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BEHAVIOR OF INTUMESCENTS COATINGS

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SOMETHING TO KNOW ABOUT UPC:

The UPC is the University for people who contribute to imagine the future and move the world.

The Polytechnic University of Catalonia, Barcelona Tech (UPC) is a public institution of higher education and research, specializing in the fields of engineering, architecture and science.

In a highly creative context and commitment to the environment and change research projects, teaching and management of the UPC are based on the principles of freedom, justice, democracy, solidarity, cooperation, sustainability, efficiency, transparency and accountability social.

From the intellectual rigor, critical thinking, gender mainstreaming in knowledge, teaching innovation and entrepreneurship, the UPC is competent and professional people with skills and abilities to meet the present and future challenges.

The activity of their campuses and centers make a point of reference and, in complicity with the productive, an agent and engine of economic and social change, to add value to basic and applied research and technology and knowledge transfer society.

The Polytechnic University of Catalonia has scientific and technological infrastructures which are available to groups and research centers, researchers and students, professionals, companies and institutions.

THE UPC ORGANIZATION IS DIVIDED IN:

Students:

29.687 of 1th grades and 2nd cycles
3.011 of university masters
3.000 of doctorate
2.822 of continue research

Personal:

2.780 PDI (docent and investigator personal)
1.694 PAS (administration and servicer personal)

Where we are:

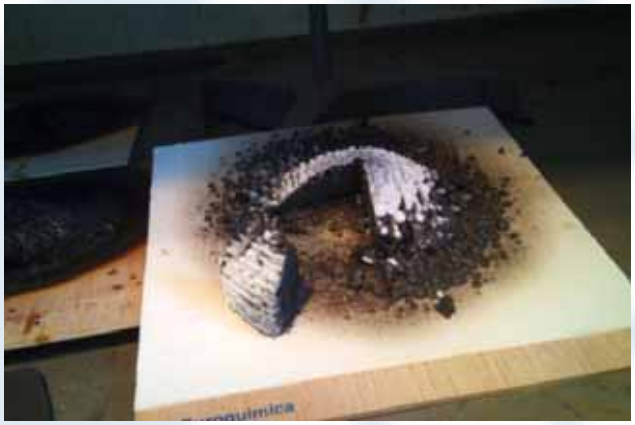
Settled in 11 campuses and territorial centers of Catalonia with 23 schools and faculties.

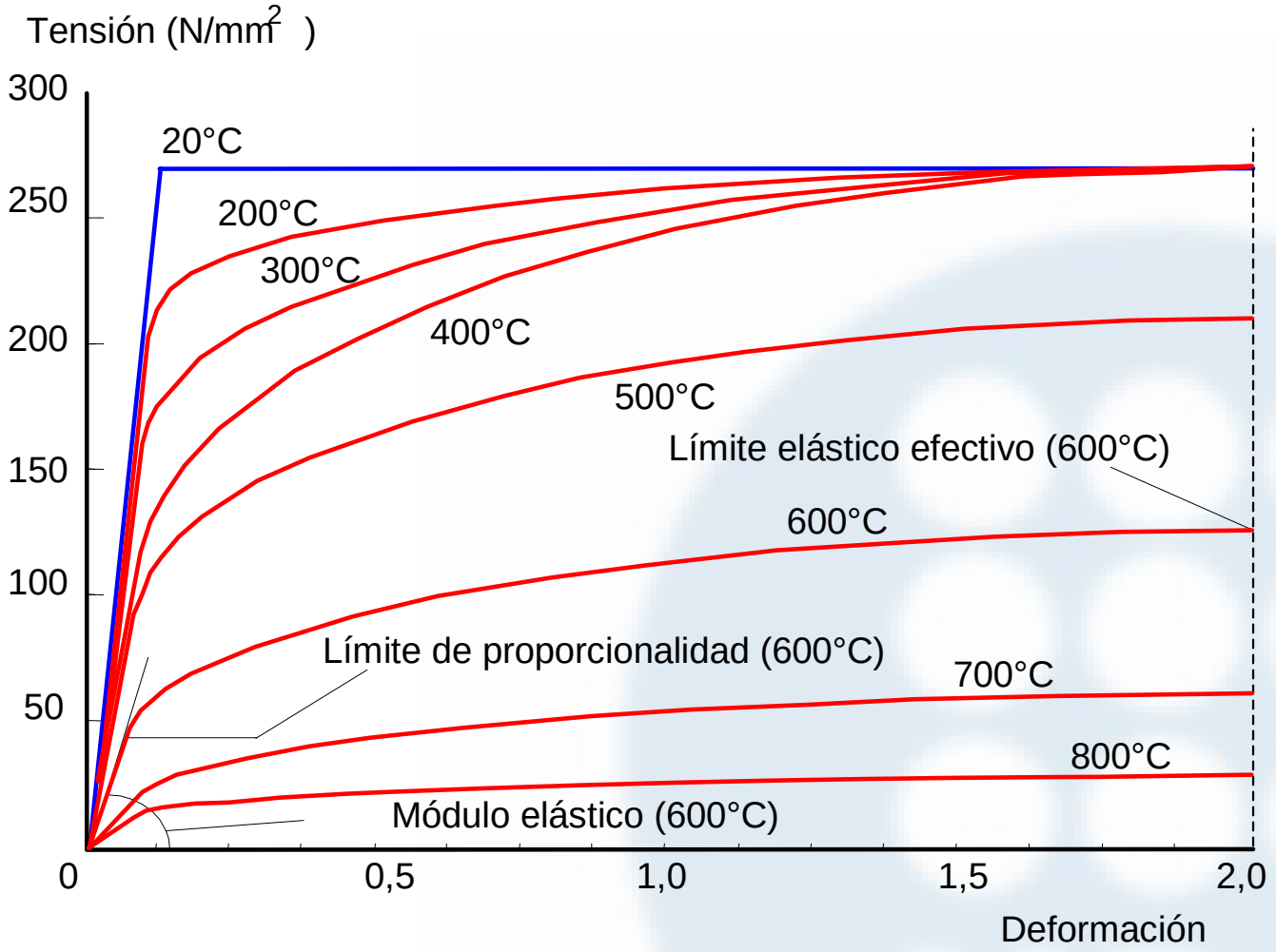
Investigation:

42 departments
6 investigation institutes
183 investigation groups
17 specific centers of investigation
19 investigation centers of TECNIO
19 linked investigation centers
64.164.414 € were admitted by I+D+I and technology transfer

INTRODUCTION OF INTUMESCENTS COATINGS:

In the 70's this technology started being developed and applied in steels and timbers to protect them from fire.




Tensión (N/mm2)
300
250
200
150
100
50
0
0,5
1,0
1,5
2,0
Deformación
20°C
200°C
300°C
400°C
500°C
Límite elástico efectivo (600°C)
600°C
Límite de proporcionalidad (600°C)
700°C
800°C
Módulo elástico (600°C)

PHASES OF INTUMESCENT COATINGS:

First of all there are some factors which define intumescent coatings:

a) Good adhesion to the painted structure:

It is essential because if the paint felt down it wouldn't protect the structure during the fire. The adhesion becomes a critical factor in the intumescent process because chemical reactions occur in this process may affect the primer's adhesion. This is the reason why each type of paint needs a specific primer and studies are made with both.

b) Painting consistence during and after the intumescent process:

Once when the intumescent process has finished the paint becomes porous and very inconsistence.

c) Good solvent evaporation during the paint's drying:

Because if solvent has been not well solved it's able to contribute in a fire affecting directly in the steel protected.

The method of paint application is essential to ensure the features listed above, which is why every company that research, produce and sale intumescent paints must specify in detail the method to apply it.

PHASES OF INTUMESCENT COATINGS:

1) Melting:

2) Intumescence:

3) Char formation:

4) Char degradation:

VISUAL TEST:

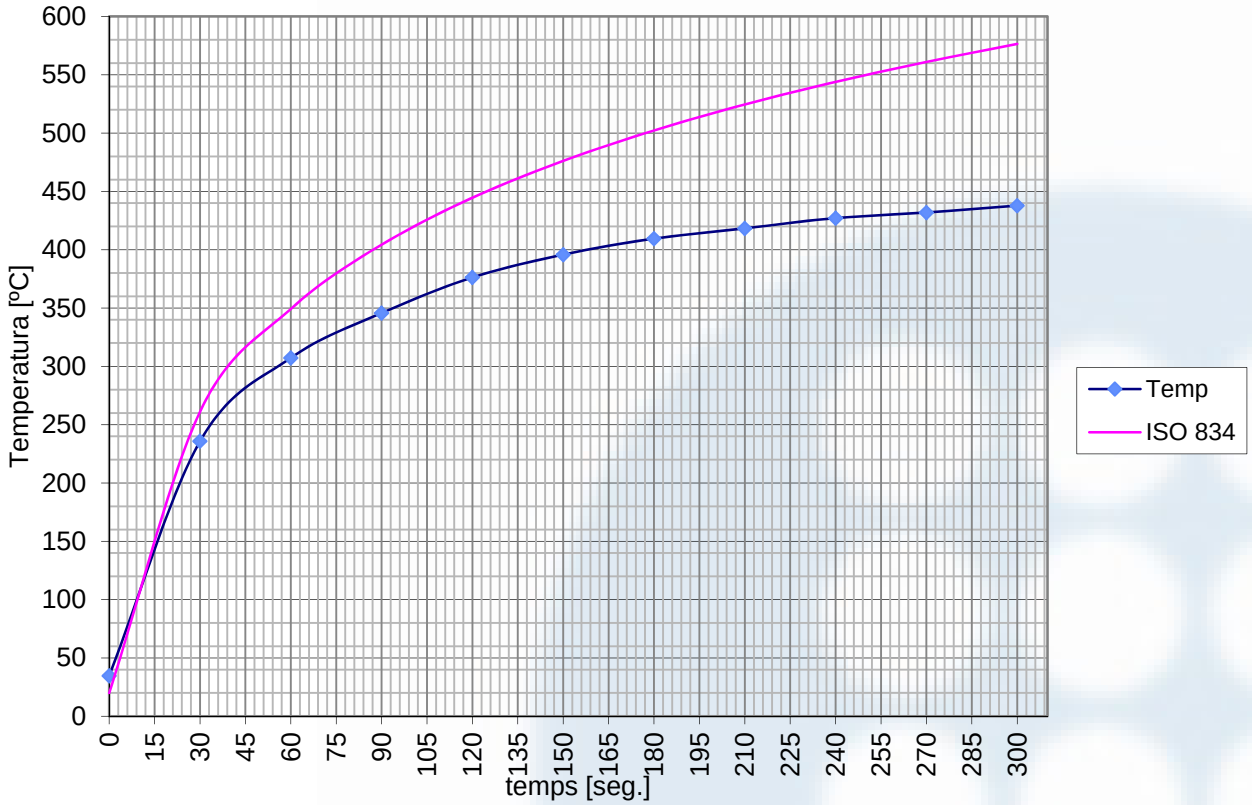
Steel thickness: 1mm
Intumescent coating thickness: 0.1mm

28 sec / melting

1min 22 sec / exp = 23.7mm

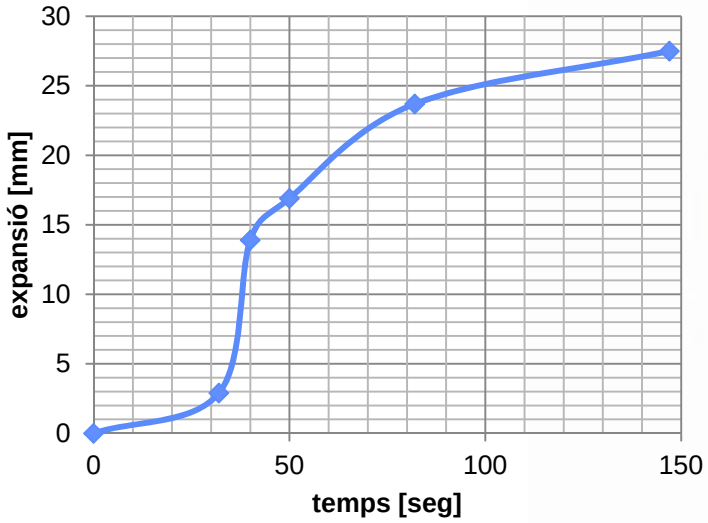
2min 27 sec / end exp. = 27.5mm

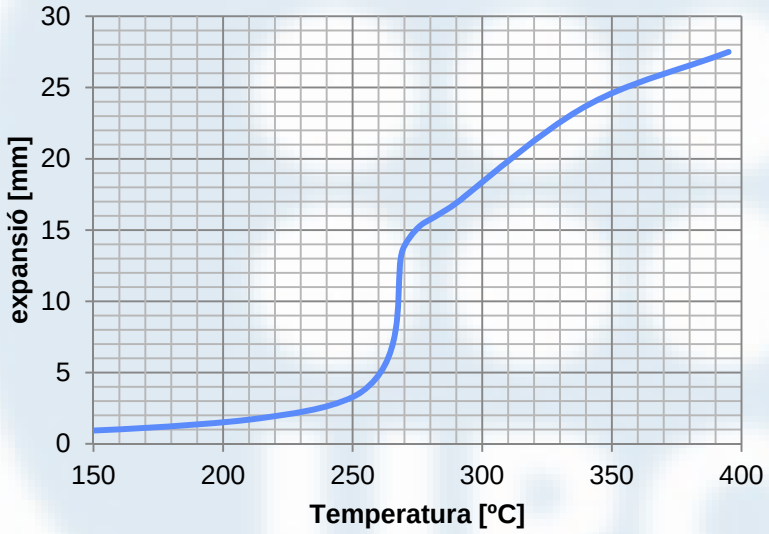
VISUAL TEST



Comparation between T_{iso} and $T_{resistor}$

t [sec]	Expansion [mm]	Temp [ºc]
0	0	34,7
32	2,9	245
40	13,9	270
50	16,9	290
82	23,7	340
147	27,5	395





WHAT IS THIS PROJECT ABOUT:

The aim of this project is to determine the conductivity of the intumescent coating and try to simulate this behavior with ANSYS software considering 3 parameters:

- steel thickness
- IC thickness
- Temperature

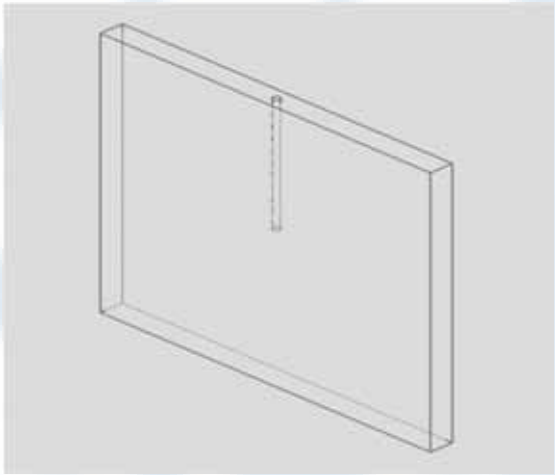
FURNACE TEST – EQUIPMENT

Furnace: 50x30x30 cm
Power: 5kW

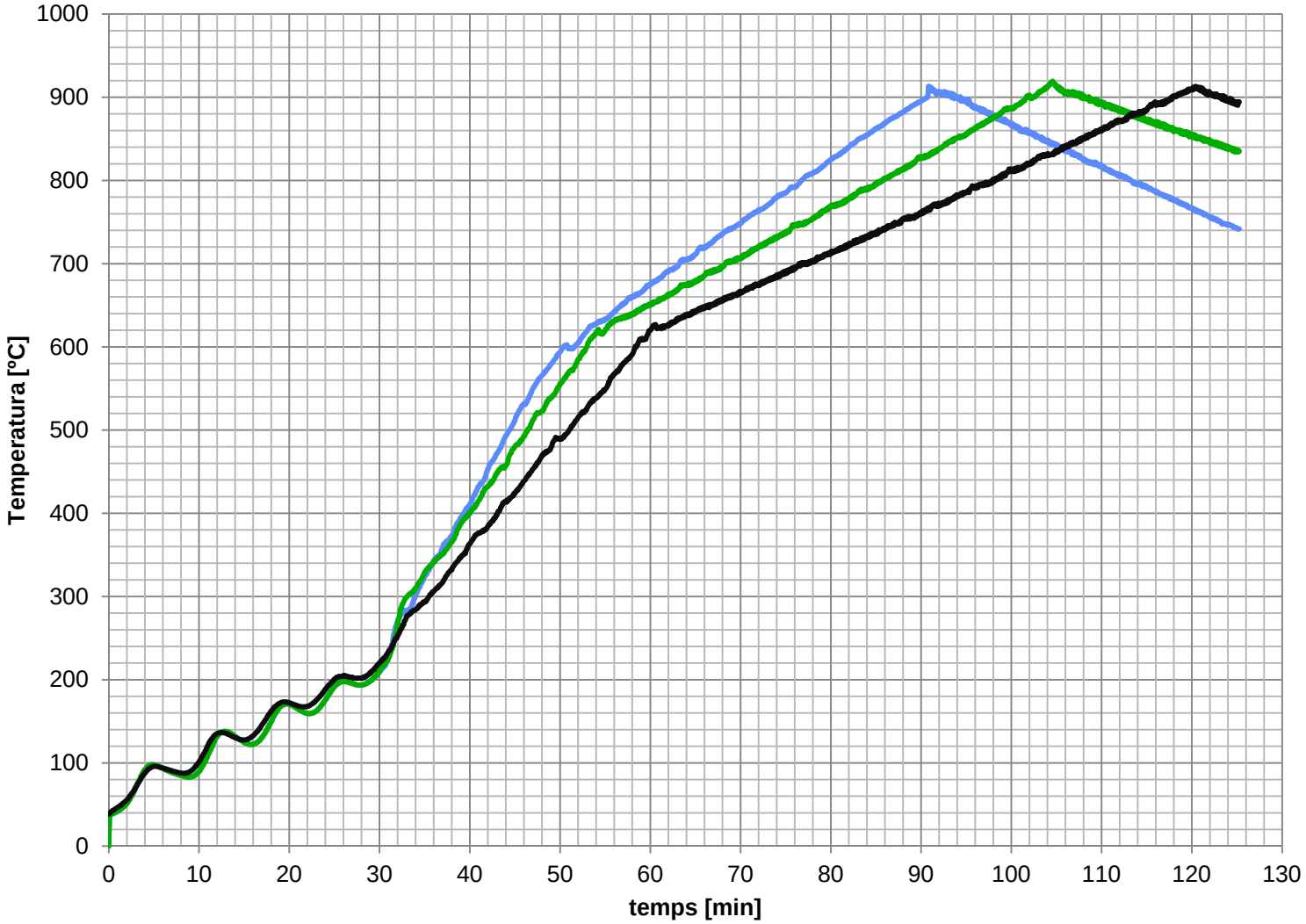
Insulating material: Calcium Silicate

Steel samples:

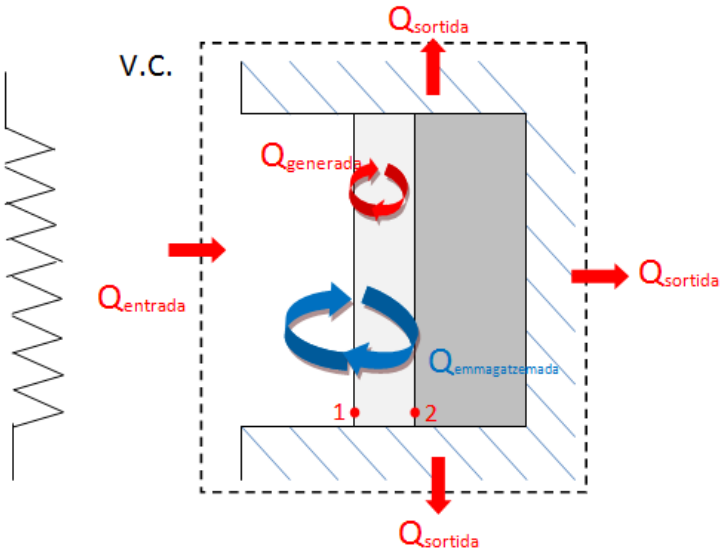
I.C. thickness [mm]	
0,6	
1	
1,2	



TEMPERATURE



THEORY :



$$Q_{entrada} + Q_{generada} - Q_{sortida} = Q_{emmagatzemada}$$

$$Q_{entrada} = Q_{emmagatzemada}$$

$$\frac{\partial}{\partial x}\left(k\frac{\partial T}{\partial x}\right) + \frac{\partial}{\partial y}\left(k\frac{\partial T}{\partial y}\right) + \frac{\partial}{\partial z}\left(k\frac{\partial T}{\partial z}\right) + \dot{q} = \rho c\frac{\partial T}{\partial t}$$

$$Q_{pintura} = (\lambda_{pintura} \times A) \times (T_1 - T_2) \Big/ L_{pintura}$$

$$Q_{acer} = \rho \times V \times C \times \frac{\Delta T}{\Delta t}$$

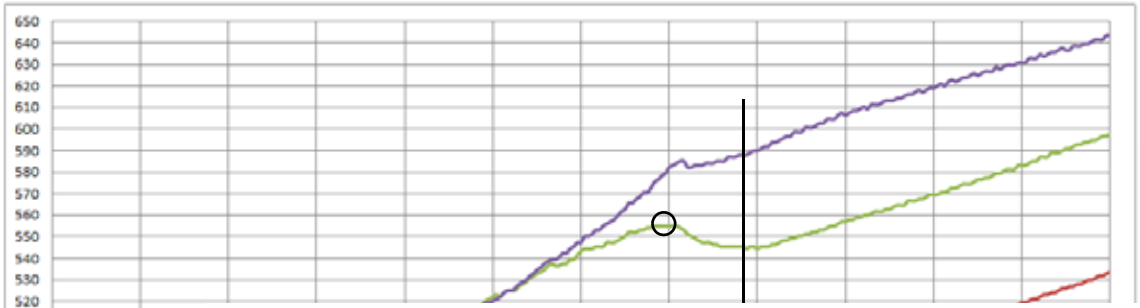
$$\lambda_{pintura} = (\rho \times g_{acer} \times C \times \frac{\Delta T}{\Delta t}) \times L_{pintura} \Big/ (T_1 - T_2)$$

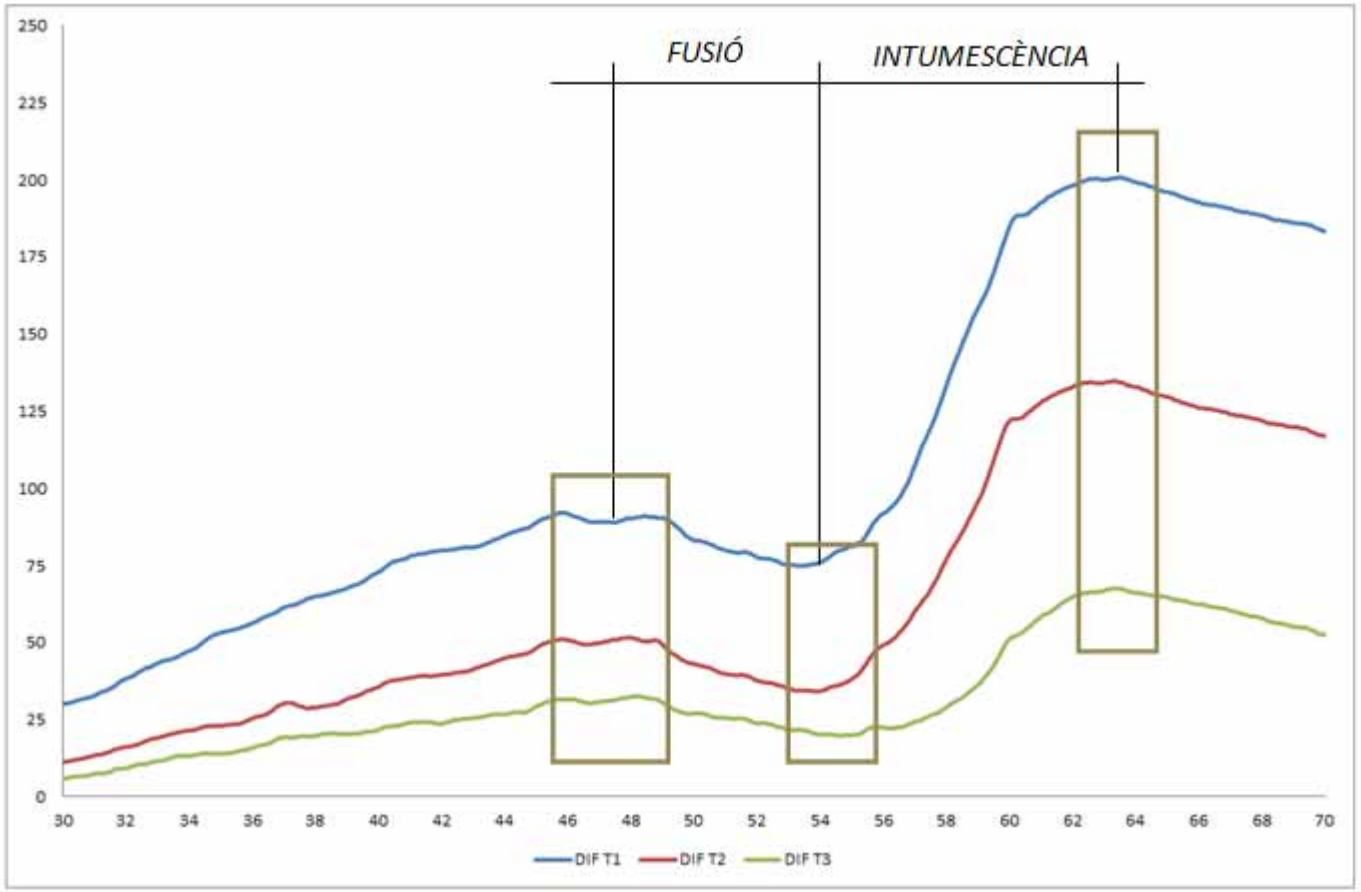
RESULTS

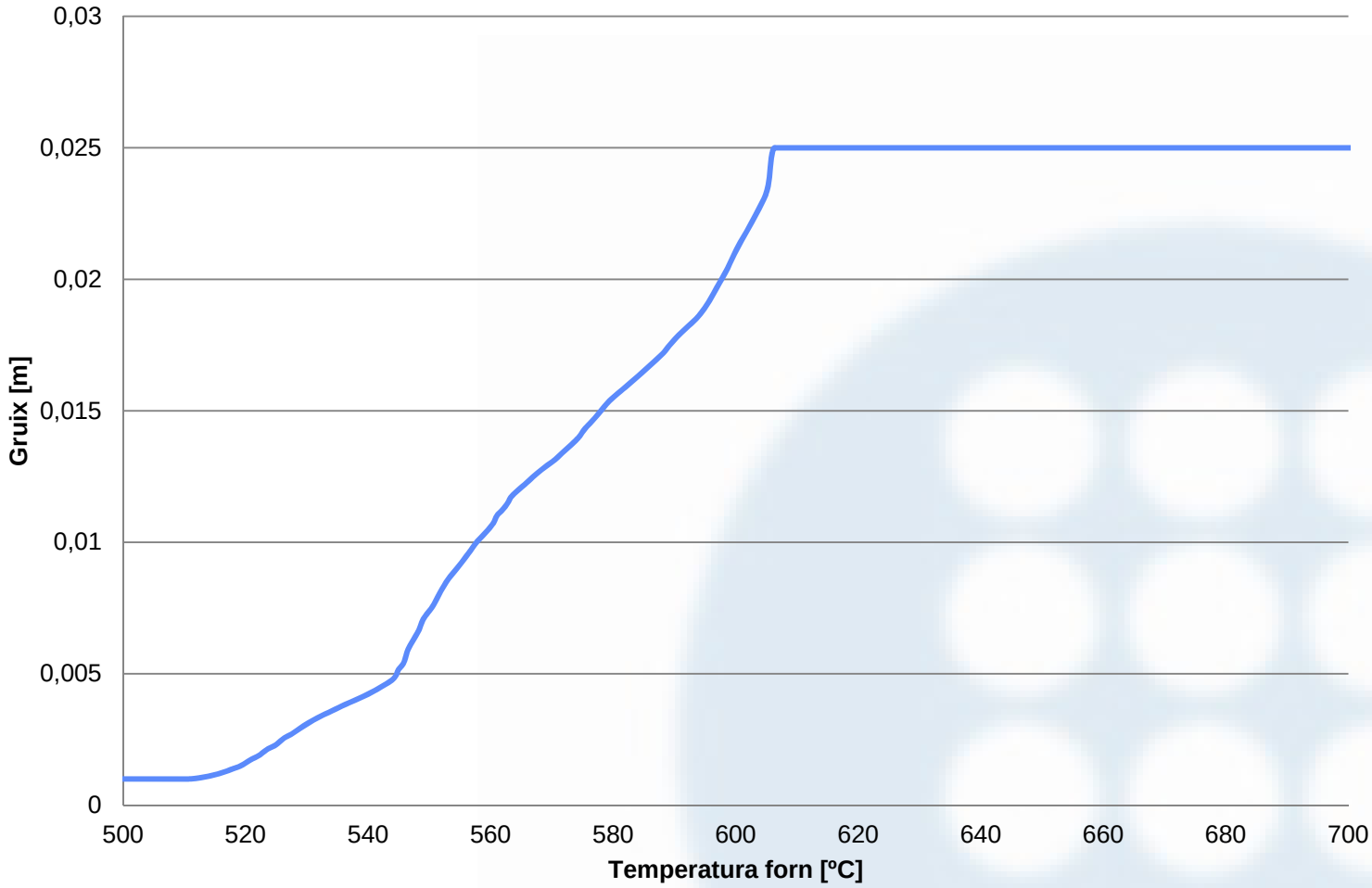

Melting / Intumescence
Temperature [ºC]
time [min]
T furnance
T steel
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75

Cost Action IFER

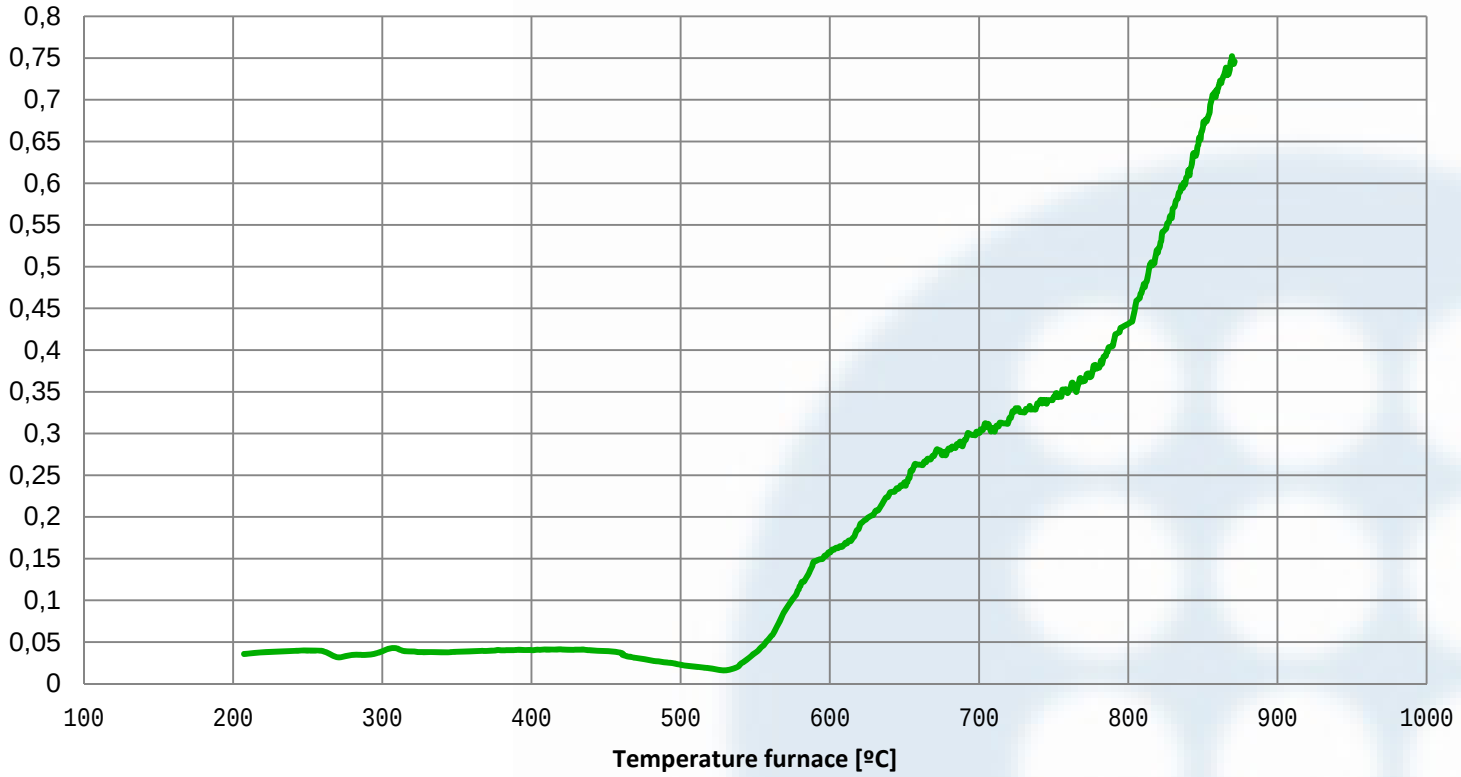
Integrated Fire Engineering and Response






0,03
0,025
0,02
0,015
0,01
0,005
0
Gruix [m]
500
520
540
560
580
600
620
640
660
680
700
Temperatura forn [ºC]

RESULTS: conductivity



Cost Action IFER

Integrated Fire Engineering and Response

Thanks for your attention

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