coefficient of friction (ZOOMED) – Plastic Tube WITH Lubrication

CONCLUSION

The Nanovea Tribometer allowed for the coefficient of friction between a Teflon ball and a plastic tube to be measured by performing the test through a Linear method. We were able to run multiple tests of the Teflon ball on Plastic with and without Lubrication. This was done in a controlled and repeatable fashion, which will allow the testing and comparing of both test groups under identical conditions. The test parameters can be adjusted, such as reducing the load, to better simulate real-life applications. The amount of solution added to the samples with lubrication may have an effect on the data. If the amount of solution placed on the plastic tube was too small there would not be enough solution to lubricate the ball. In conclusion, the Nanovea Linear Tribometer is a very effective way to study COF under different conditions to determine the best methods to use and the affect of different methods on the coefficient of friction of a given application.