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BROOKFIELD AMETEK

Instrumentation & Specialty Controls Division

Quality Packaging

seal strength

Packaging is an emerging science that has become a great contributor to the success of the food industry. It plays an important role to primarily protect the food product against physical, chemical and mechanical damage as well as contamination. Packaging has also become the core sector for marketing and the means by which manufacturers can differentiate their products from those of their competitors. Here we look at two examples of the seal strength and peel strength of packaging materials in the food industry.

Seal Strength

For food manufacturers in the fast moving consumer products arena, packaging products in sachets is a quick and easy way for consumers to obtain their product. Many condiments, such as ready-made sauces and dressings, are packaged into sachets. Choice of packaging materials is important at first glance because it's a means by which new products can be promoted in the market place. The more important function, however, is to maintain the cleanliness or sterility of the product throughout all stages from manufacturing to transportation to storage on shelf until the consumer makes the purchase. For the manufacturer to ensure successful packaging of their products, the integrity of the seal must be assessed.

Figure 1: Dual Grip Assembly Fixture

A seal strength test using a Texture Analyser measures a quality of the seal purposed to provide a barrier protecting the product from its external environment. Using the tension testing method, seal strength can be measured by the capability of the seal to resist separation. A typical example of a test device used for this type of tension testing is the Dual Grip Fixture (TA-DGF). See Figure 1

The Dual Grip assembly is a multipurpose fixture used in tensile testing. The grips are 25 mm wide and fitted with rubber inserts to maximise the secure clamping of the sample. These grips are capable of holding rectangular samples up to 5 mm in thickness and are used to pull a sample apart.

Figure 2: Load verses time graph for the seal strength of a pepper sachet

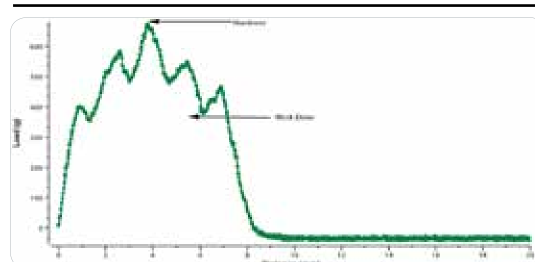


Figure 2 is a typical graph from a tension test using the Dual Grips with a Texture Analyser to measure the seal strength of a black pepper sachet:

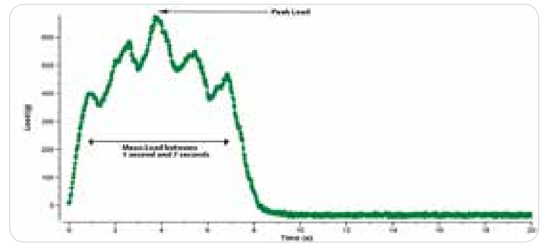
As the tensile force increases, the seal begins to weaken at various points seen by fluctuations in the load values on the graph. The maximum force value on the graph is a measure of the force required to initiate tearing at the seal. When the maximum tension force is reached, the seal begins to tear away more easily, as seen by the gradual drop in tension load until total separation when the load value drops to zero. The mean load indicated on the graph is the average force required to weaken and tear the seal.

Figure 3 is a typical load vs. distance graph for the same tension test using the Dual Grips with a Texture Analyser to measure the seal strength of a black pepper sachet. This is an alternative option for displaying the test information. Here the work done to weaken and tear the seal is measured as the area under the graph.

A summary of the results for one sachet is shown in the following table:

Sample	Peak Load (g)	Mean Load (g)	Work Done (mJ)
Black Pepper Sachet	672	497	13.3

Figure 3: Load verses Distance graph for the seal strength of a pepper sachet



Peel Strength

Peel tests measure the adhesive or bond strength between two materials. Typical examples include films and backing materials for adhesive patches amongst others. A peel test is performed when a tension load or force is applied to the material under investigation in one of three ways as listed below:

(1) Pulling a flexible material away from a non-flexible material both of which are held vertically.

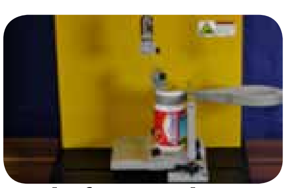
(2) Pulling a flexible material (positioned vertically) away from a non-flexible material (positioned horizontally).

(3) Pulling two flexible materials axially apart from each other. This is known as the "T" peel test.

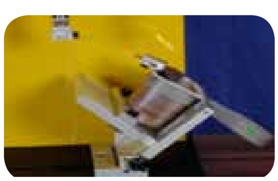
A typical example of a peel test fixture is the General Peel Jig (TA-GPJ). The fixture is designed such that it can perform 0°, 45°, and 90° peel tests based on the position of the fixture relative to the base of the instrument. See Figure 4

Figure 4: General Peel Jig

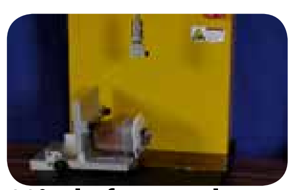
In preparation for the test, the free end of the flexible material (backing, film, etc) is inserted into the grip (or partially peeled prior to inserting into the grip) and the product container (e.g., the non-flexible material) is locked into position on the fixture platform using the thumb screws. The sample holder straps the product container in place at the neck region, thus fastening the item into a fixed position for testing. The Texture Analyzer is connected to the grip by a string and applies a gradually increasing tensile force to the flexible material. The protective material (e.g., backing or film) is peeled away from the product container. The force required to peel the flexible material away is a direct measurement of bond strength between container and seal.



0° platform peel test



45° platform peel test



90° platform peel test

In quality control, performing a peel test is important in order to assess the seal integrity and safety of the product. The tests also ensure the proper functioning of the adhesive seal by ensuring that the seal is strong enough to keep the product sterile, yet easy enough to peel without causing spillages or inconsistencies in peel strength.

The graph in Figure 5 shows data taken from a 0 o peel test of a seal on a yogurt bottle using the General Peel Jig.

The two peak values seen on the graph are a measure of the force required to break the rim-seal contact at the start of peeling and then again at the end of the peeling when the seal finally lifts off the container. The dotted line on the graph is the force required to continue peeling at a constant force and is calculated to be the average peak load. The fluctuations in the actual data on the graph indicate the small variability in peel strength as the seal is removed.

Figure 6 shows the graph for an alternative option to display the test results. The graph shows the distance travelled by the tensile grip throughout the peeling process. The average peak load can however only be calculated from the load vs. time graph in Figure 5 as the calculation involves a defined time interval.

A peel test will indicate potential problems that may arise from the seal quality. This data can be used to require the package engineering team to improve seal strength. If the peak force is very high at the start of the test followed by a rapid drop in force, this indicates the possibility of spillages for low viscosity products as the user attempts to peel off the seal from the container. Moreover, large fluctuations in the force to continue peeling will also indicate poor seal quality with inconsistencies in peel strength and spillages also likely to occur. The advantage of this peel test is that it can be extended to all types of rectangular, oval, and circular containers.

The following table summarises the results from the peel test.

Sample	Peal Load (g)	Average Peal Load (g)	Work (mJ)
Yoghurt Bottle	561	35.7	14.43

Figure 5: Peel strength test to remove a seal from a yogurt drink bottle

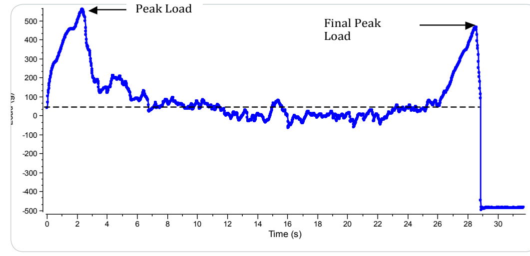
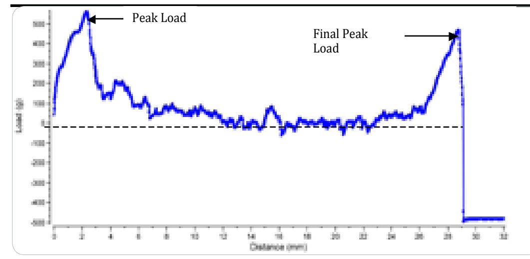


Figure 6: Load verses distance graph for peel strength test of seal from a yogurt drink bottle



CONCLUSION

Two methods for evaluating the force required to open packaged food items have been illustrated. Texture Analysers are highly flexible pieces of equipment that can come with a variety of fixtures to perform a battery of tests on packaging materials. Any food laboratory that wants to be competitive will use this instrument to verify not only the consistency of their product, but also the integrity of their packaging.

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