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Data Journal

Relative Thermal Indexing

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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

Fixed Time Frame Method: Saving Time, Saving Money

The Fixed Time Frame Method (FTFM), developed by ELTEK Labs, is the preferred method for most RTI testing. With this method specimens are tested across a range of temperatures at five pre-set time intervals, and calculations are done to determine the temperature where 50% retention is reached for each interval.

The FTFM has several advantages over the Fixed Temperature Method (FTM); also known as Traditional Sampling). First, FTFM provides a "Screening Test". 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 program after only 552 hours (approx. four weeks).

Another advantage of the FTFM is that it provides predictable completion dates of both the Screening Test and the full thermal aging project. With this method, Long Term Thermal Aging projects to establish RTI of polymeric materials can be completed in less than one year. Other benefits include simplified lab scheduling, more rapid evaluation of new materials, immediate comparison between the Control and Candidate materials since both are on the same Fixed Time Intervals, and the option to request Provisional Recognition after approximately 12 weeks with two or three Fixed Time Intervals complete.

Project Setup

Generally it is expected that the target rating will be the lowest aging temperature for the project. To select temperatures for the remaining time frames, the following rule of thumb is used: doubling the aging time will reduce the 50% retention temperature by ten degrees. Each time frame is roughly double the previous time frame, so for each new time frame the highest temperature is dropped and a new low temperature is added at ten degrees below the lowest temperature.

Occasionally it is necessary to adjust the rule of thumb based on the performance of either the Candidate or the Control material in the screening test. Ideally, the 50% retention point of the material under test would fall between the two middle temperatures of each time frame. If this is not the case for the screening test then the temperatures for the next time frame must be selected accordingly. A material that performs better than expected may require the aging temperatures for the balance of the test begin higher than in an average program. A material that does not perform as well as expected may require that the aging temperatures for the balance of the test begin lower than in an average program.

Another factor that can affect selection of aging temperatures is the rate of decomposition of the material in the screening test. Materials that show little evidence of decomposition across the selected temperature range may require that the same aging temperature range is used for two consecutive time frames. Materials that show evidence of excessive decomposition across the selected temperature range may require that the high and low temperatures for each time frame are reduced by twenty degrees rather than ten.

For most projects, the loading schedule will be filled out in two parts. During initial project setup, the details for the first time frame (552-hrs, the screening test) will be defined. After the screening test is complete, the data collected will be used to determine the layout for the remaining four time frames. After the layout is planned, the specimens can be loaded into the ovens and the full thermal aging begins.

The Screening Test

A Fixed Time Frame Method RTI program consists of two parts: the screening test and the balance of the testing. The screening test is the first of five intervals to be used for the total program.

The aging temperatures are selected based on the desired rating of the Candidate Material. To gauge whether the temperature range is appropriate and whether the candidate material can reasonably be expected to reach the target rating, only the first time frame is loaded into the ovens at the beginning of a project. The specimens are aged and tested, and the results are used to determine whether adjustments should be made to the aging temperature range before loading the remaining time frames. After the screening test results are available the customer may choose – based on the results – whether to continue to the full thermal aging, or to abort the remainder of the project if the candidate material is not performing as well as expected.

The Balance of the Test, Fixed Time Frame Method

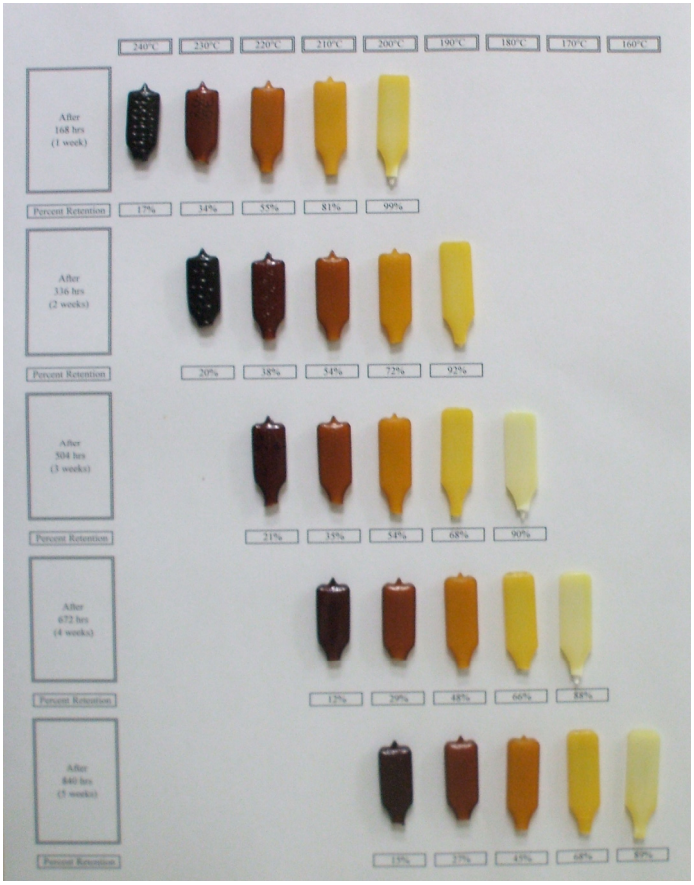
The balance of the test consists of the remaining four time frames in the full program. Once the screening test is completed and any necessary adjustments have been made to the program, the remaining four time frames can be loaded. From this point it will take approximately seven months to complete the project, unless modifications are made at some later point in the program.

The Pull Schedule, Fixed Time Frame Method

Projects being run under the Fixed Time method require that specimens are removed from the aging ovens after a specific number of days. To ensure that pull dates correspond with working days the pull schedule is planned out at the beginning of a project, before specimens are loaded. This technique allows for easy integration of planned holidays, vacation days, or other interruptions to the normal workweek schedule. By combining the new pull schedule with the pull schedules for other current projects, it is also possible to plan the RTI schedule so that the workload is relatively consistent.

It is required that all specimens for a time frame (candidate and control) are loaded on the same day, but it is not required that all time frames for a project are loaded on the same day. However, the time frames for a program should be loaded within a few days of each other to keep the project on a reasonable schedule.

Each project must have an individual pull schedule that corresponds with the data on the loading schedule. The individual schedules are integrated into a master schedule detailing all scheduled pulls for all current projects. The master pull schedule of all projects must be maintained regularly and changes updated as new projects are sent to the RTI lab. The current month of master schedule must be posted so that other technicians may take over in case of illness or other absence.



Decomposition over 9 temperatures at 5 time frames

Pulling Specimens and Testing, Fixed Time Frame Method

Specimens are pulled according to the monthly master schedule posted in the RTI lab. A pull tab is prepared for each temperature of each project being removed from the aging ovens. Each pull tab is placed in an aluminum tray, one tab per tray, before the specimens are removed from the ovens. The specimens are then removed from the ovens directly into the trays to ensure that the temperatures are not mixed up and projects are not confused with one another.

The specimens are placed into the Conditioning Chamber and remain there for a minimum of two days prior to testing. After conditioning, the testing is conducted. All data is recorded onto the datasheets. After testing is complete, the data is transferred into the database. The written copy of the data is retained in the project binder until completion of the project.

Analysis, Fixed Time Frame Method

Most RTI projects run at ELTEK Labs are submitted to UL for a rating assignment. In these cases ELTEK does not offer an analysis of the data to UL. An analysis of the data is not given to the customer unless it is specifically requested, and then only with the disclaimer that UL makes the official analysis and assigns the final rating to the material. ELTEK's analysis should be used only as a "ballpark figure".

For RTI projects not submitted to UL for a rating assignment, ELTEK will provide an analysis of the data with the Final Report. The analysis is a simple linear regression slope calculation, with a comparison between the rate of decomposition of the candidate material and that of the control. The points plotted on the graph are *Aging Hours* vs. *Temperature at Which Specimens Reached 50% Retention*.