WHAT DATA SHEETS TELL YOU AND WHAT THEY DON'T

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In the previous two articles of this series, I have described some of the key features of the Association of Rotational Molders (ARM) Low Temperature Impact Test; this is generally accepted within our industry as the best way of assessing material toughness in rotomoulded parts.

As previously described, a machined dart is dropped on to consecutive rotomoulded plaques and the drop height is increased or decreased, by a standard increment, to reflect whether the previous sample tested has survived the impact or has been broken.

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The ARM test was primarily developed as a way of testing rotomoulded polyethylene (PE) samples. Grades of PE retain a degree of flexibility, even at very low temperatures and the test protocol specifies that sample plaques should be conditioned to -40° before they are impacted. Incidentally, the absence of temperature units in the last sentence is deliberate; -40° is the same temperature whether measured in Celsius or Fahrenheit units.

A domestic freezer will not deliver a temperature as low as -40°, but many freezers used in the catering industry frequently are able to go down this low. Therefore it is not necessary to buy expensive laboratory freezers in order to do the ARM test properly.

Conditioning at -40°, as opposed to Room Temperature, has been shown to provide a clearer definition between properly and improperly processed materials. Even at low temperature, a good rotograde PE should break with a ductile failure rather than brittle failure (see Fig 1). However, if the material is under-cooked or over-cooked, failure mode will revert to brittle and ductile failures will not occur. In the early 1990's, I suggested that this onset of brittle failure could be used to precisely define the processing window of different rotograde PE's; over the following 20 years of designing commercial PE rotogrades, this proved to be a very useful indicator of the width of the processing window. Given the variation inherent in the rotomoulding process, moulders tend to favour grades with wide processing windows.

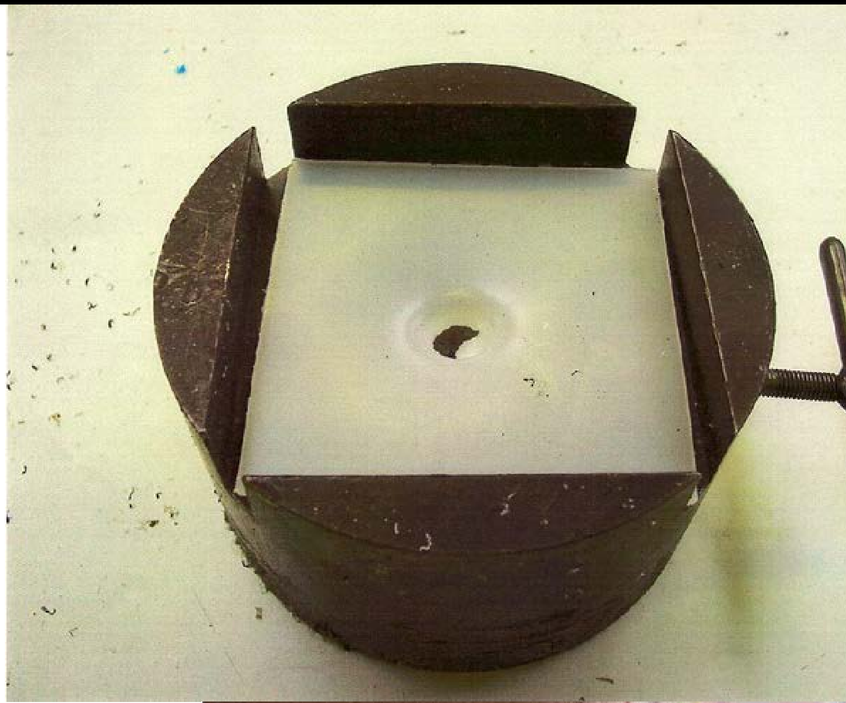

Figure 1
Sample plaque in holder exhibiting a ductile failure

Once you have completed the test, usually on at least 20 plaques, you can easily calculate the weighted average drop height that causes failure. The precise details of this calculation are specified in the protocol for the test, which is available for download at http://www.rotomolding.org/pdf/lowtemp.pdf

Once you have the Mean Failure Height (MFH, in m), for the test samples, this can be converted simply into a Mean Failure Energy (MFE, in J) using the equation :

$$MFE = MFH \times \text{Dart Weight} \times g$$

The specific dart used can be individually weighed (in kg) during the original building of the tester (see Fig 2).

Be aware that very heavy use (or misuse) of the test may result in the striking point of the dart becoming slightly flattened; if this happens, your data will not make sense, get the point re-shaped and don't forget to re-weigh the dart and adjust the calculation formula.

Figure 2
Impact dart – the "10 pound" version is shown