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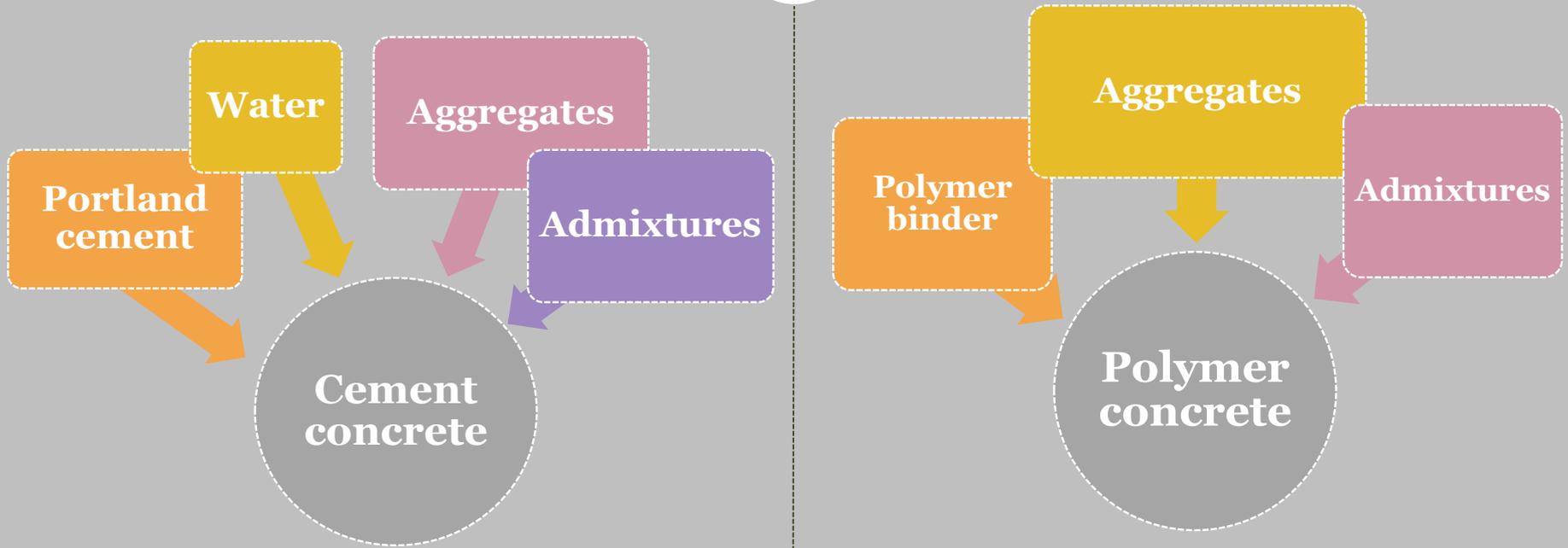
EFFECTS OF THERMAL LOAD TO THE MECHANICAL PROPERTIES OF POLYMER CONCRETE

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Cement/polymer



NO water, NO cement!!!

Polymer concretes have good strength characteristics, dense structure, slight moisture absorption, high chemical and physical resistivity, rapid solidification.

Material composition



Binder: POLIMAL 144-1
16w%



Catalyst: Trigonox 44B



Initiator: Co-1 Cobalt



Quarz gravel 2-4 mm
38w%



Quarz sand 0-2 mm
38w%



Calcium-Carbonate
5w%

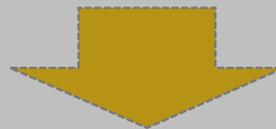
Polymer concrete vs. temperature



In general, high temperature results degradation and finally, **loss of strength of the polymers.**



Thanks to the polymer component, the mechanical properties and possible applications of polymer concretes are essentially **influenced by** the change of **temperature** and the load caused by fire.



The goal



- **Determine the behaviors of the polymer concrete of given composition under thermal load.**
- Defines the **residual values** of
 - compression strength
 - flexural strength
 - modulus of elasticity**after exposed high temperature.**



Preliminary experiment

Derivatographic measurement is a simultaneous **thermo-analytical method** which simultaneously produces thermo-gravimetric (TG), differential thermo-analysis (DTA) and derivative thermo-gravimetric (DTG) signs from a small amount of the material.



Derivatograph Q-1500 D

The process



A small amount of polymer concrete...



After crushing...

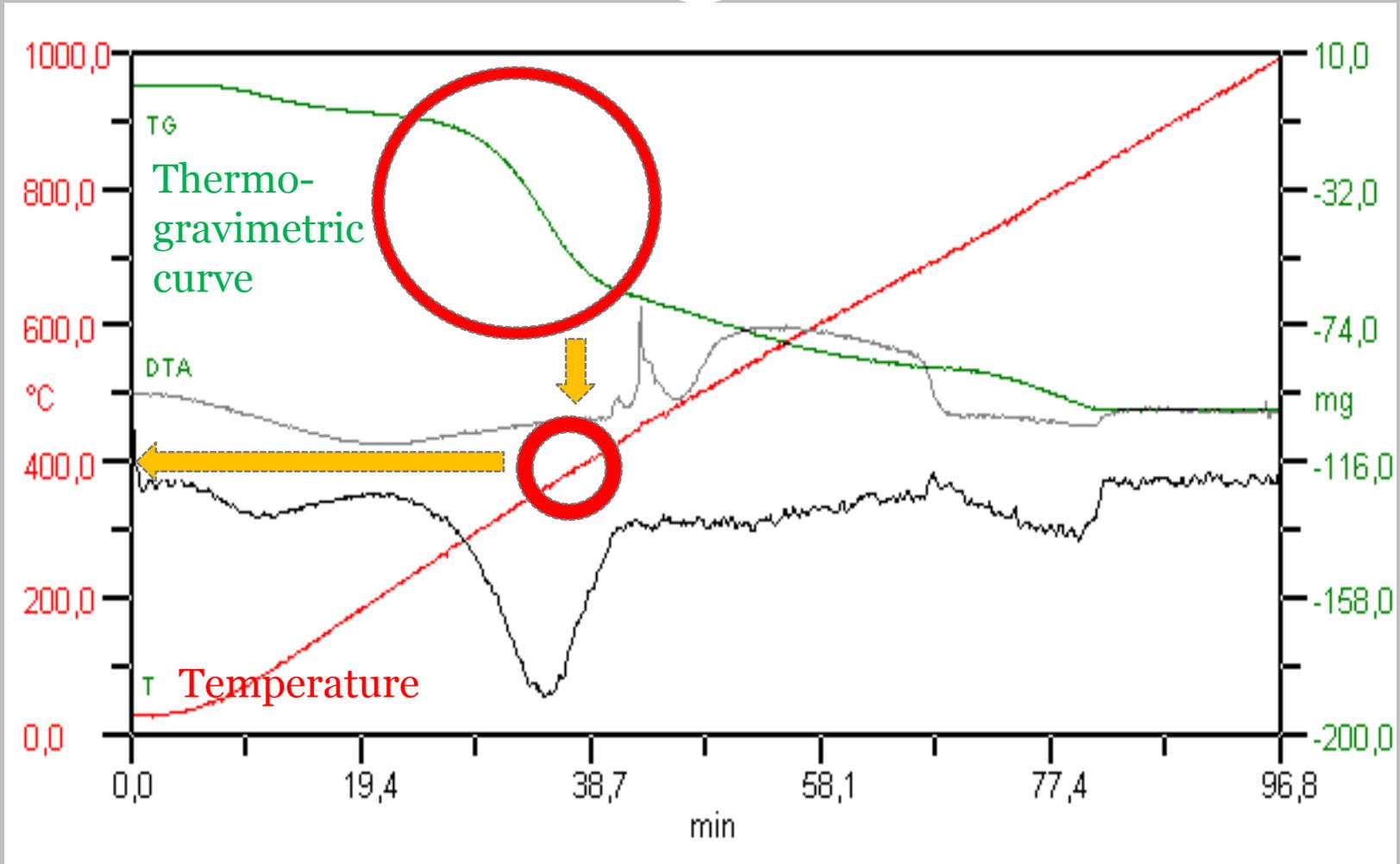


Put in the measurement equipment and ignite on high temperature



The changes in the mass of the sample (TG curve) were measured!

Derivatogram of the UP polymer concrete





400 °C !

During the 400°C heat load the specimens caught fire without any lighting effect and ...





...continued to burn freely until they got carbonized.

In the case of concrete with plastic binder, the burning of the plastic provides enough energy for the continuation of burning.



The specimens



Compression strength



150 x 150 x 150 mm cubes
3-3 pieces in all heat step
performed on the basis of the
MSZ EN 12 390-3:2009 Standard

Flexural strength



70 x 70 x 250 mm beams
3-3 pieces in all heat step
performed on the basis of the
MSZ EN 12 390-5:2009 Standard



The heat stages

During the tests, the polymer concrete specimens of given composition were subjected to load in four stages:

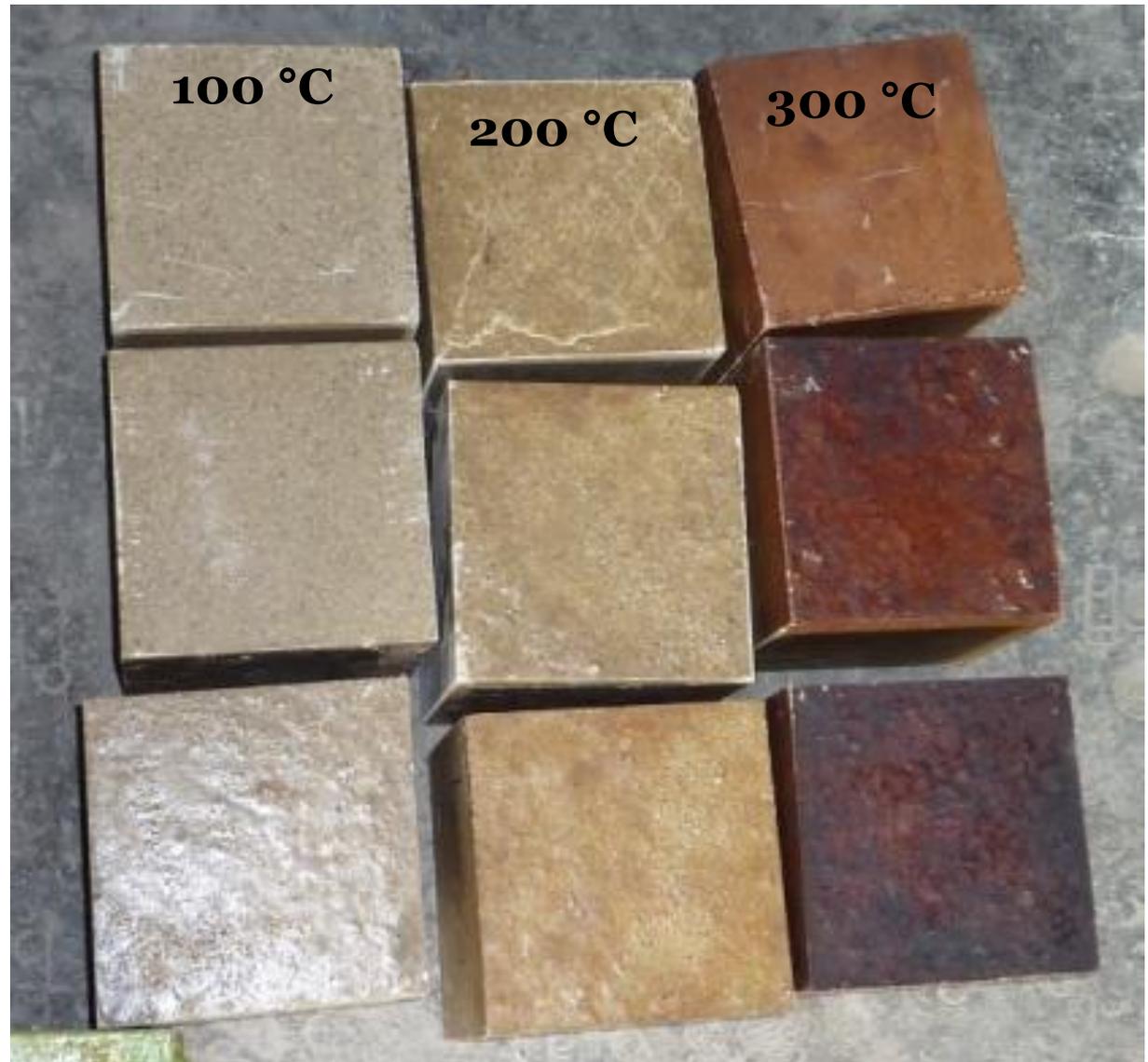
20°C,

100°C,

200°C,

300°C

Testing without any direct flame effect!





Inner layer

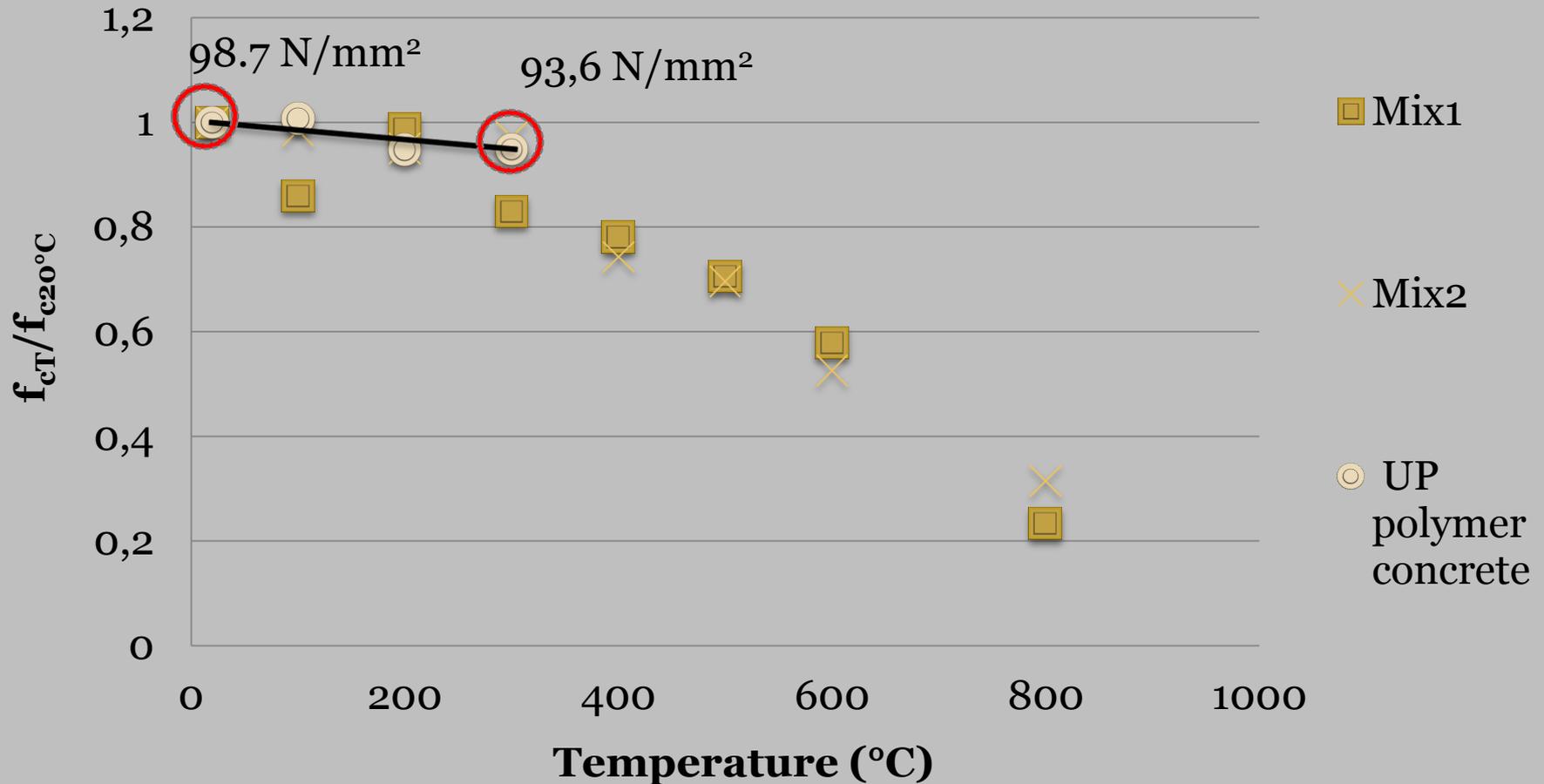
The inner layer was not discoloured during the **two-hour heat load**



After the experimens...



Relative residual compression strength

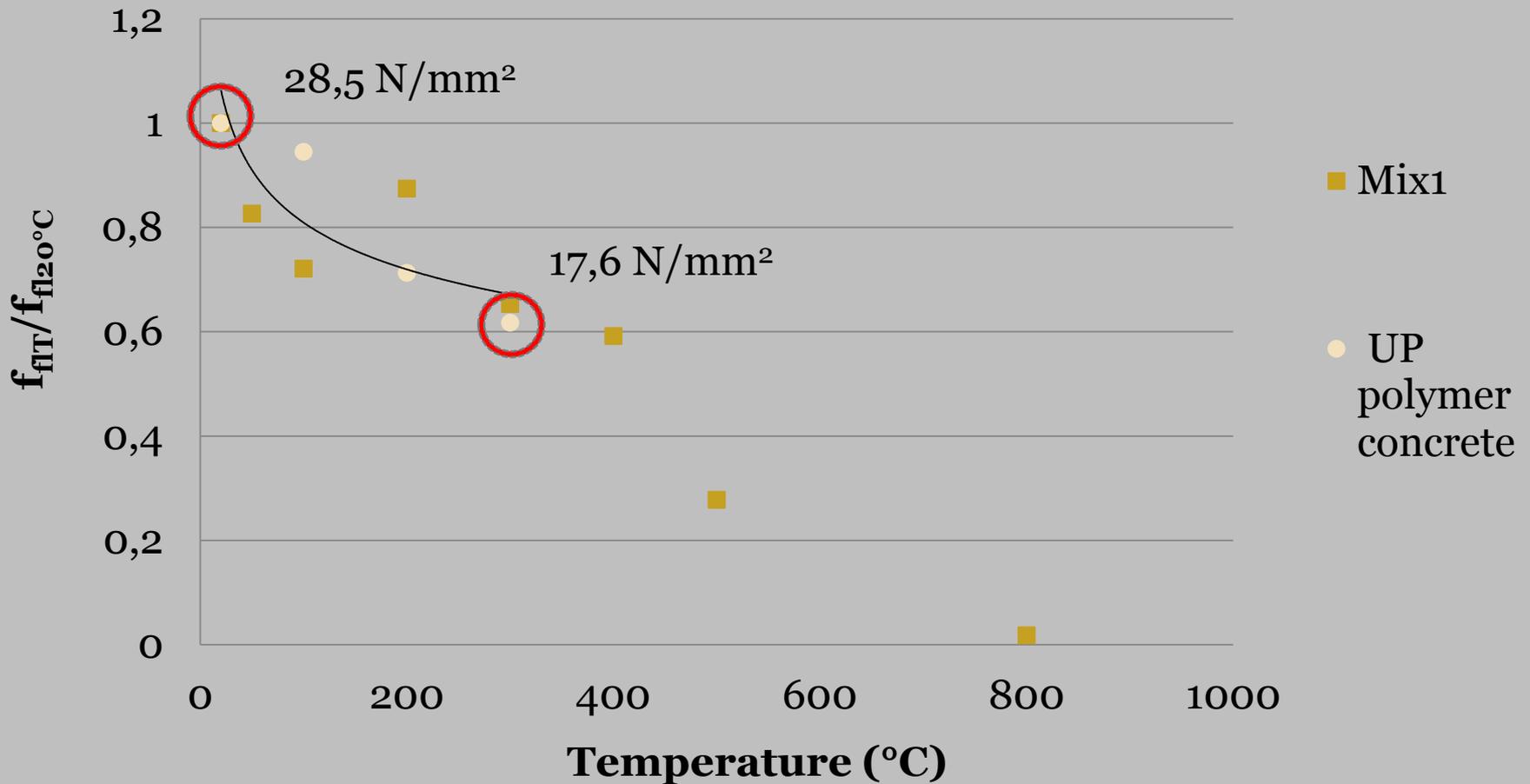


Conclusions of the compression strength test



- the extent of the strength reduction of polymer concrete does not exceed the strength reduction of concrete of the same strength, up to a heat load of 300°C;
- in the case of concrete of a lower strength (Mix1), the extent of strength reduction was higher than in the case of polymer concrete;
- BUT: over 300°C the UP polymer concrete started to burn and continued to burn freely until the specimens got carbonized, practically until their strength was considered to be 0 N/mm²

Relative residual flexural strength



Conclusions of the flexural strength test

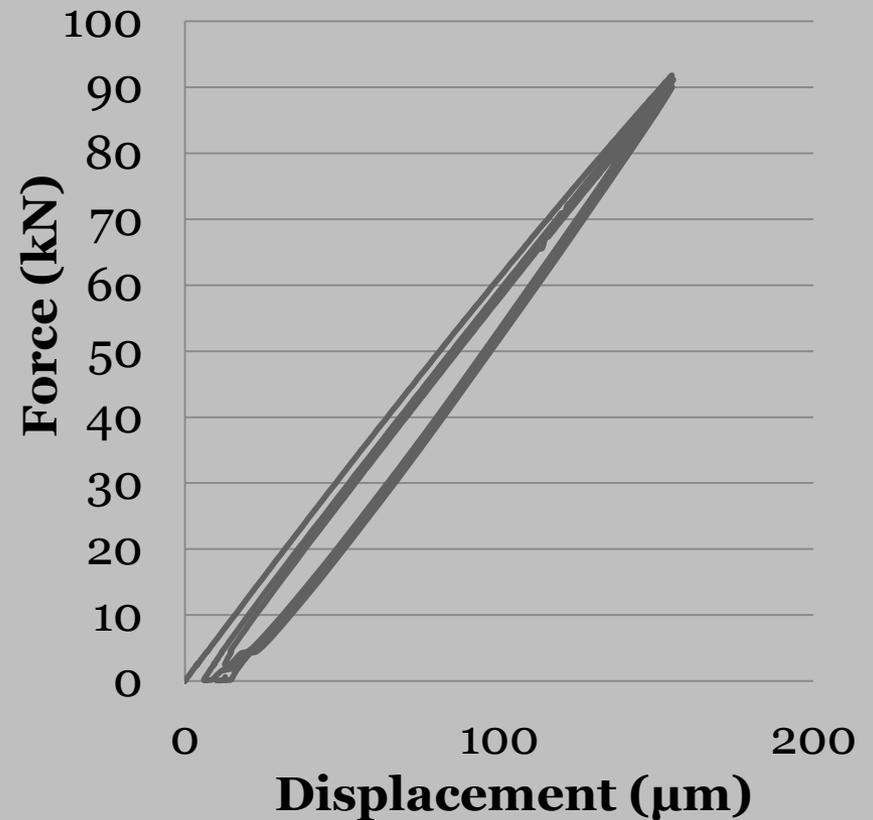


- the extent of the flexural strength reduction of polymer concrete is higher than the extent of compressive strength reduction;
- the extent of the flexural strength reduction of polymer concrete exceeds, up to a head load of 300°C, the strength reduction of concrete.

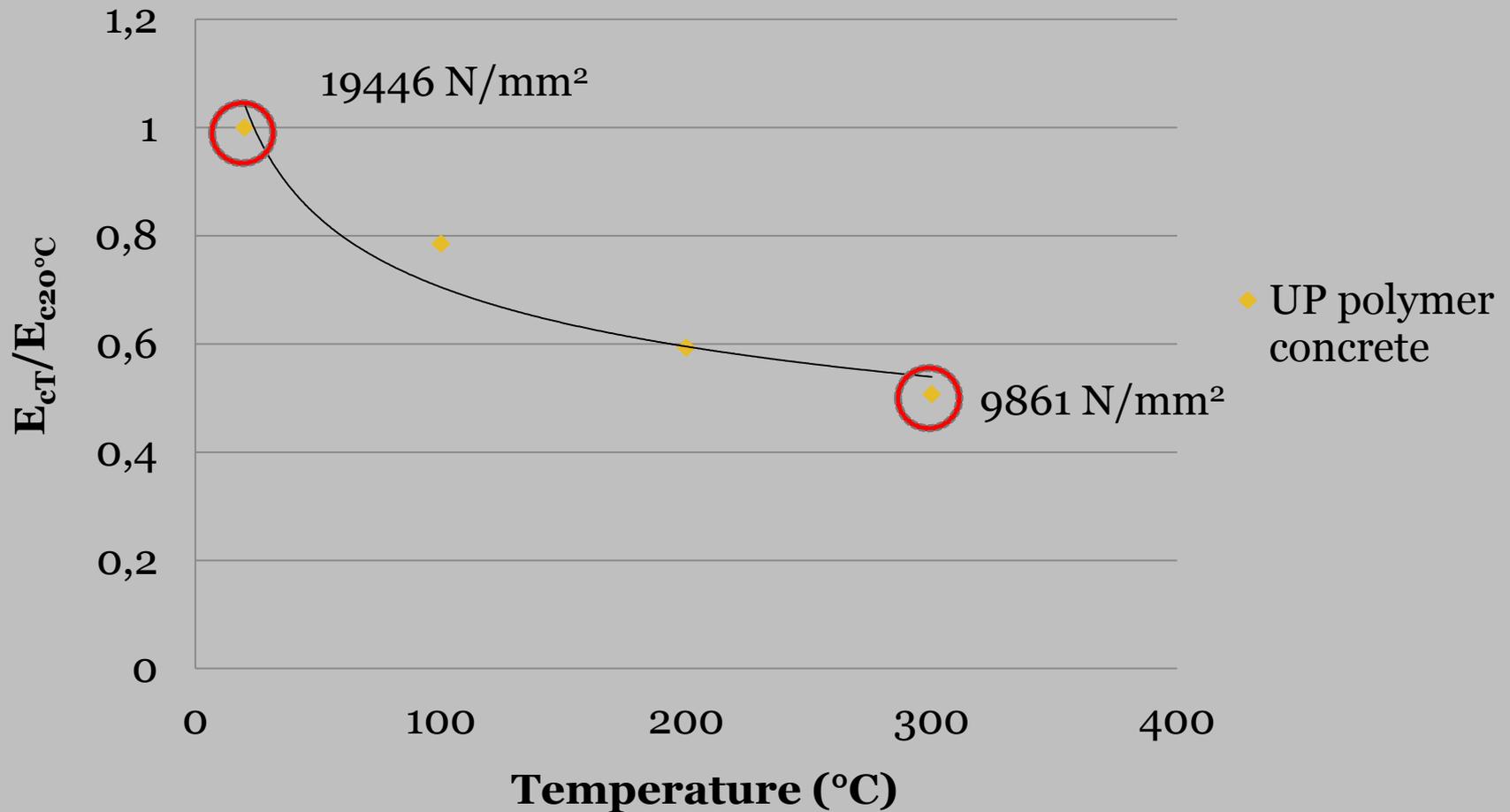
Modulus of elasticity



typical force – displacement curve



The residual values of the modulus of elasticity depend on temperature





Summary

This study examined the effect of high temperatures on UP polymer concrete. Experiments were conducted to detect the behaviour of UP polymer concrete at 4 different temperatures.

- the extent of the strength reduction of polymer concrete does not exceed, up to a heat load of 300°C, the strength reduction of concrete of the same strength;
- the tendency of the extent of the flexural strength reduction of polymer concrete and the extent of the modulus of elasticity reduction of polymer concrete are similar, but they show more significant decrease up to a head load of 300°C.
- **In continue:**
The UP polymer concrete had no fire resistance. Our future research will be extended in this direction.

Thank you for kind attention!



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