ELCHI S.r.l. – HQ MOULDING MATERIALS
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Thermal traitment: a way to improve properties

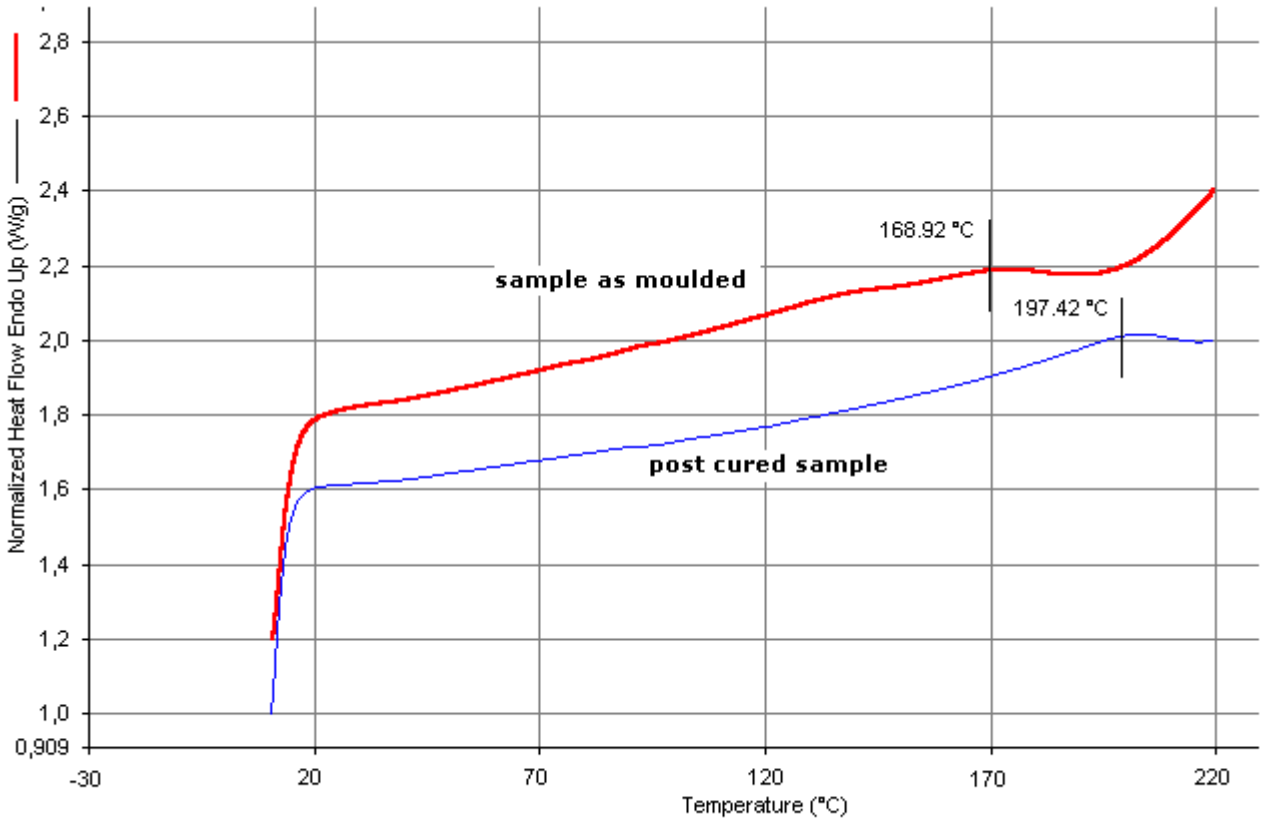
Post-curing is the process of exposing moulded parts to additional heat in an oven.
This is done for a number of reasons, e.g. to:

- Complete the Curing reaction
- Drive off volatiles gas developped during moulding
- Improve the Dimensional stability, Heat and Compressive creep resistance

Complete the Curing reaction

Since material probably never approach complete cure after moulding, the effect of post-curing on the degree of cure is quite significant. By post-curing the three dimensional crosslinked structure is increased. This behaviour is studied in ELCHI by DSC (Differential Scanning Calorimetry).

A sample quantity of moulded material is supposed to a cycle of temperature increasing, e.g from 20°C up to 220°C, at a standard increasing rate (10°C/min).
Increasing of temperature is driven out by supplying thermal energy to the sample, via an electrical resistance.
When a physical/chemical change occurs in the sample, it can't respect the programmed temperature and this is shown by a modification in the linear trace of DSC analysis.



In figure, DSC of two samples of DELGRA 100 material coming from a gas-meter part
The part was moulded at a tool temperature of 160 – 165 °C.

Red line shows behaviour of a sample as moulded (without post-curing traitment), while blue line is due to a sample which has been post-cured in oven.

A higher degree of cure (as measured by the higher "falling" on DSC trace) indicates that moulded part can withstand more severe service conditions, such as elevated temperature exposure without changing its own nature.

The initial modification of a moulded part is the same as the tool temperature. Post-curing raises the temperature at which material starts modify itself.
The post-curing temperature has a much bigger effect on this behaviour than time at temperature.
Temperatures of 120°C or 150°C are insufficient for significantly increasing cure.
Higher temperatures of 180°C or 200°C have a much greater effect.

Improve of Dimensional stability, Heat and Compressive Creep Resistance

By post-curing the degree of cross-linking is increased. This limits not only the movement of large molecular segments but also limits the microscopic movement of polymer segments. The result is the completion of post-shrinkage and the enhancement of heat and creep resistance.
Dimensional stability is fundamental for gas meters part, where measuring has to be constant during years.

Shrinkage during controlled post-curing is predictable. Higher temperatures and longer post-curing times generally result in the greatest shrinkage. Although loss of volatiles is accompanied by volume shrinkage, exposure to excessively high temperatures can also cause an irreversible expansion due to high internal gas pressures or blistering of the part.
Therefore a stepwise post-curing cycle works best, where the initial temperature is kept under the moulding temperature.

In addition post-curing can be used to relieve moulded-in stresses, improve the exposure to elevated temperature and also increase the creep resistance and surface hardness of moulded parts

Recommendations

- A stepwise post-curing cycle gives optimum property enhancement
- Starting temperature should be below tool temperature
- During the post-curing cycle the oven temperature should never exceed
- The final post-curing temperature depends upon the service requirements of the component
- Although temperature has the greatest effect on the degree of cure and elimination of volatiles, the time of post-cure is important too

It is reasonable to try to decrease post-curing times by using a relatively high temperature.
ELCHI staff is at your disposition for any enquiry on particular application of post-curing traitment.