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Data Journal

Relative Thermal Indexing

Tests run in the LTTA Lab

Some examples of ASTM methods:

ASTM D-149
ASTM D-256
ASTM D-638
ASTM D-790
ASTM D-882
ASTM D-1822
ASTM D-3801
ASTM D-6272

Some examples of UL methods:

UL 94
UL 746B

What is Long Term Thermal Aging?

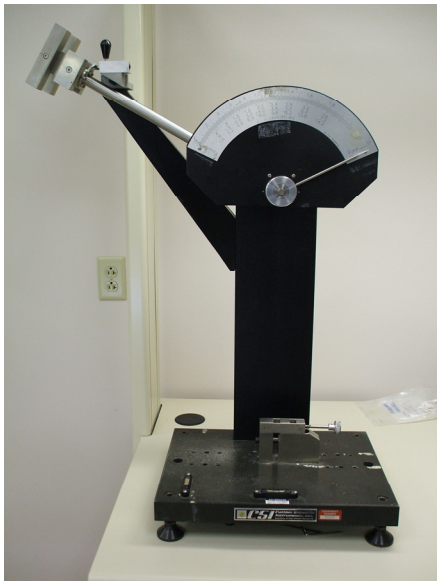
Written by: Marcie Muzzey

Relative thermal indexing (RTI) is a method of establishing a thermal rating for a "candidate" material by comparing it to a "control" or "calibration" material, which already has an established rating. Specimens undergo thermal aging, are tested, and a rating is established based on a comparison between the candidate's results and the control's.

Thermal Indexing (TI) is a similar method of establishing a thermal rating for a material, but the aging is conducted on a "candidate" material only; no "control" material is used as a comparison. Thermal indexing projects are more susceptible to the normal fluctuation of conditions within the test since there is no comparison to nullify the fluctuations.

RTI mainly involves the thermal aging and testing of various types of materials, most of which fall into three major categories:

- Plastics – covers a wide range of chemistries. Examples are Polycarbonates, Polyamides, Polyimides, and ABS materials. Specimens are to have a thickness up to 14mm.
- Thin Plastic Sheeting – has nearly the same definition as plastics, but specimens are no more than 1.0mm in thickness. This category also refers to films, films being defined as sheeting having nominal thickness not greater than 0.25mm. Examples are PET, PEN, and Polyimide films, etc.
- Polypropylenes – a special category of rigid plastics in which the Fixed Temperature Method & observation of 'crazing' is used in aging/testing.



Impact Tester

What Happens When We Test RTI Specimens?

After a specimen has been aged and conditioned, it is ready for testing. The test results will indicate how much decomposition has occurred in the specimen during the aging period. As more data is collected, it begins to show a profile of the general behavior of the material. At the completion of the project, the profile of the candidate material is compared with that of the control material and the comparison is used to project a rating for the candidate material.

RTI Projects look at property retention of materials as they undergo thermal decomposition. We conduct many different tests on these materials in accordance with our customers' needs. RTI projects commonly evaluate:

- Tensile – Samples are basically long and rectangular in shape. They may be either films or plastics. Films are generally cut into strips, while plastics are molded into some variation of a "dog bone" shape. The exact dimensions of the samples are determined by the client in accordance with ASTM standards.
- Dielectric – Samples are generally round or square. They may be either films or plastics.
- Impact Strength – Samples are rectangular but much smaller than tensile samples. Impact samples are only made from rigid materials, as films have insufficient resistance to flexing. Impact Strength can be tested as Izod, Notched Izod or Tensile Impact.

We also conduct testing of other properties such as flexural strength and compression strength.

Different Methods of Sampling which can be used for Thermal Aging

Fixed Time and Fixed Temperature refer to the two methods of sampling used to organize an aging program. Both sampling techniques use

- the same test methods to evaluate the same property such as tensile strength
- use the same test specimens
- measure the same properties

The Fixed Temperature method, also known as the Traditional Sampling, specifies that at least four temperatures are selected for evaluation of the material. A sample set is periodically pulled from each temperature for testing. A sufficient number of specimens are loaded into each temperature to evaluate the property retention of the material from its original condition thru a point of decomposition greater than 50%.

Phenix High Voltage Dielectric Tester

The Fixed Time method specifies that at least four time intervals are selected for evaluation of the material. A sample set is pulled at each time frame for testing. A sufficient number of temperatures are selected for each time interval to evaluate the property retention of the material from a small amount of decomposition thru a point of decomposition greater than 50%.

Advantages of the Fixed Time Frame Method (FTFM)

Benefits to the manufacturer of polymeric materials:

- Provides predictable completion dates both of the Screening Test and the full thermal aging project.
- The results of the Screening Test can provide an estimate of the potential RTI value. This information can be of assistance in determining the advantages of committing to a full thermal aging project after only 552 hours [approximately 4 weeks] of testing.
- Long Term Thermal Aging projects to establish RTI of polymeric materials can be completed in less than 1 year.
- Permits simplified lab scheduling.
- Provides immediate comparison between the Control and Candidate materials because both materials are on the same Fixed Time Intervals.
- Provides more rapid evaluation of new materials.
- Provisional Recognitions may be requested after 12 weeks with two or three FT-intervals completed for both the control and candidate materials.

Fixed Temperature VS Fixed Time

	Fixed Temp.	Fixed Time
Requires evaluation of both a Control and Candidate material.	**YES**	**YES**
Can be used to establish RTI rating for • Tensile Strength • Flexural Strength • Impact Strength • Dielectric Strength	**YES**	**YES**
Uses established ASTM and IEC/ISO test methods.	**YES**	**YES**
Uses established ASTM and IEC/ISO test specimens.	**YES**	**YES**
Uses established UL and industry end-of-life criteria.	**YES**	**YES**
Is intended for the evaluation of materials that follow a near linear thermal decomposition behavior.	**YES**	**YES**
Uses test results from four or more elevated aging temperatures.	**YES**	**YES**
Requires a minimum of 500 hours at high temperatures and 5,000 hours at low temperatures.	**YES**	**YES**
Allows for a Provisional Recognition, if applicable.	**YES**	**YES**
Allows for scheduling of lab equipment, such as aging ovens.	NO	**YES**
Reduces total project cost due to controlled time and reduced number of test specimens.	NO	**YES**
Uses test data from as many as 8 to 12 independent aging temperatures.	NO	**YES**
Provides for predictable completion dates.	NO	**YES**
Allows for completion in less than 1 year.	NO	**YES**
Allows for product planning.	NO	**YES**

The Fixed Temperature method generally requires a longer aging period than the Fixed Time method. Because of this and the benefits listed above, the Fixed Time method is generally the method selected for RTI projects run at ELTEK Labs.