Application manual No. 081

Production: BAKED BEANS

Objective: Comparison of firmness and total extrusion force of baked beans by bulk compression

Type of action: Extrusion test

Test mode settings:

Speed	Test mode	Trigger	Target	Hold
5 mm/s	Distance (c)	0 gf	68 mm	0 sec

Accessory:
Ottawa Cell, Platform

Sample Preparation:
Samples of tinned baked beans are drained and washed and then weighed into equal portions. It is important that this weighed amount is enough to approximately fill the Ottawa cell by 50% of its capacity e.g. 200g.

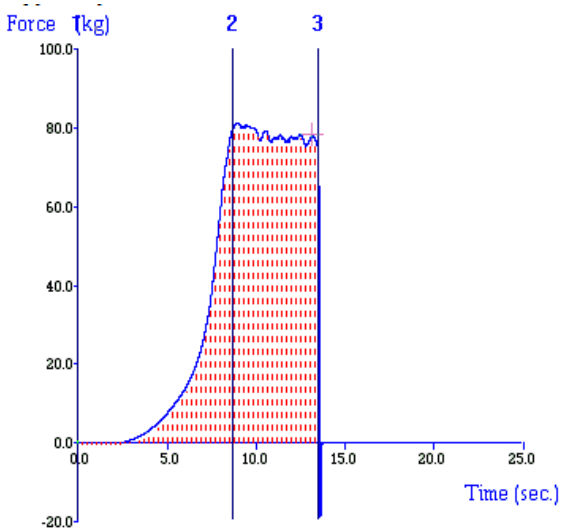
Test Set-Up:
The empty Ottawa Cell is loosely fixed onto the machine base. The plunger is attached to the load cell carrier and is lowered slowly into the Ottawa Cell. The Ottawa Cell is then manoeuvred until clearance is visible between the plunger and the sides of the cell. The Product Catchment Drawer is positioned under the Ottawa Cell, to catch the extruded sample. The plunger is then raised above the cell to allow for placement of the test sample.

Before carrying out the test using a zero trigger one must calibrate the plunger to acknowledge the bottom of the cell as a zero position. To do this, lower the plunger, so that it is close to the bottom of the cell. Click on CALIBRATE Height. Specify the distance that you want the plunger to start from for each test - e.g. 70mm is suggested.

The plunger will move down and touch the extrusion plate and then move up to the specified start distance. For the comparison of results it is crucial that the test always begins at the same distance from the bottom of the cell, this distance can be programmed into the CONTROL PROBE feature.

Prior to each test ensure that there is good clearance around the plunger to avoid frictional effects. This can be checked by running a 'blank' test i.e. one without any sample in the cell, to ensure that the plunger is not touching the sides. The plunger is then raised above the cell to allow for placement of the test sample. Place the sample into the cell, ensuring that there are no gaps and run the test. In between tests clean the plunger, extrusion plate, and the inside of the cell to remove any remaining sample, as this will cause variable results.

Typical plots:



The left curve was produced from testing 200g of tinned baked beans (drained and washed) at 20C.

Observations:
Once the plunger has reached the sample (from a starting position of 70mm from the base), force is seen to increase at a steady rate. As the plunger moves down further onto the sample the force begins to increase rapidly as the sample begins to deform and rupture. After rupturing has occurred the subsequent increase in force is as a result of the force required to push and extrude the sample through the slots in the extrusion plate to a final position of 2mm above the extrusion plate. The mean maximum force and total area under the extrusion curve 'Work of Extrusion' are obtained and used as an indication of firmness.

Data Analysis:

☒Max Force

☒Ave (+) (From 8 to 13 second)

Results

Sample	Mean Max.Force 'Firmness' (+/- S.D.) (kg)	Mean Area 'Work of Extrusion' (+/- S.D.) (kg·mm)
Baked Beans - tinned	74.4 +/- 3.1	2431.9 +/- 85.8

Notes:

- The sample to be compressed and extruded is often of variable configuration or structure. The result is an average of the forces required to compress and extrude the sample of variable geometry.
- The extent of compression and extrusion has been based on the use of an Ottawa cell with a 100kg load cell. A greater degree of compression and extrusion would therefore require a 250kg load cell.
- When attempting to optimize test settings it is suggested that the first tests are performed on the hardest samples to anticipate the maximum testing range required and ensure that the force capacity allows testing of all future samples.
- The units of area are dependent on the axes displayed at the time of data analysis e.g. if force (kg) versus distance (mm) is shown, then the composite units would be kg · mm.