COLLABORATIVE WORK BETWEEN ACADEMIA AND INDUSTRY

Rafael Colás

Budapest
November, 2019

Universidad Autónoma de Nuevo León

Public state University in the Northwester state of Nuevo León, Mexico.

Poor Mexico, so far from God and to close to United States (*Pobre de México tan lejos de Dios y tan cerca de Estados Unidos*).

Porfirio Díaz (1830-1915).

Poor of our Mexico, so close to football and so far from science (*Pobre México nuestro tan cerca del futbol y tan lejos de la Ciencia*).

Carolina Aranda Cruz (10 years), june 2007.

Universidad Autónoma de Nuevo León

Philosophy and Grammar Chairs in 1703.
Law Chair in 1824.
Medicine Chair in 1828.
***Colegio Civil* (Civil College) funded in 1857.**
***Universidad de Nuevo León* created in 1933.**
University Autonomy conceded in 1971.

Nowadays:
204,000 students,
110,000 bachellor,
10,000 postgraduate,
6,900 academicians,
26 Faculties,
25 Preuniversity schools,
4 Industrial schools,
41 RDi Centres.

www.uanl.mx

Facultad de Ingeniería Mecánica y Eléctrica

Industrial School Alvaro Obregón in 1930.
Faculty established in 1947.

Nowadays:
19,200 students,
1,200 postgraduate,
520 academicians,
11 B.Eng. degrees,
3 specialities,
10 master programs,
3 doctoral programs.
4 RDi Centres

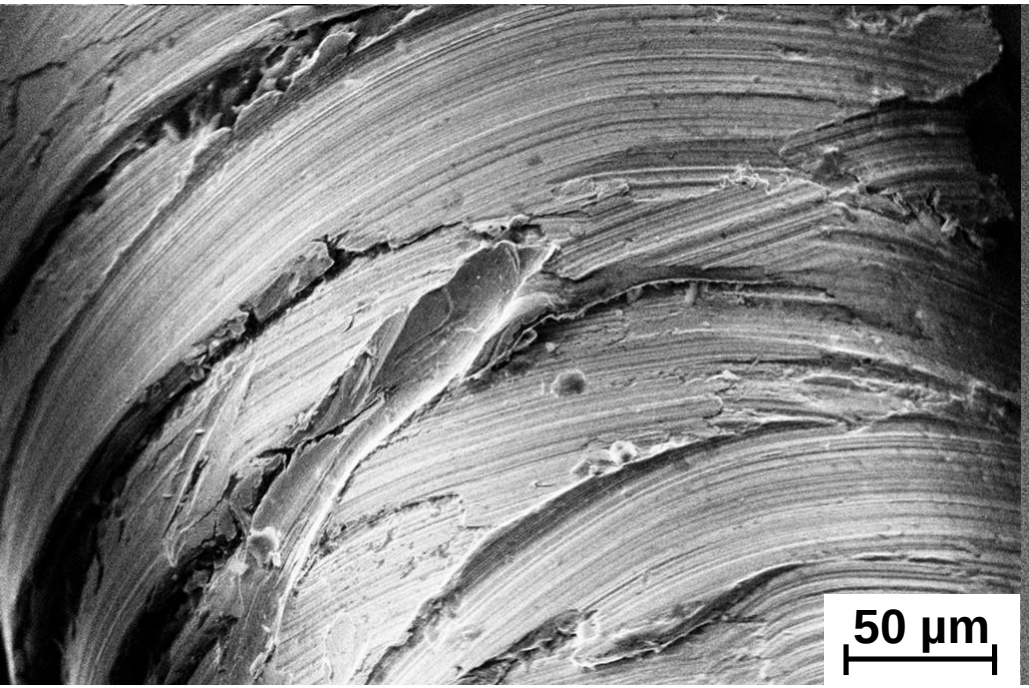
www.fime.uanl.mx

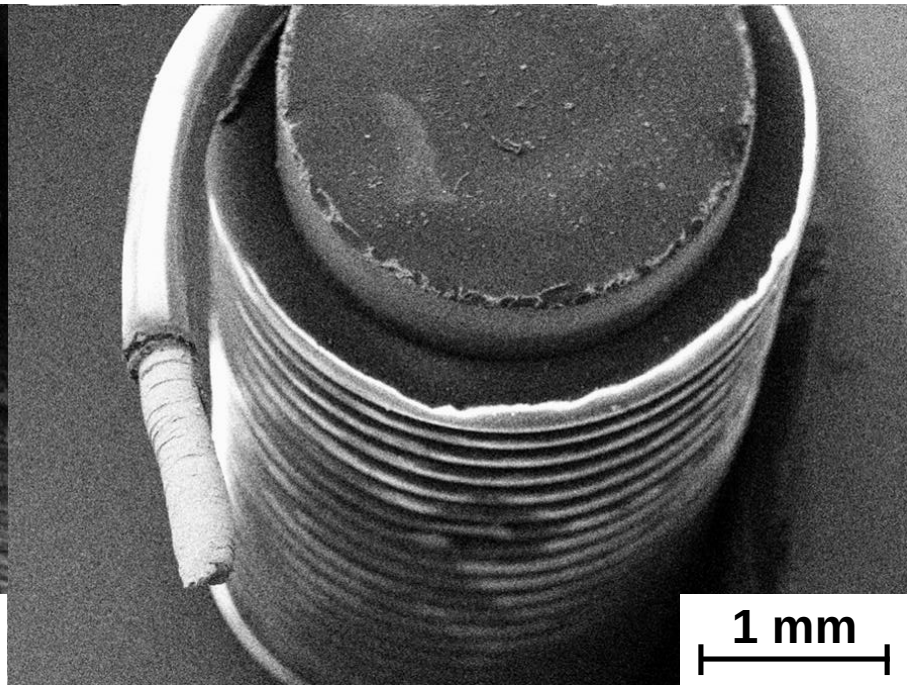
Working model

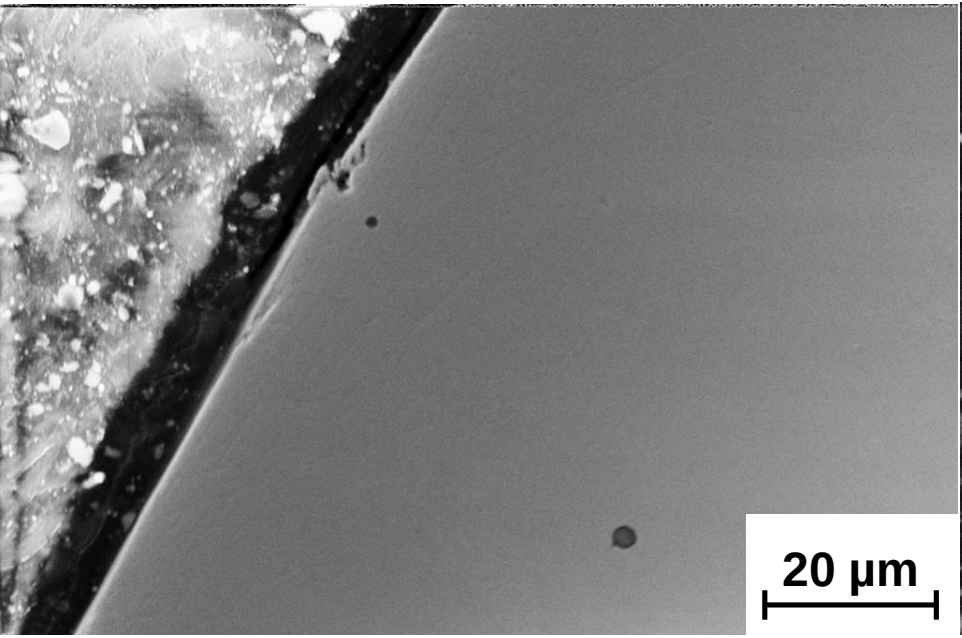
The University approaches industry with the aim of establishing partnerships to carry out applied research and technological development.

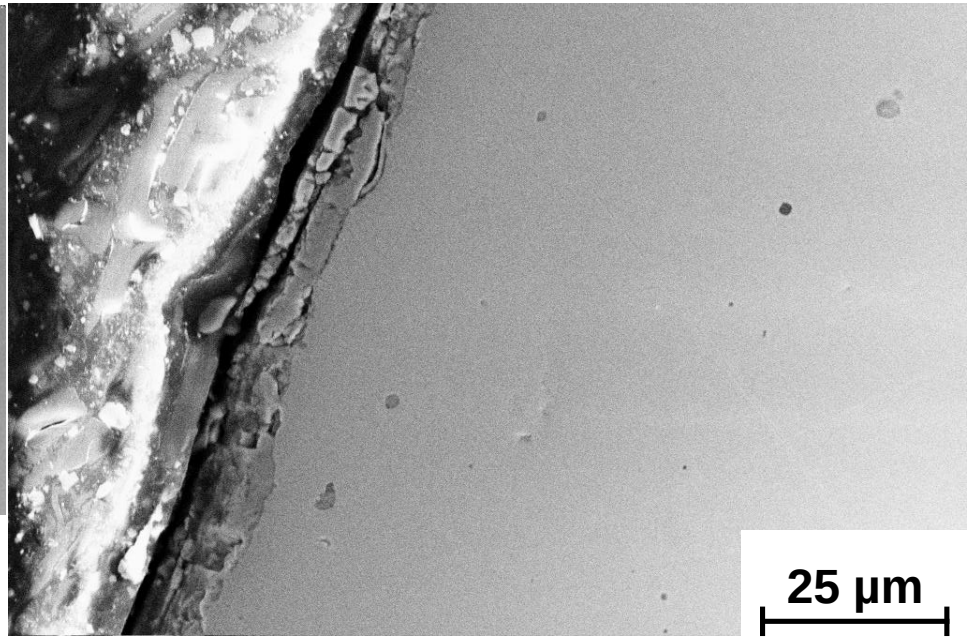
The duration, the degree of the participants, the experimental or analyses procedures and the confidentiality of the results are established.

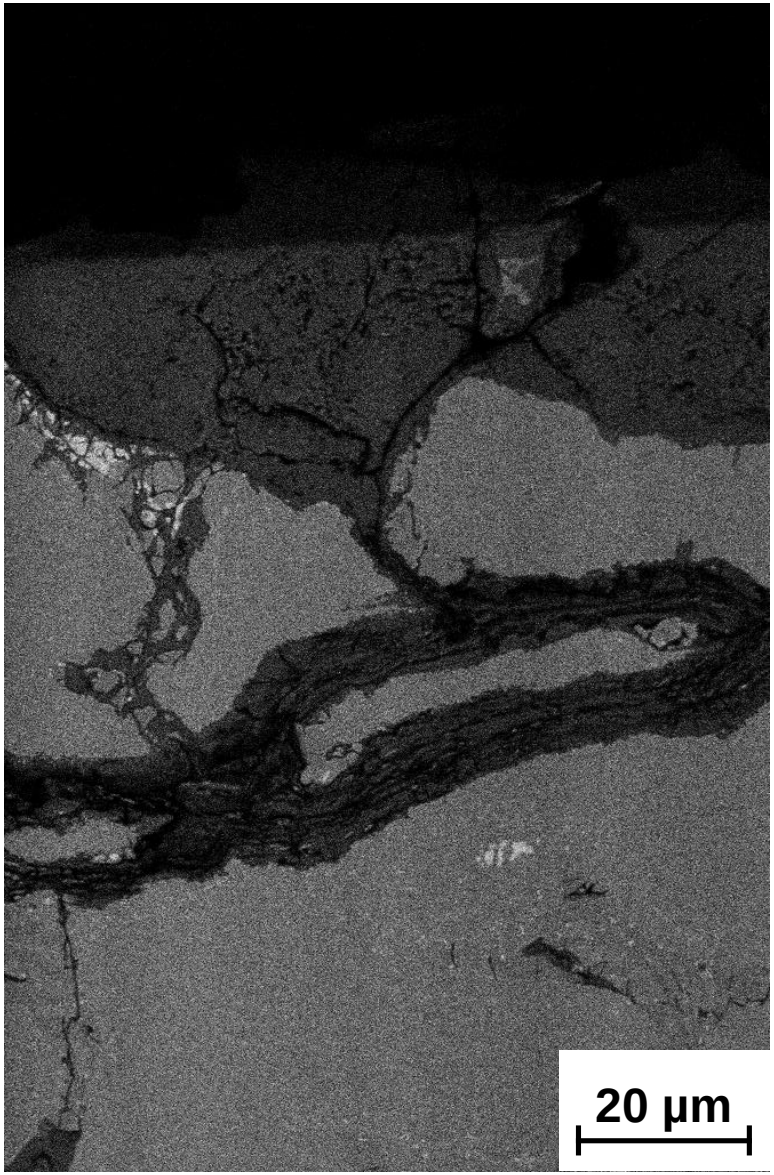
It is required to distinguish between services (product and process characterization, failure analysis, etc.) or consultancy, which provide a good source for external finance, but limit the direct collaboration of students or young researchers.

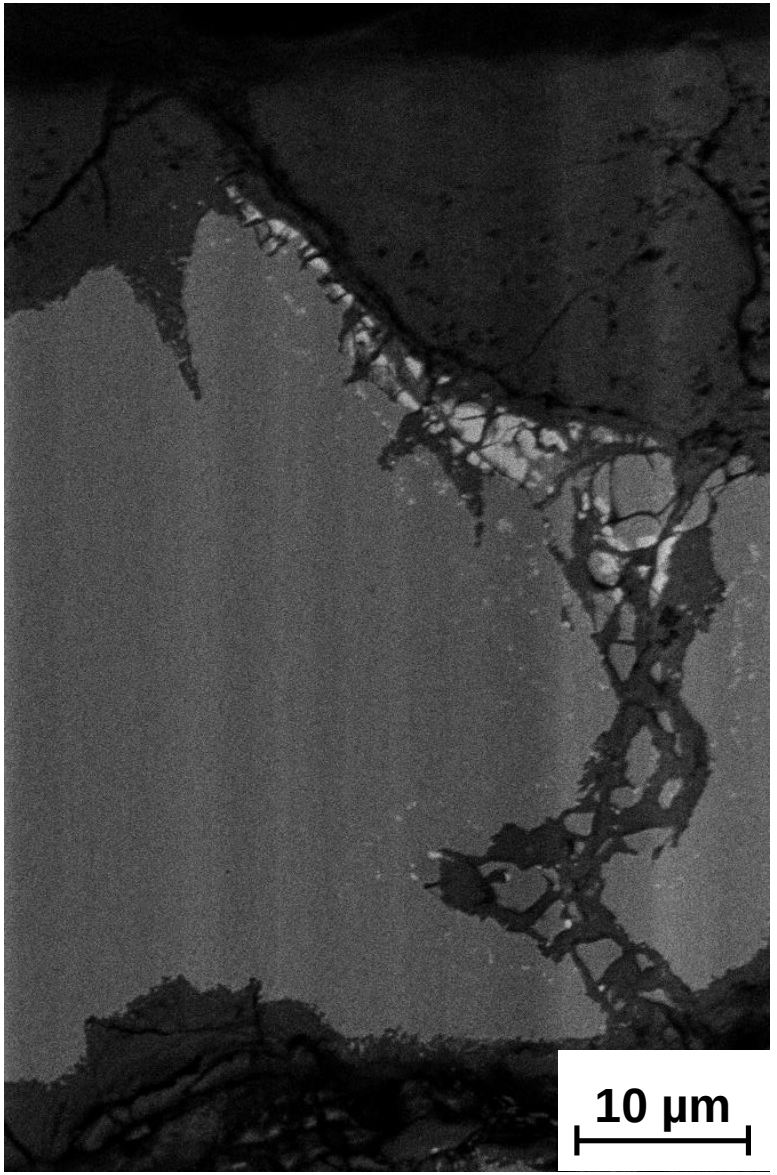

50 µm


1 mm

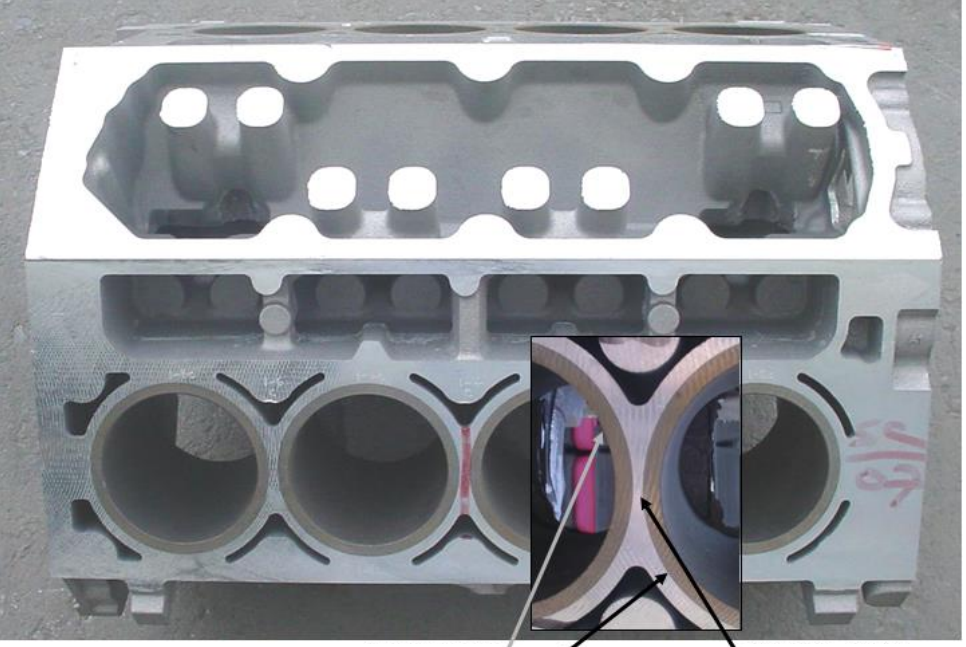

20 µm

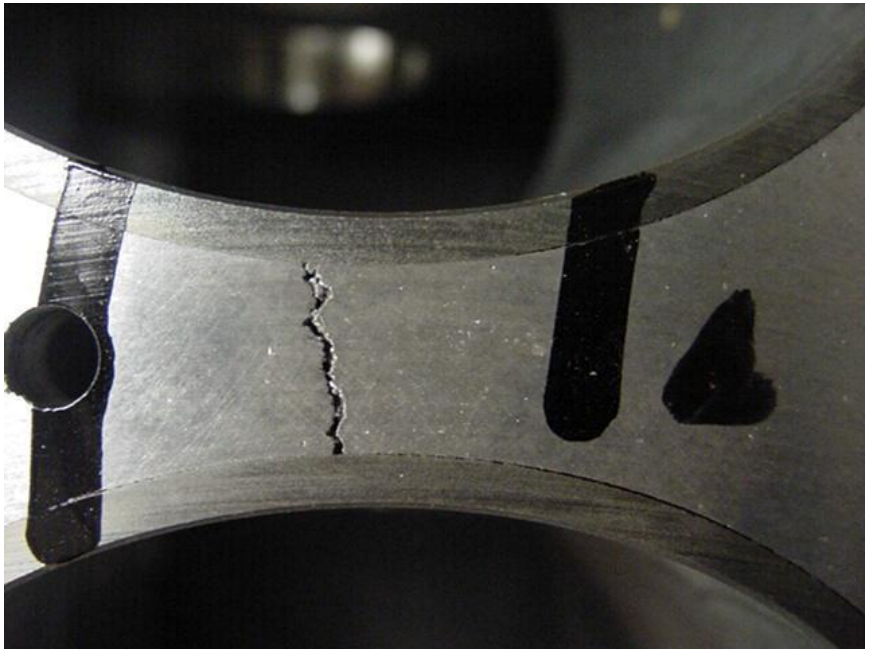

25 µm

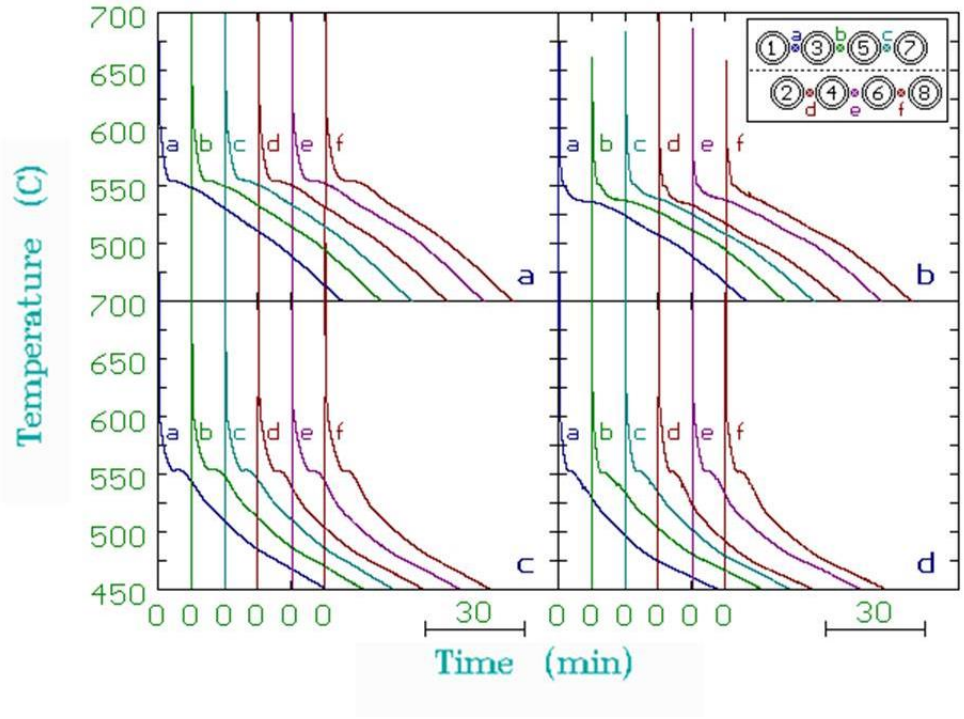




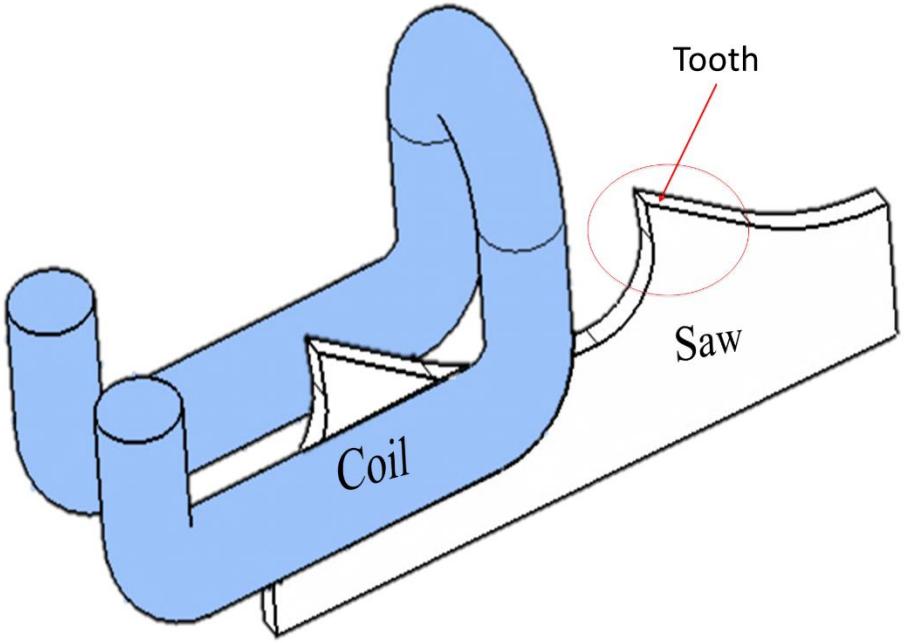
R. Colás, J. Ramírez, I. Sandoval, J.C. Morales and L.A. Leduc, Damage in hot rolling work rolls. Wear, 230 (1999), 56-60.
V. González, P. Rodríguez, Z. Haduck and R. Colás, Modelling the oxidation of hot rolling work rolls. Ironmaking Steelmaking, 28 (2001) 470-473.

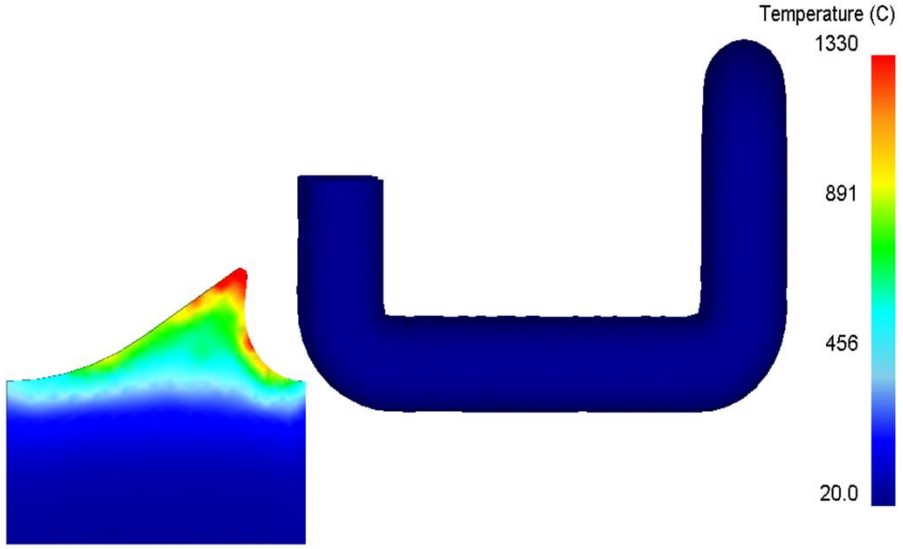


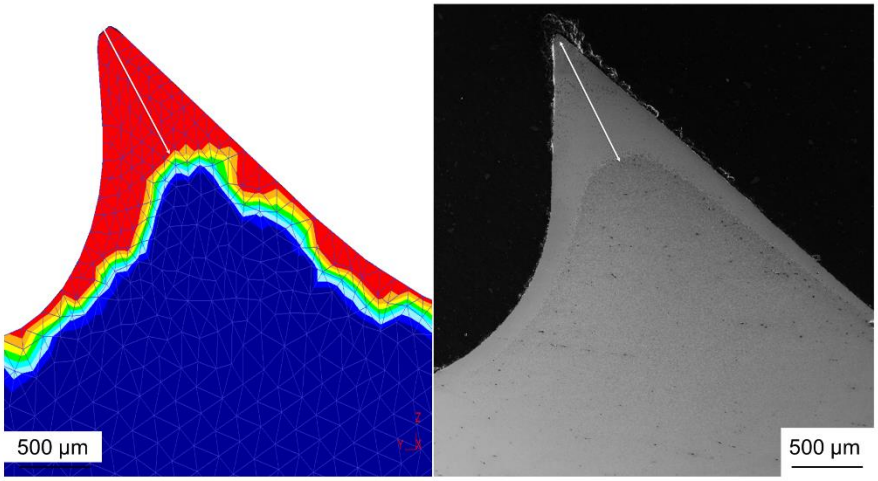




R. Colás, A. Rodríguez, J. Talamantes and S. Valtierra, Solidification analysis of aluminium engine block. Int. J. Cast Met. Res., 17 (2004) 332-338.







H. Torres, F.A. Pérez-González, O. Zapata-Hernández, N.F. Garza-Montes-deOca, J.H. Ramírez-Ramírez, Z. Fried, I. Felde, M. Réger and R. Colás, Modelling the induction hardening of high carbon saw blades. Mat. Perf. Char., 8 (2019) 261-271.

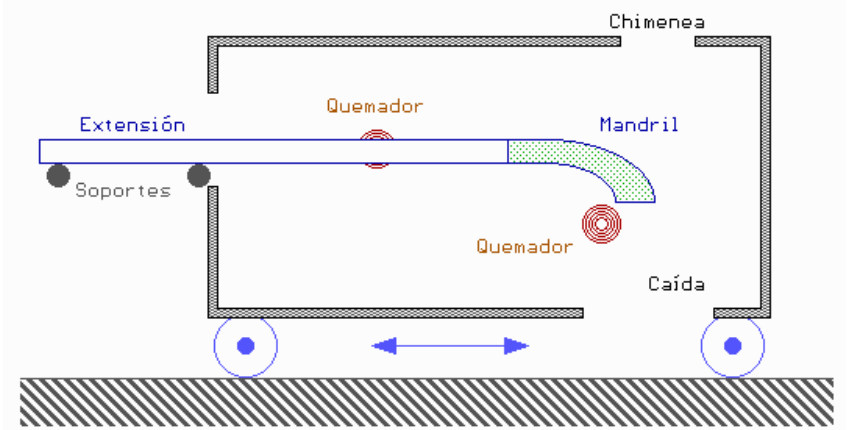
Participation of students is encouraged in research projects, to get their academic degree.

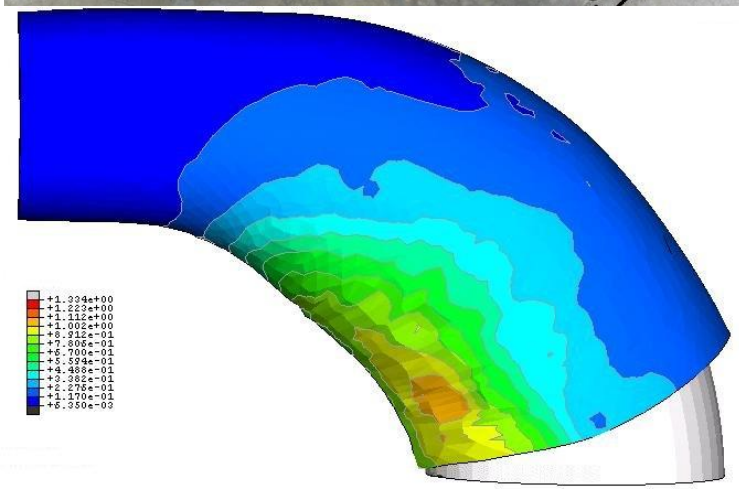
- Undergraduate students collaborate in short projects, under six months.
- Master students are assigned to projects that last from 12 to 18 months.
- Doctoral students participate for longer than 24 months.

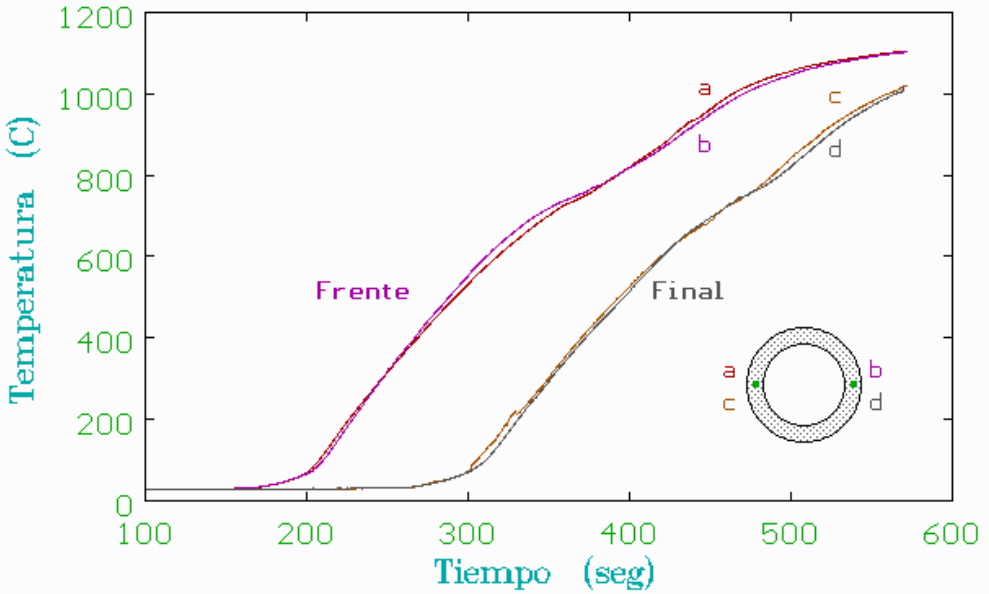
Permission for publication the results are arranged with the companies from the beginning.

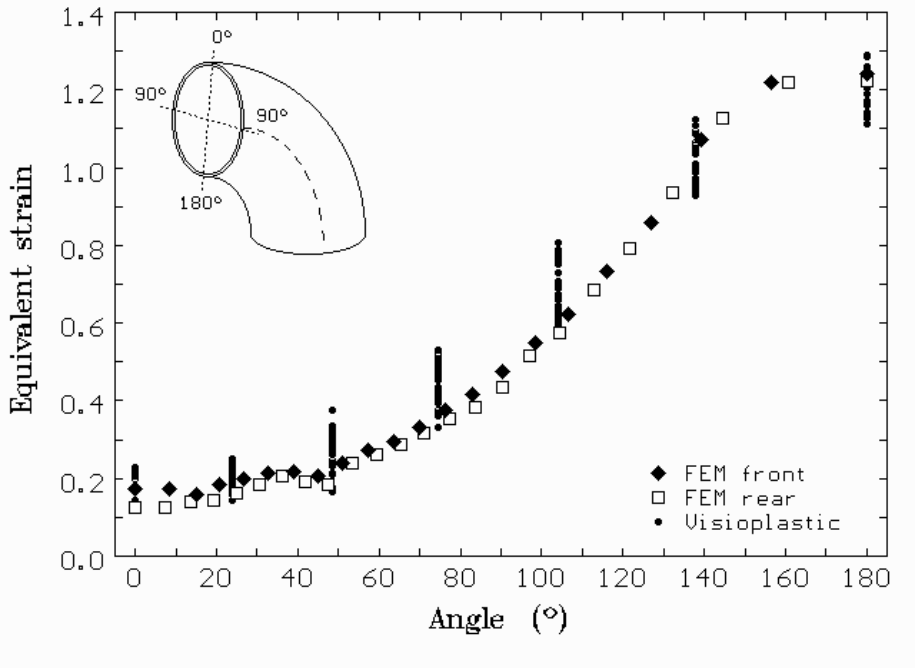
Care is taken to avoid publication of material that may be considered as sensitive or of commercial value.

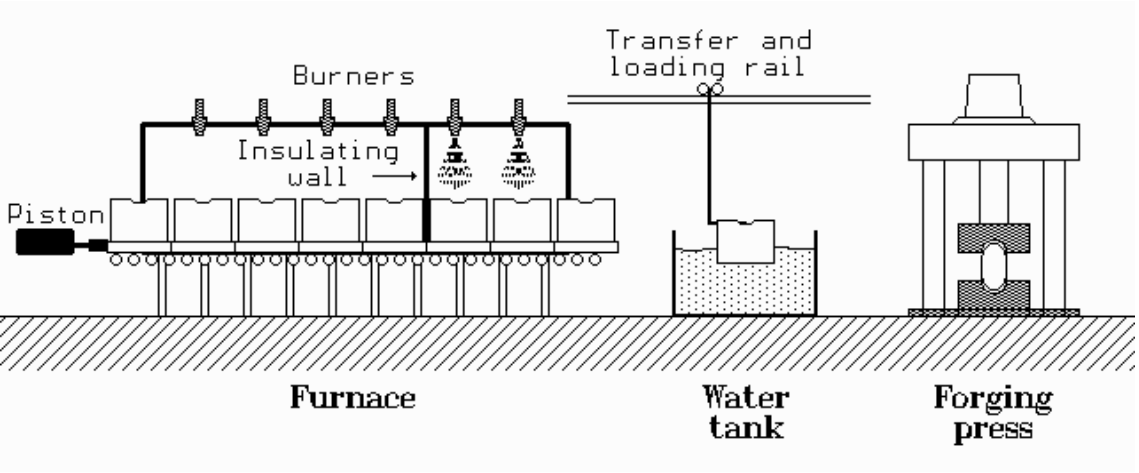
Hot forging of steel fittings

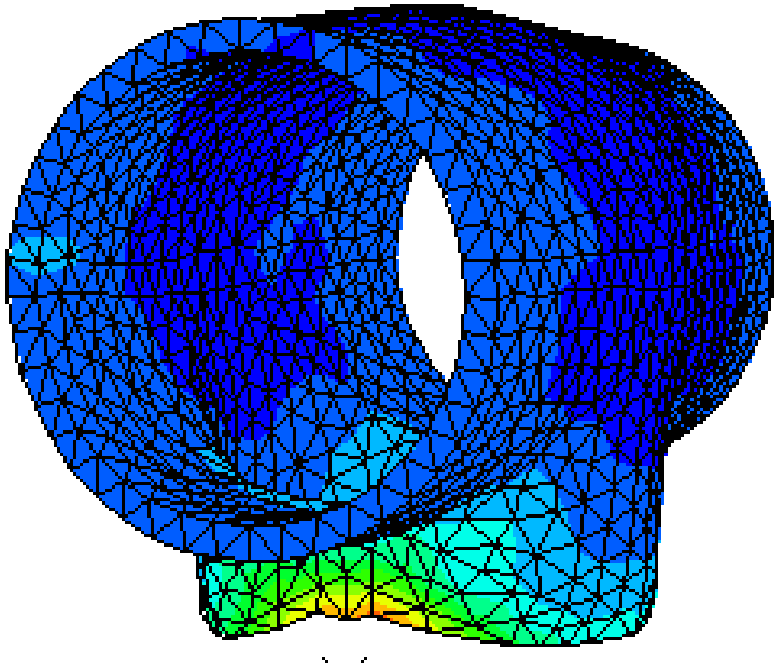












A. Rodríguez, M. Mezzetti, R. Colás, G. Olvera and P. Fodor, Forming of seamless pipe elbows improved through analysis of heating profiles. Ind. Heating, 65 (1998) 51-53.

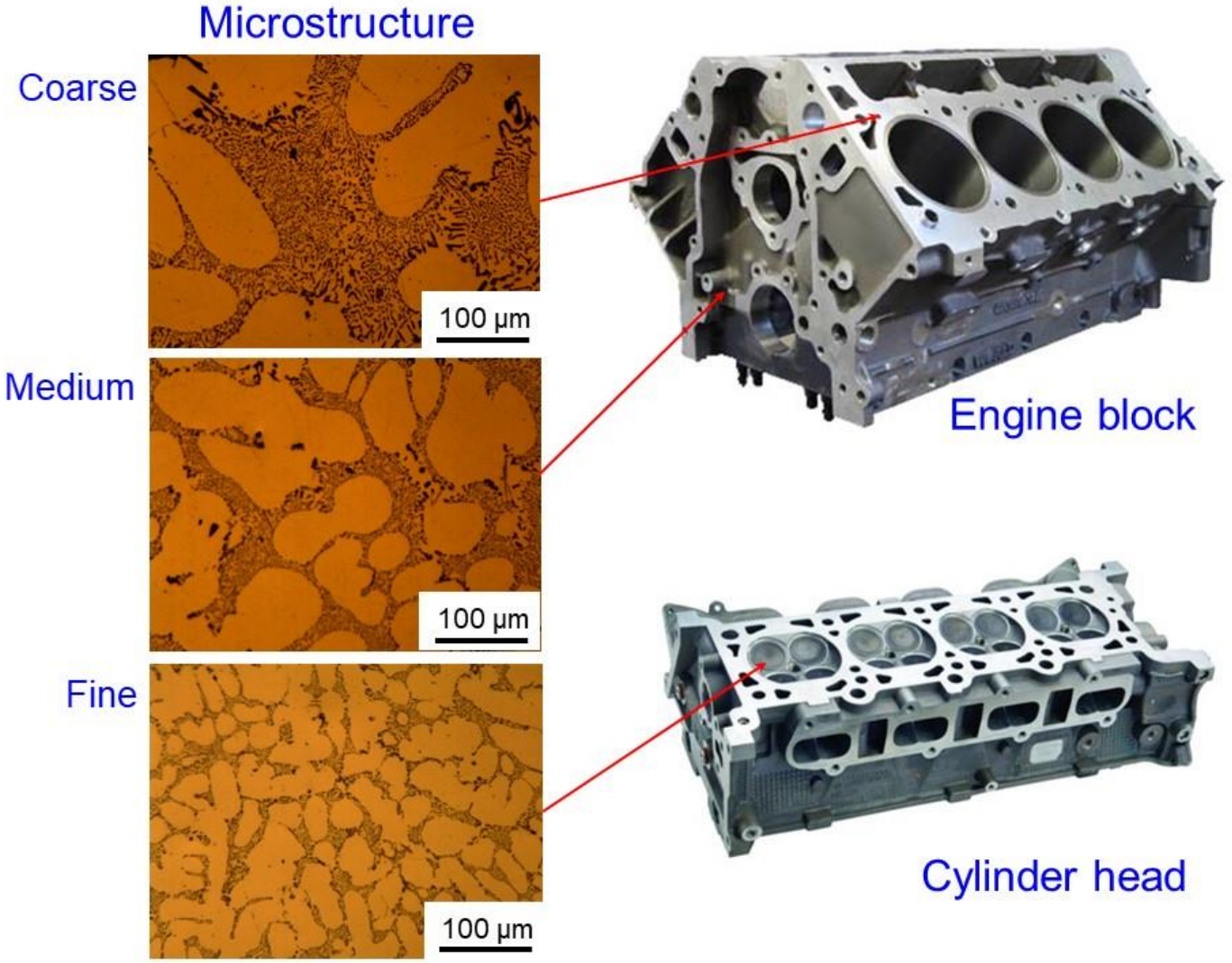
A. Rodríguez, R. Colás, G. Olvera and P. Fodor, Strain distribution analysis of hot forged seamless pipe fittings. Mat. Sc. Techn., 16 (2000) 171-174.

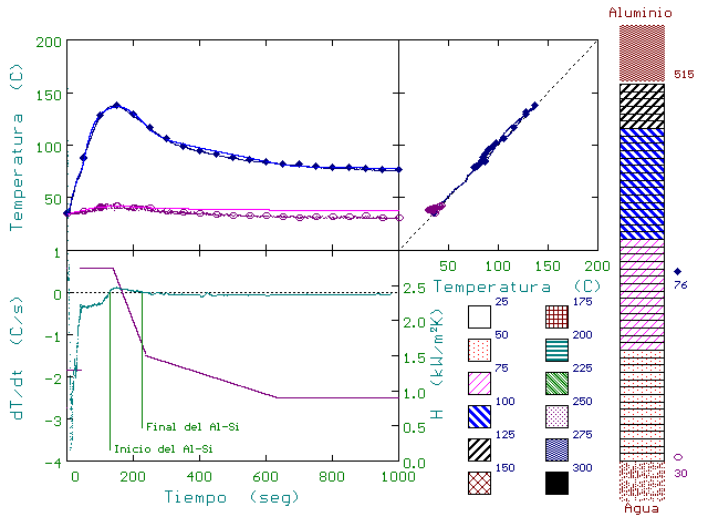
A. Rodríguez, M. Mezzetti, R. Colás, G. Olvera and P. Fodor, forming of seamless pipe fittings. J. Mat. Proc. Techn., 120 (2002) 432-437.

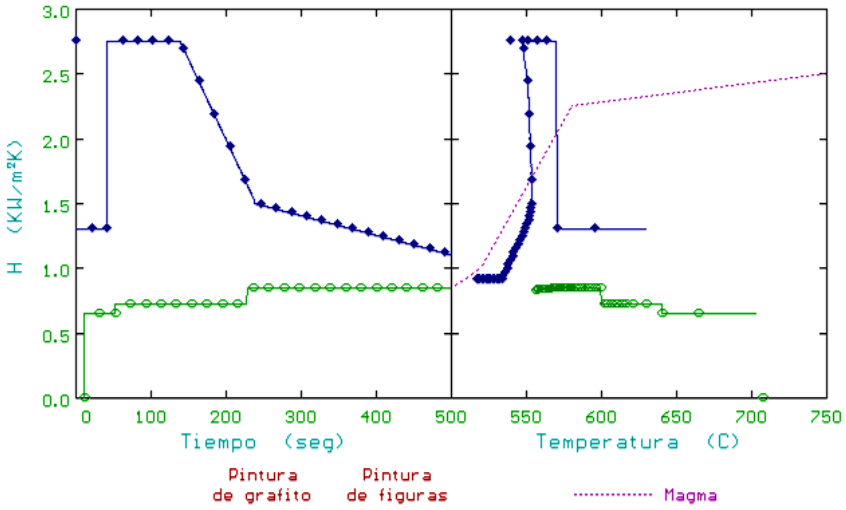
C. Lázaro-Naranjo, M.P. Guerrero-Mata, J. Martínez, P. Fodor and R. Colás, Hot forging of fittings made from seamless pipe. Ironmaking and Steelmaking, 31 (2004) 319-324.

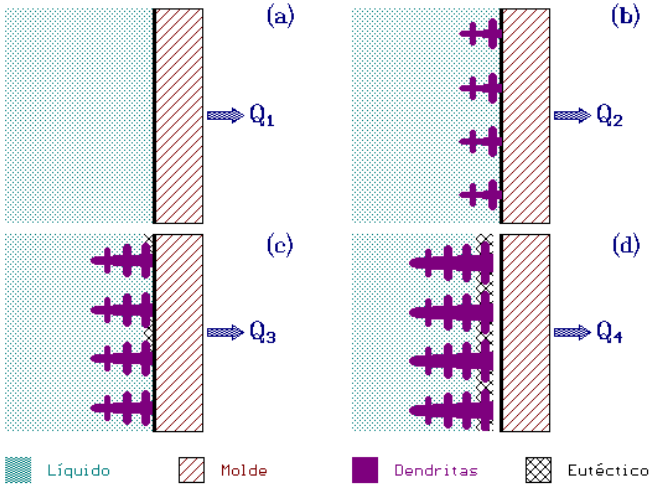
Manufacturing of automotive castings

Solidification of aluminium alloys depends on the heat extraction conditions. A wide range of microstructure can be expected within pieces.

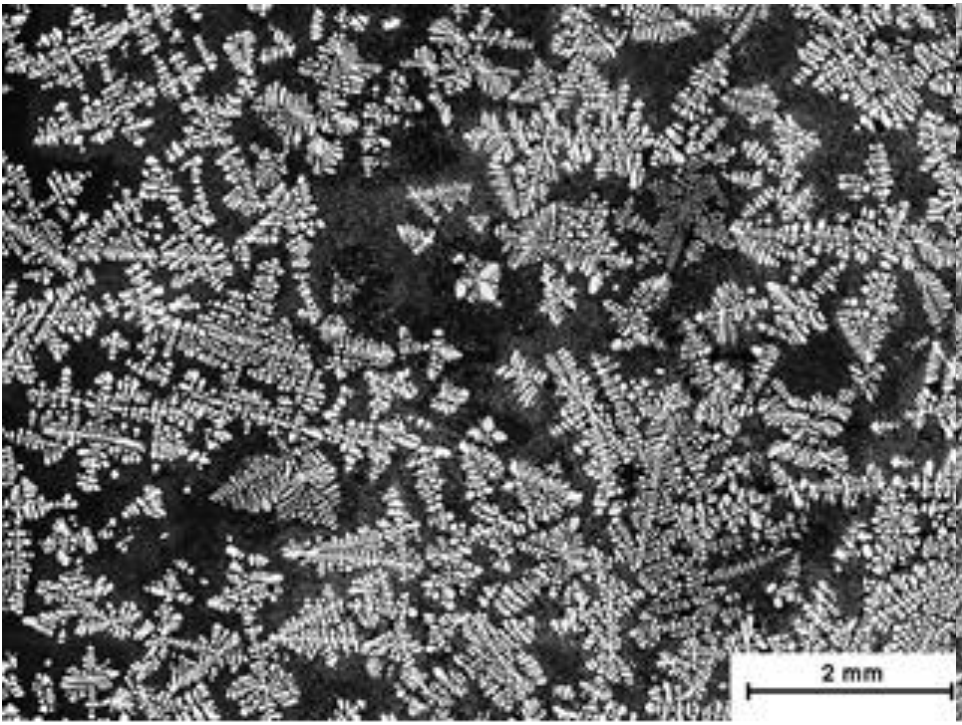




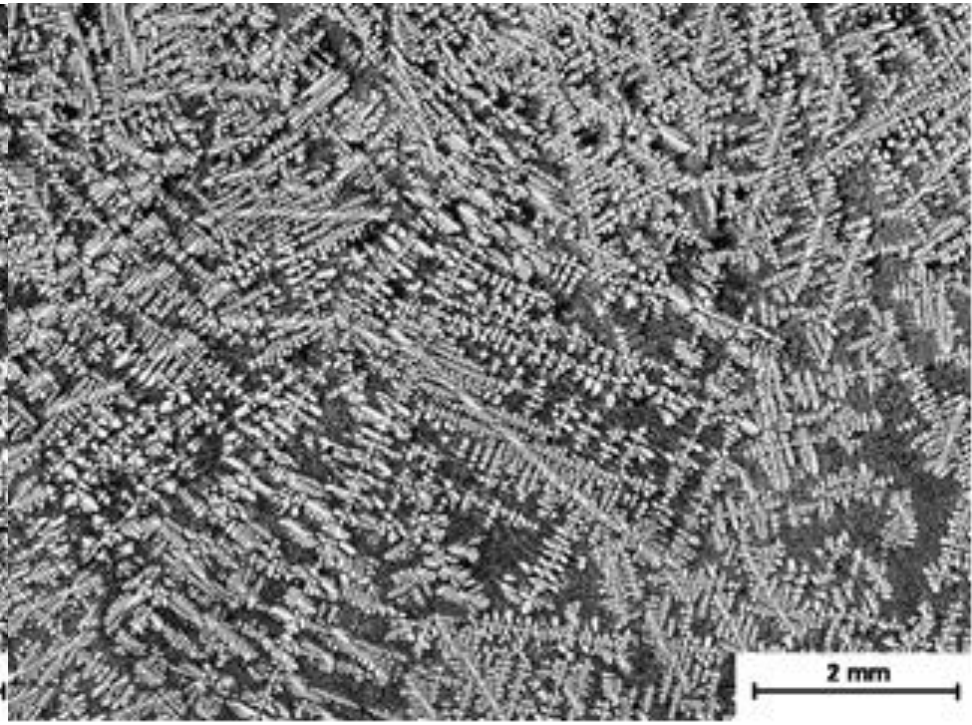




E. Velasco, J. Talamantes, S. Cano, S. Valtierra, J.F. Mojica and R. Colás, Casting-chill interface heat transfer during solidification of an aluminum alloy. Metall. Mat. Trans. B, 30B (1999) 773-778.



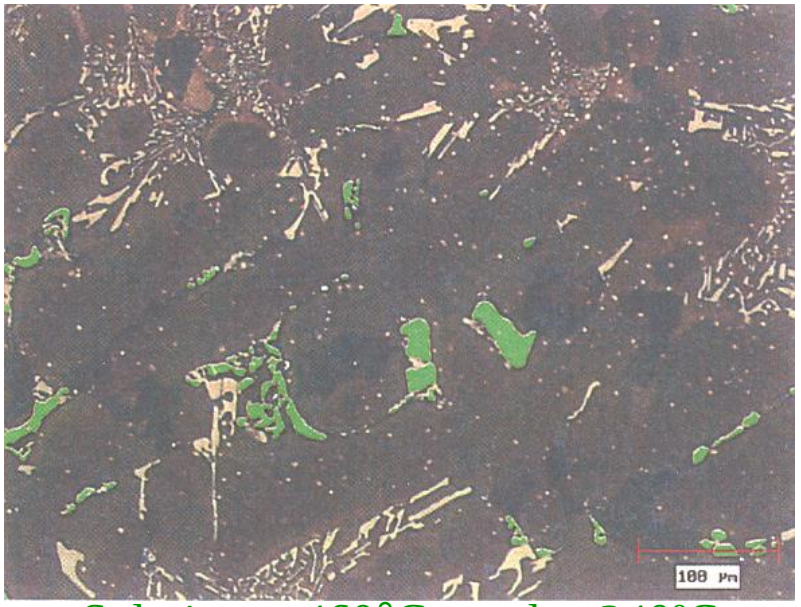
Coherency point



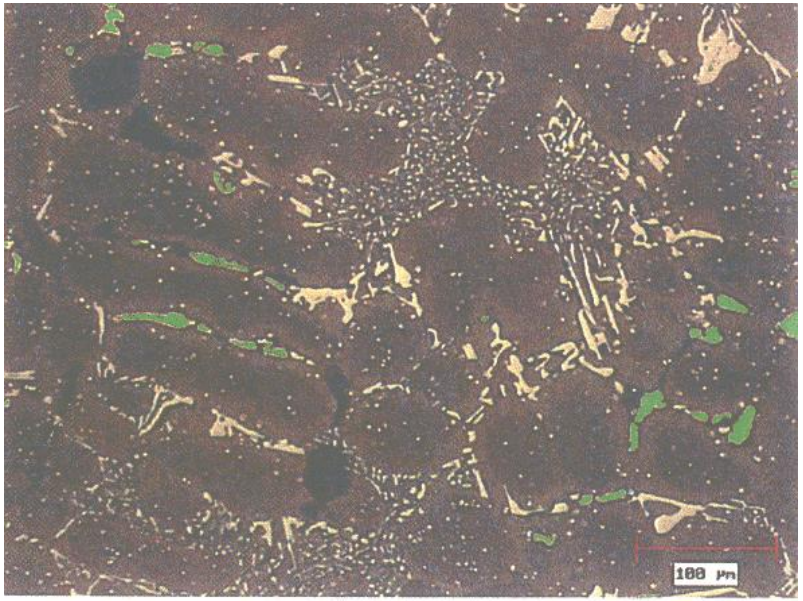
Rigidity point

R. Chávez-Zamarripa, J.A. Ramos-Salas, J. Talamantes-Silva, S. Valtierra and R. Colás, determination of the dendrite coherency point during solidification by means of thermal diffusivity analysis. Metall. Mat. Trans. A, 38A (2007) 1875-1879.

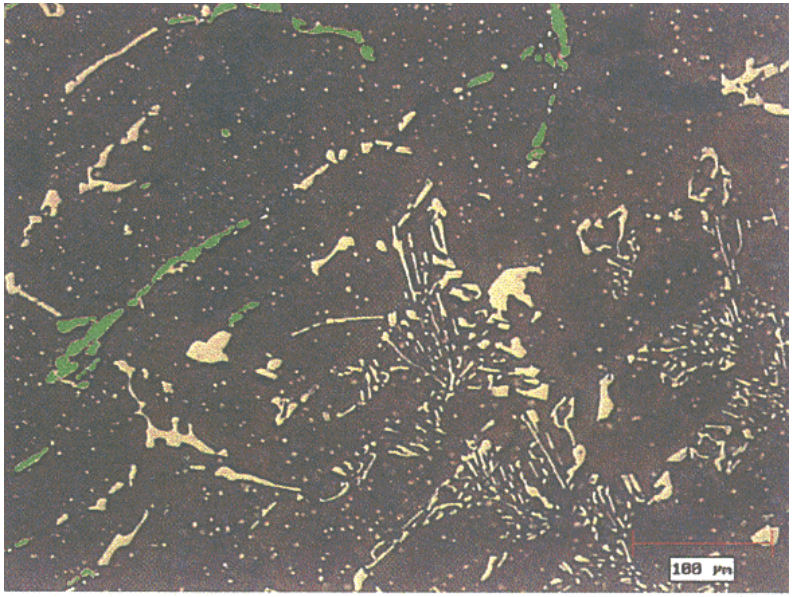
As-cast



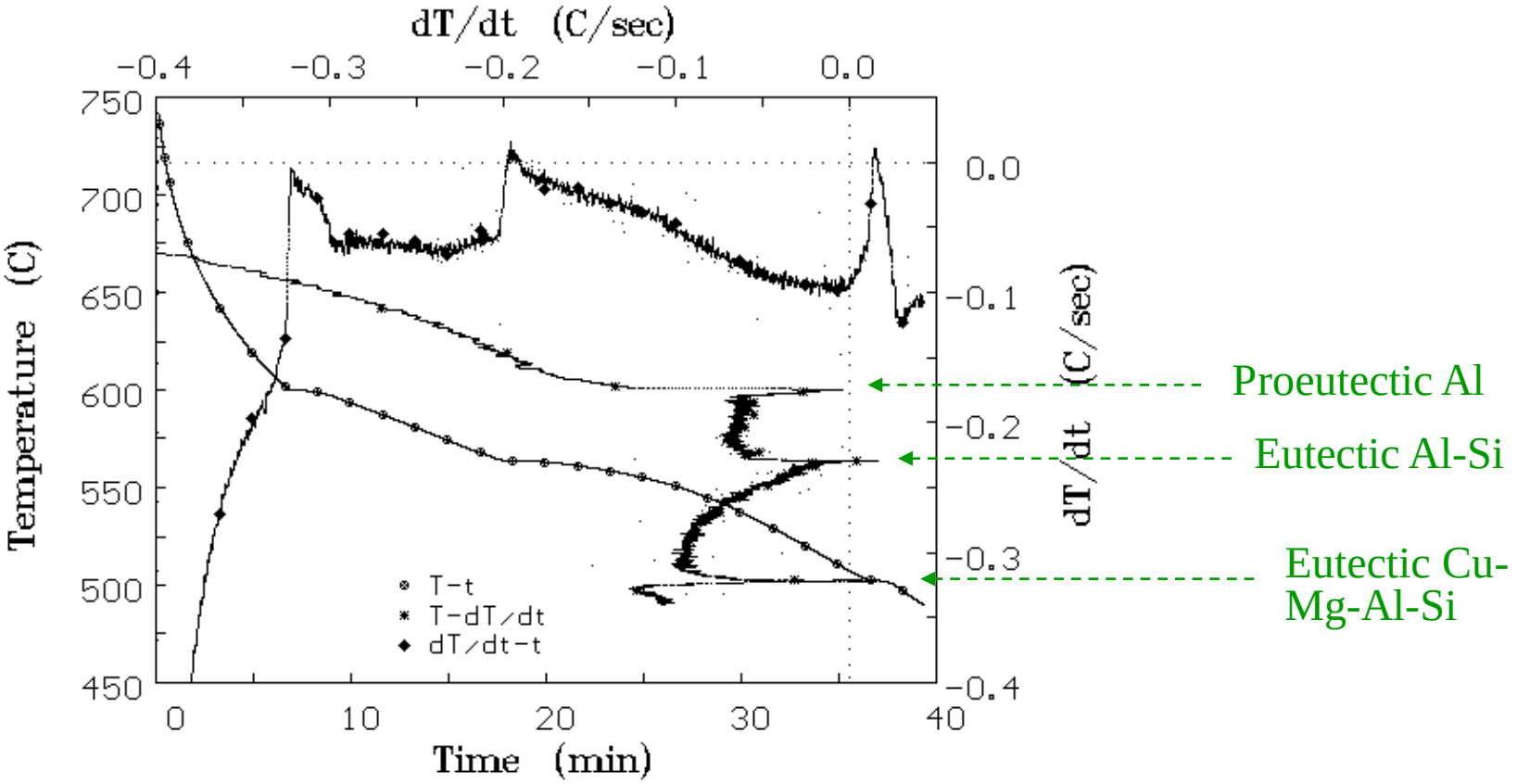
Solution at 460°C, aged at 240ºC



Solution at 480°C, aged at 240ºC



Solution at 500°C, aged at 240ºC



V. Páramo, R. Colás, E. Velasco and S. Valtierra, Spheroidization of the Al-Si eutectic in a cast aluminum alloy. J. Mat. Eng. Perf., 9 (2000) 616-622.

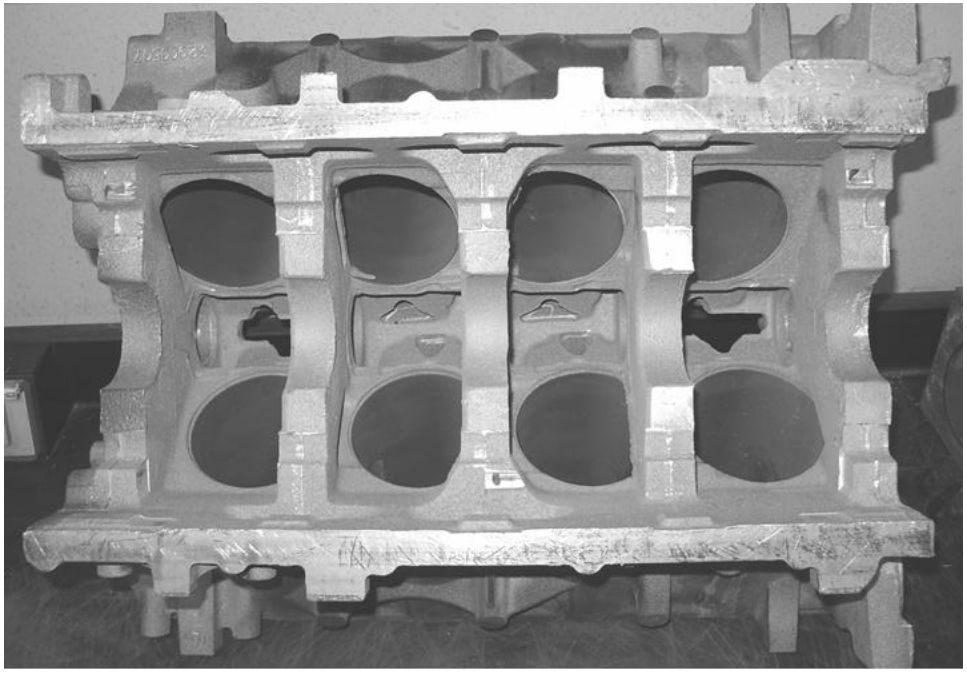
R. Torres, J. Esparza, E. Velasco, S. García-Luna and R. Colás, Characterization of an aluminium engine block. Int. J. Micros. Mat. Prop., 1 (2006) 129-138.

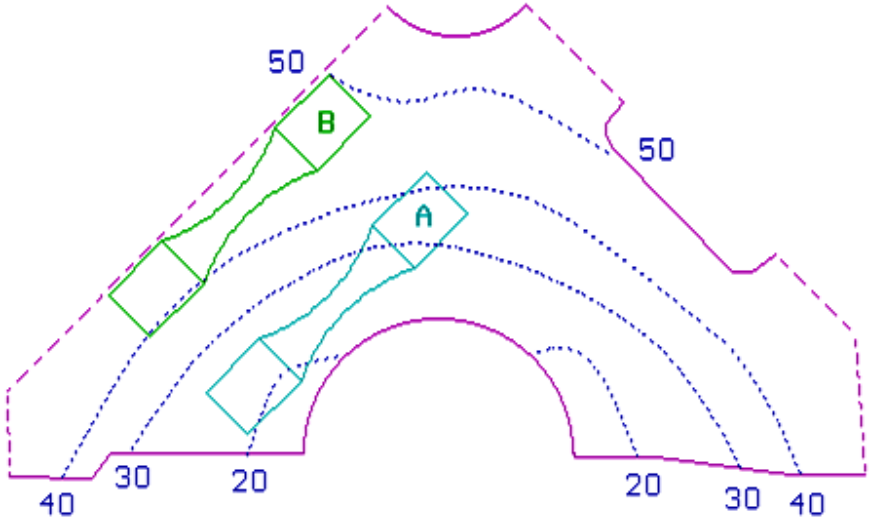
M.A. Talamantes-Silva, A. Rodríguez, J. Talamantes-Silva, S. Valtierra and R. Colás: characterization of an Al-Cu cast alloy. Mat. Char., 59 (2008) 1434-1439.

A.A. Canales, J. Talamantes-Silva, D. Gloria, S. Valtierra and R. Colás, Thermal analysis during the solidification of cast Al-Si alloys. Thermoch. Acta, 510 (2010) 82-87.

E. Carrera, J.A. González, J. Talamantes Silva and R. Colás, Effect of the delay in time between cooling and aging in heat treated cast aluminum alloy. Metall. Mat. Trans. B, 42B (2011) 1023-1030.

Fatigue

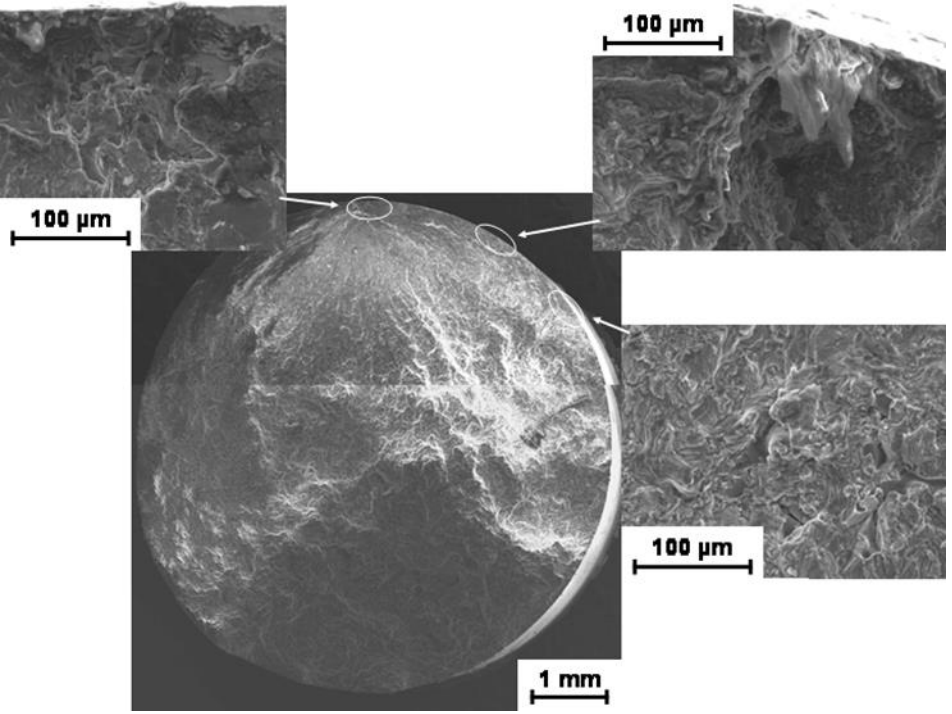


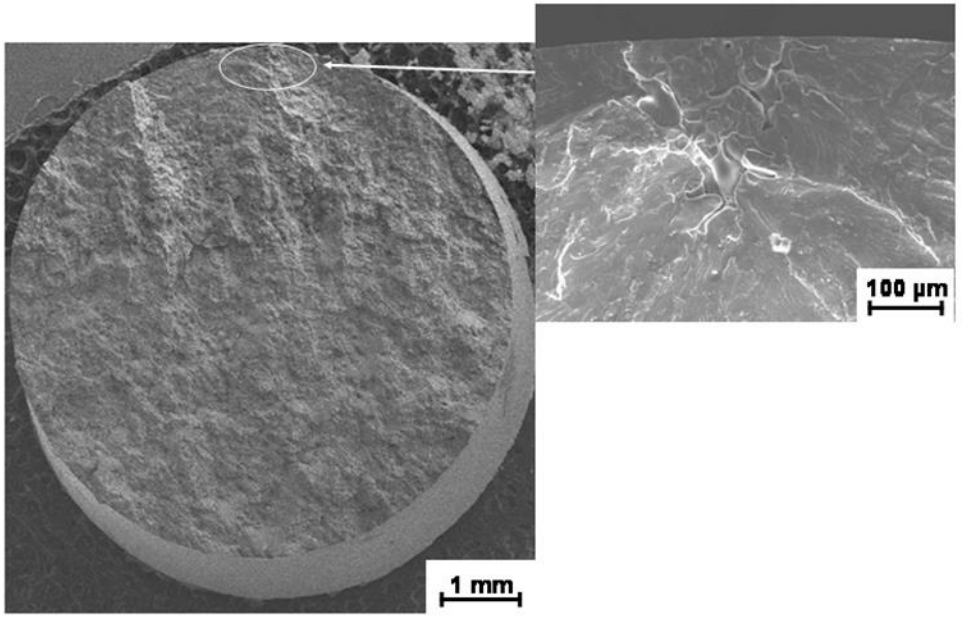


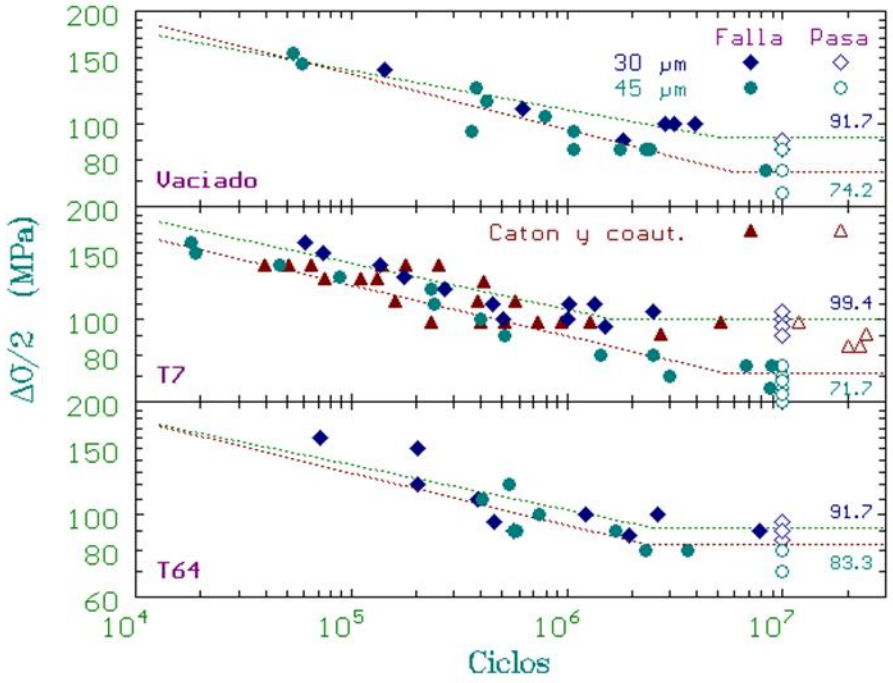
E. Velasco, R. Colás, S. Valtierra and J.F. Mojica, A model for thermal fatigue in an aluminium casting alloy. Int. J. Fat., 17 (1995) 399-406.

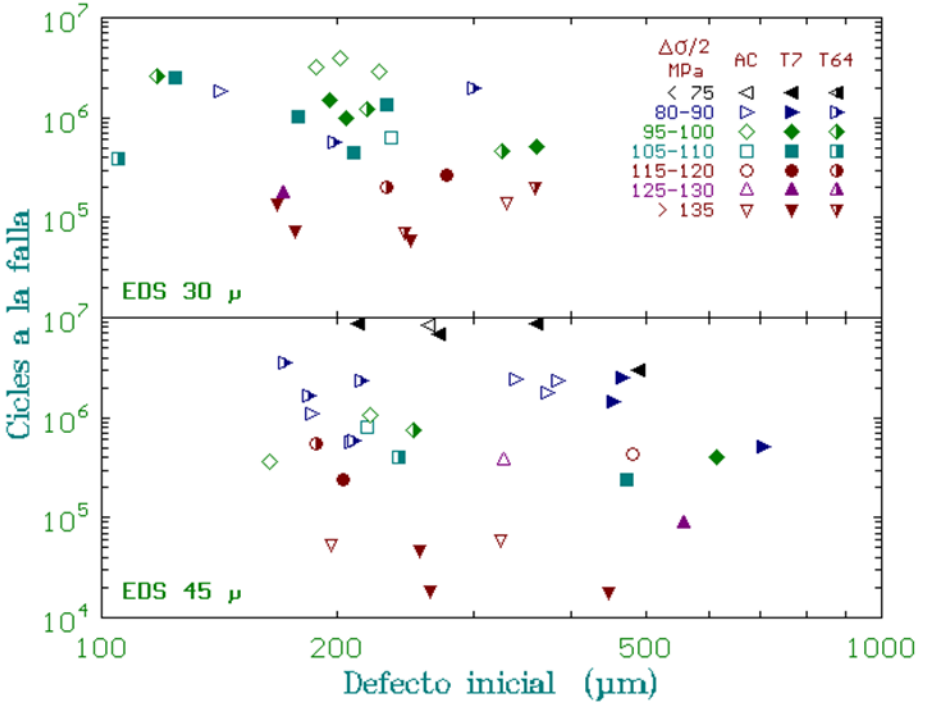
R. González, D.I. Martínez, J.A. González, J. Talamantes, S. Valtierra and R. Colás, Experimental investigation for fatigue strength of a cast aluminium alloy. Int. J. Fat., 33 (2011) 273-278.

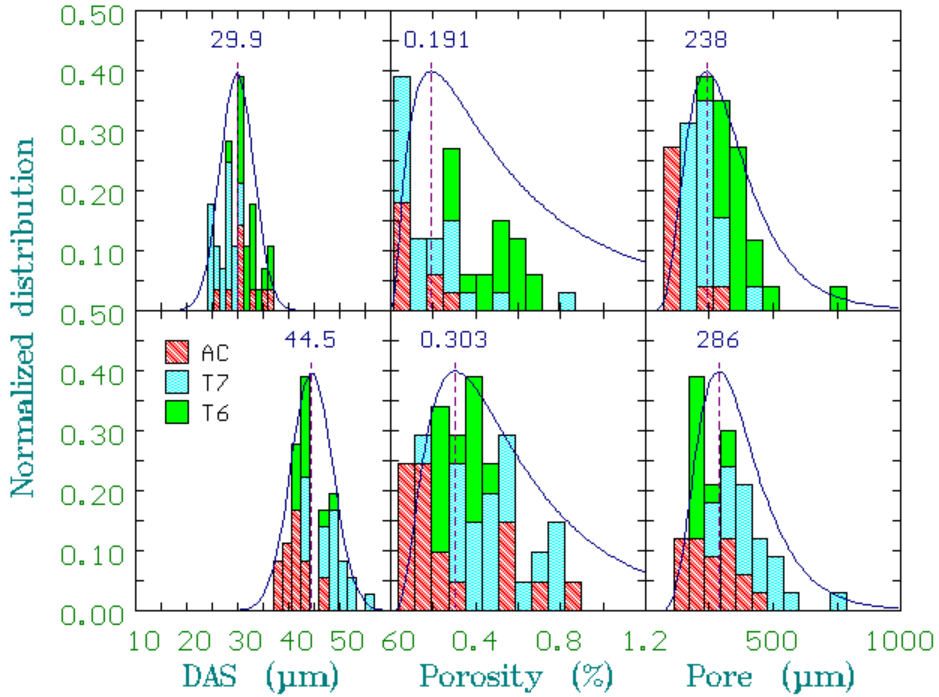
R. González, A. González, J. Talamantes-Silva, S. Valtierra, R.D. Mercado-Solís, N.F. Garza-Montes-de-Oca and R. Colás, Fatigue of an aluminium cast alloy used in the manufacture of automotive engine blocks. Int. J. Fat., 54 (2013) 118-126.

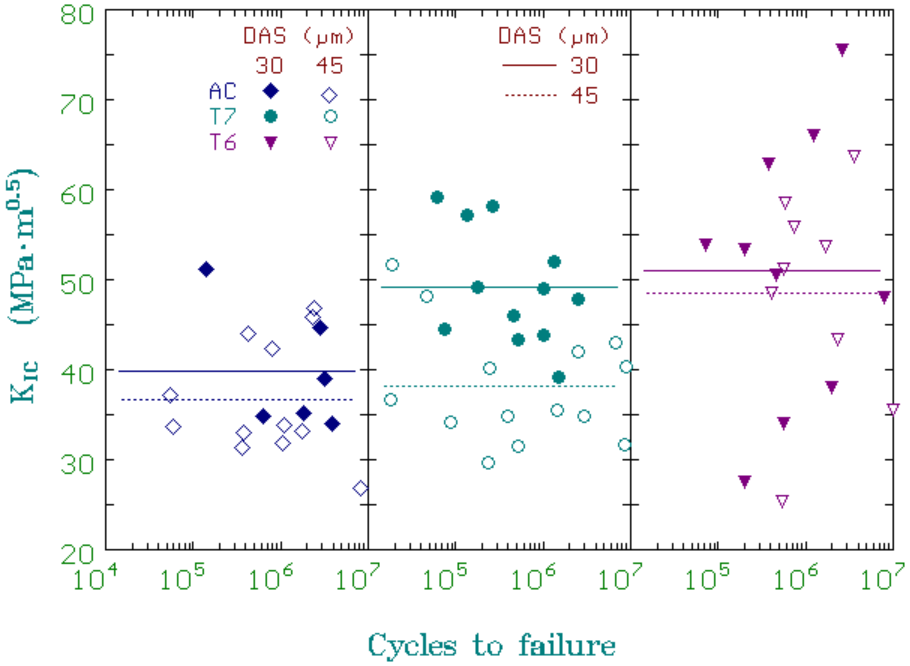

100 µm
100 µm
100 µm
1 mm

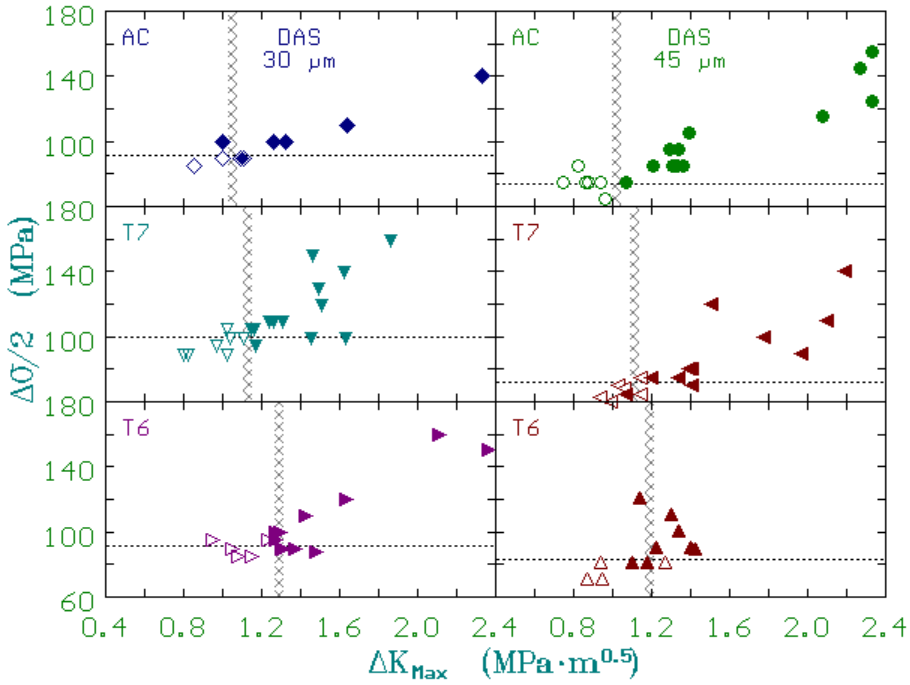

100 µm
1 mm

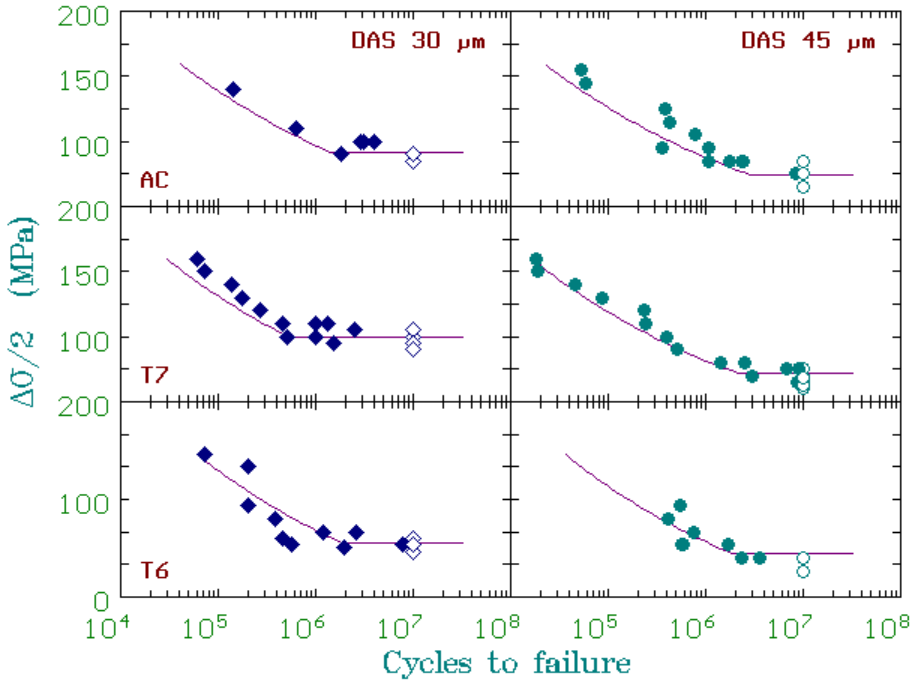

Falla
Pasa
30 µm
45 µm
Vaciado
91.7
74.2
Caton y coaut.
T7
99.4
71.7
T64
91.7
83.3
Δσ/2 (MPa)
Ciclos


Δσ/2 MPa
AC
T7
T64
< 75
80-90
95-100
105-110
115-120
125-130
> 135
EDS 30 µ
EDS 45 µ
Ciclos a la falla
Defecto inicial (µm)

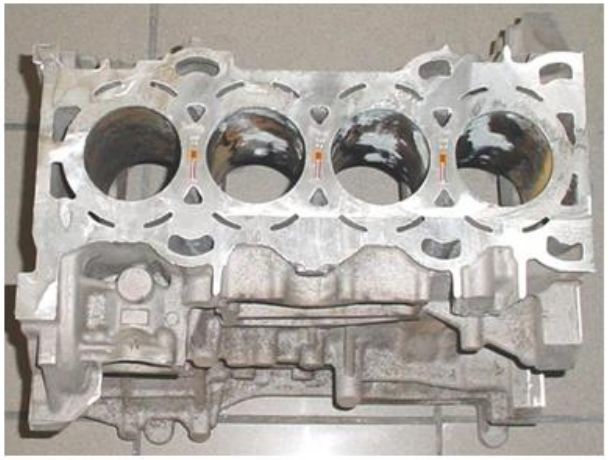

Normalized distribution
29.9
0.191
238
44.5
0.303
286
AC
T7
T6
DAS (μm)
Porosity (%)
Pore (μm)


DAS (μm)
30
45
AC
T7
T6
K_{IC} (MPa·m$^{0.5}$)
Cycles to failure


AC
DAS 30 μm
DAS 45 μm
T7
T6
Δσ/2 (MPa)
ΔK_{Max} (MPa·m$^{0.5}$)

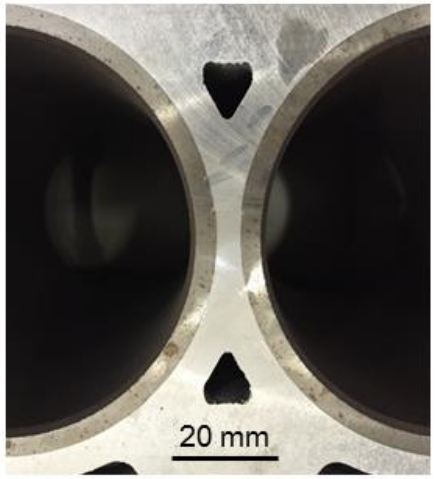

DAS 30 μm
DAS 45 μm
AC
T7
T6
Δσ/2 (MPa)
Cycles to failure

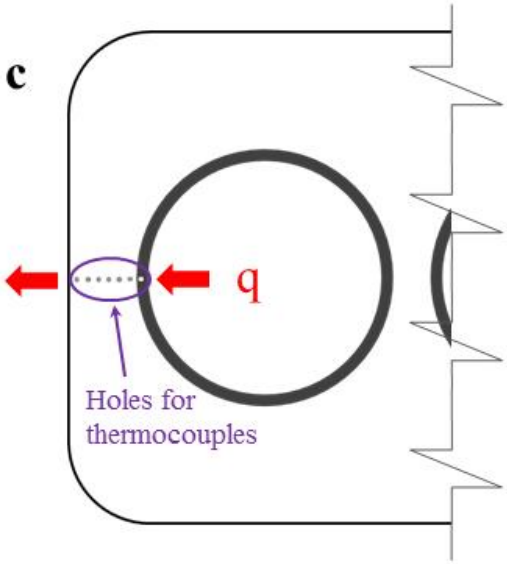
Heat extraction in engine moulds



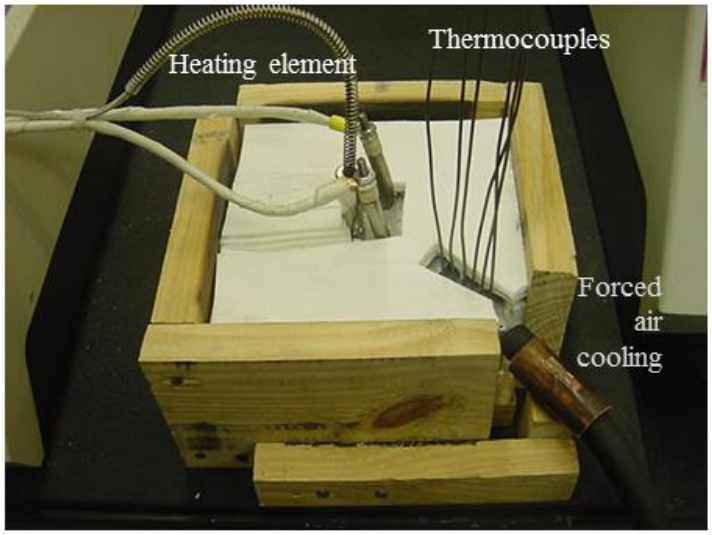
a

b

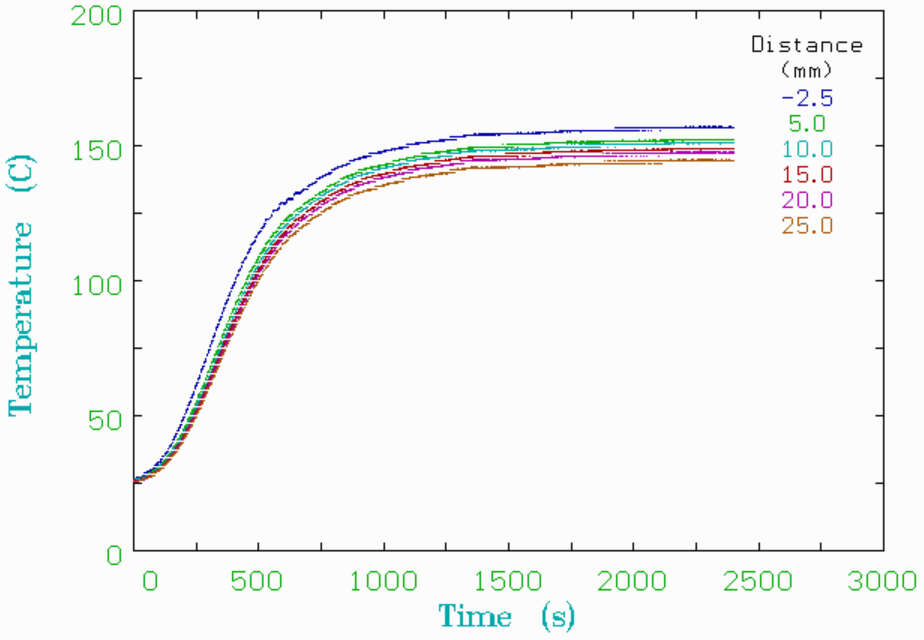


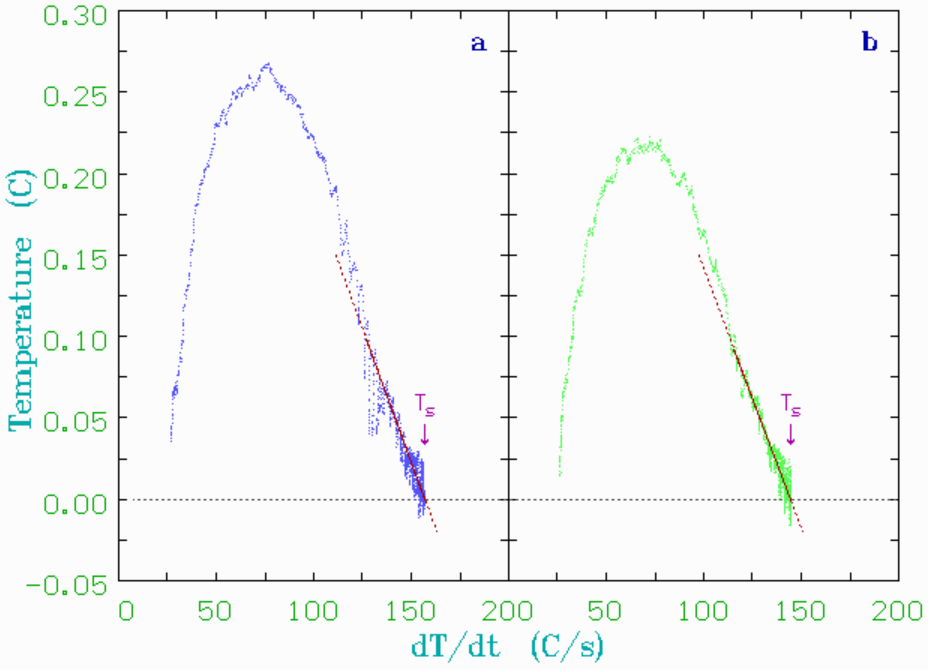


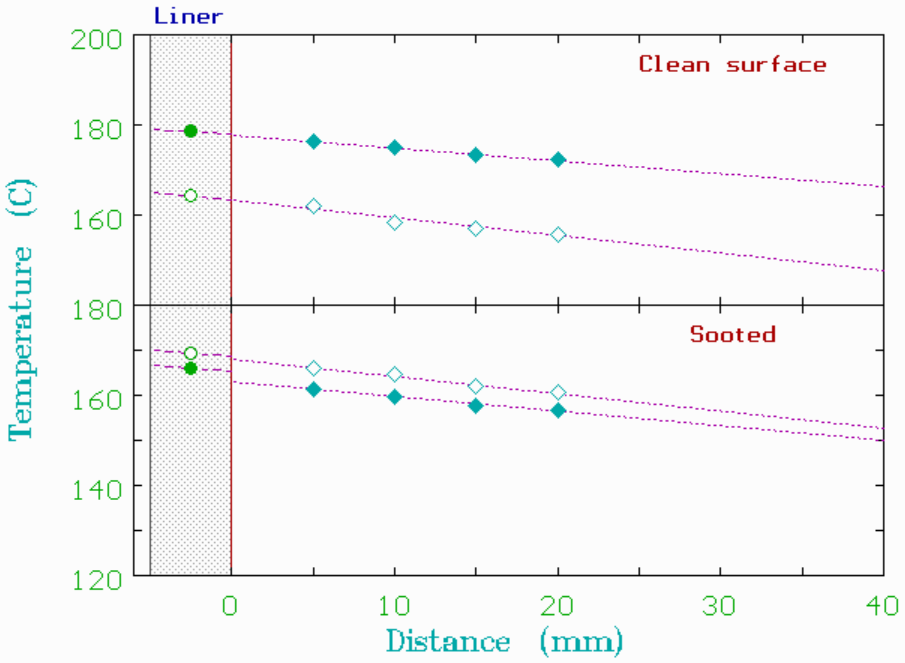
d

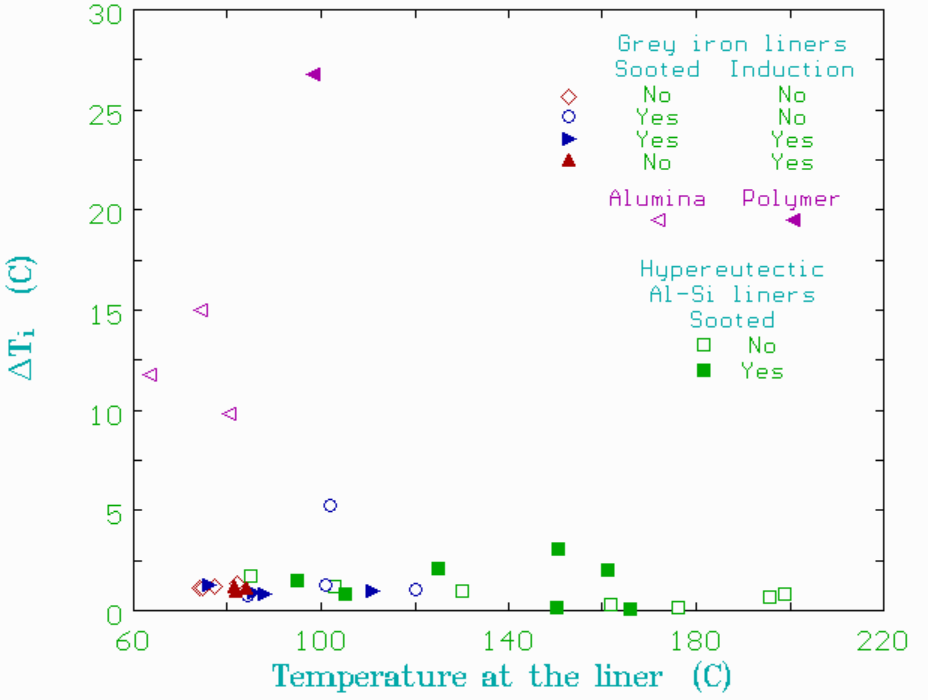


J.A. González, J. Talamantes-Silva, F. Morales, N.F. Garza-Montes-de-Oca and R. Colás, Analyses of heat conduction within combustion chambers in engine blocks. Int. J. Micros. Mat. Prop., 10 (2015) 340-349.

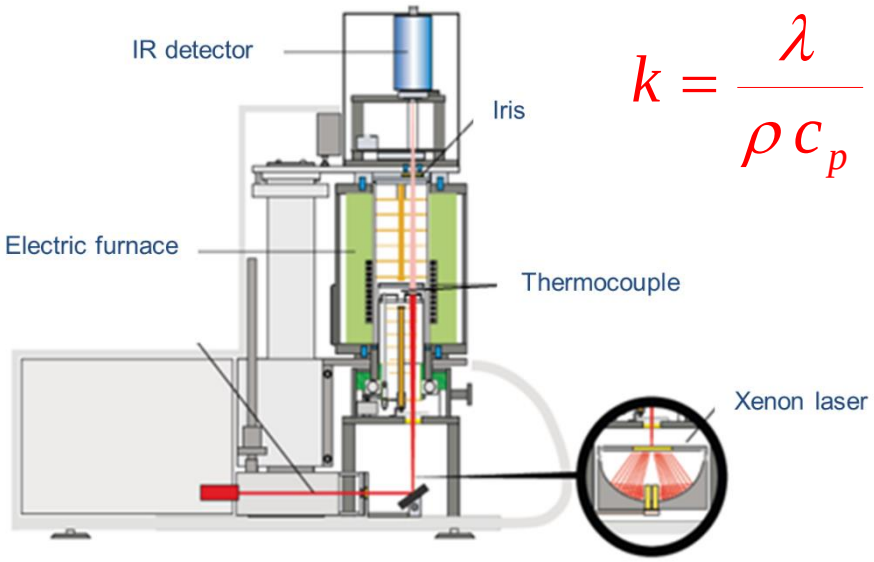

Temperature (C)
Time (s)
Distance (mm)
-2.5
5.0
10.0
15.0
20.0
25.0


a
b
Temperature (C)
dT/dt (C/s)
T_s

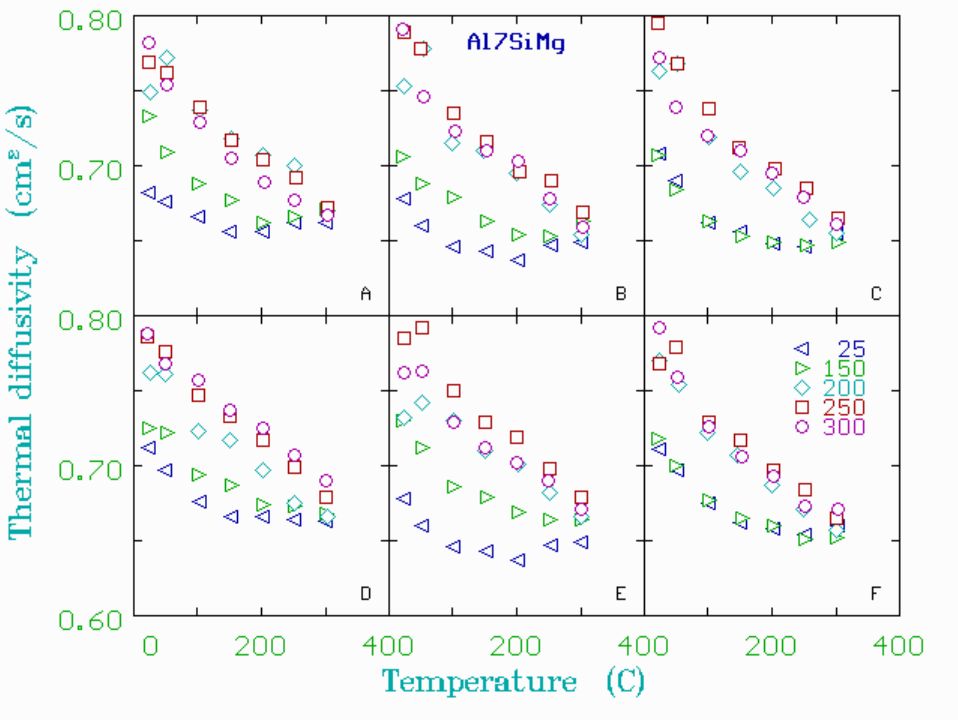

Liner
Clean surface
Sooted
Temperature (C)
Distance (mm)

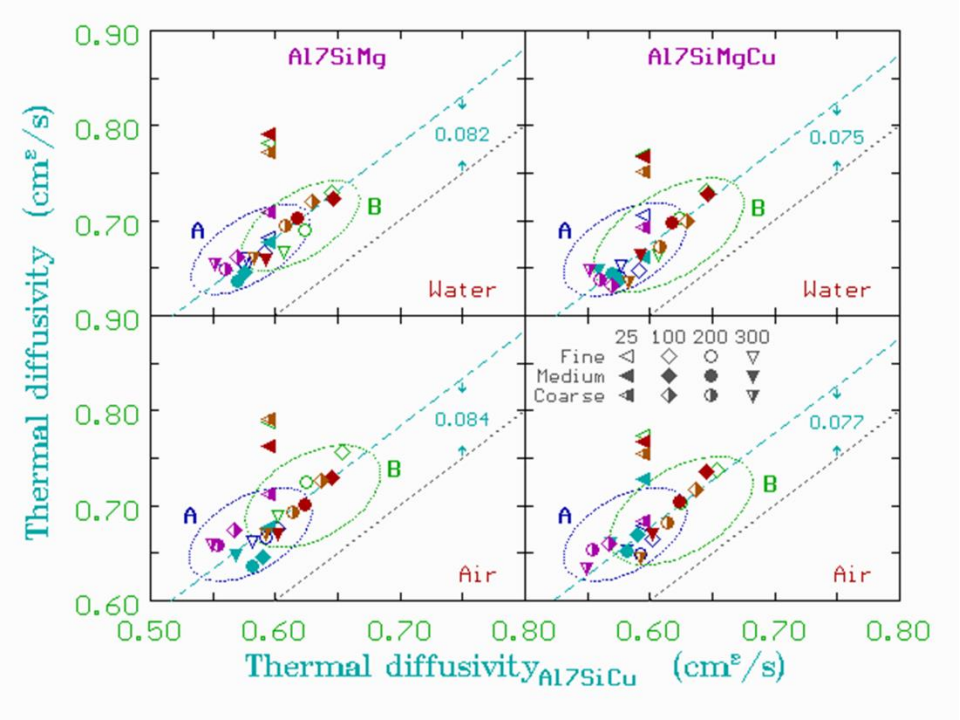

Grey iron liners
Sooted Induction
No No
Yes No
Yes Yes
No Yes
Alumina Polymer
Hypereutectic Al-Si liners
Sooted
No
Yes
ΔT_i (C)
Temperature at the liner (C)

Thermal difussivity



$$k = \frac{\lambda}{\rho c_p}$$





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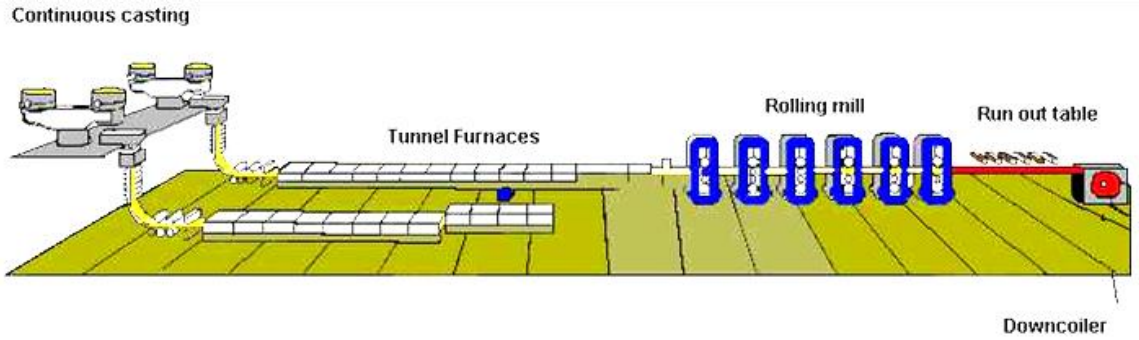
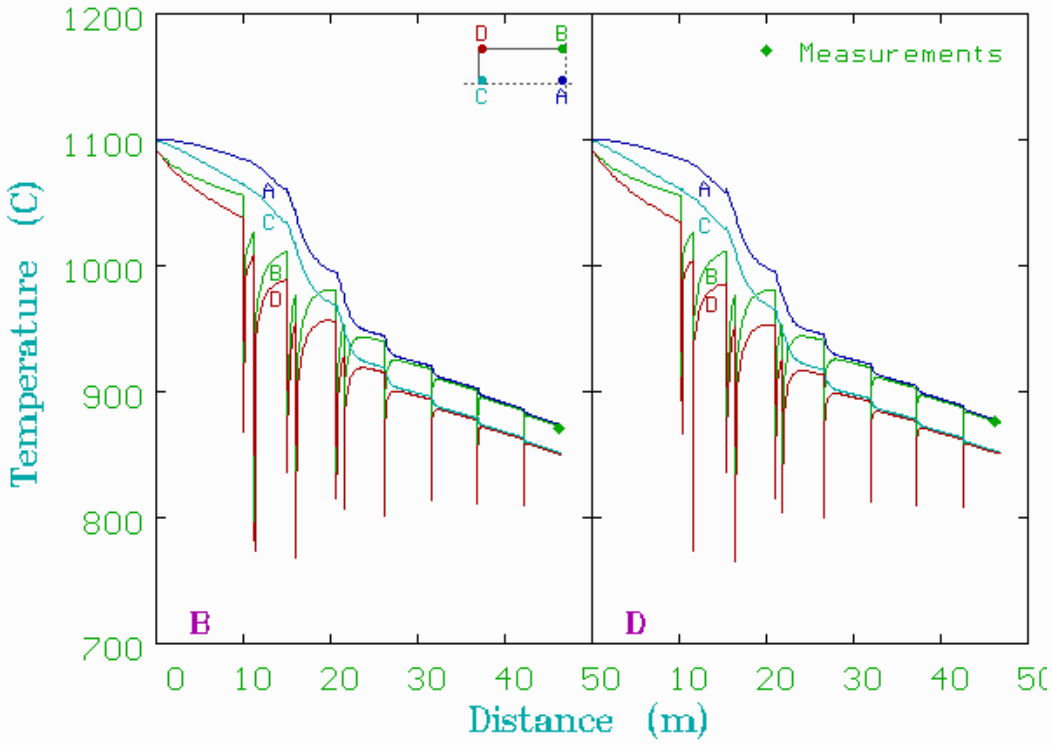
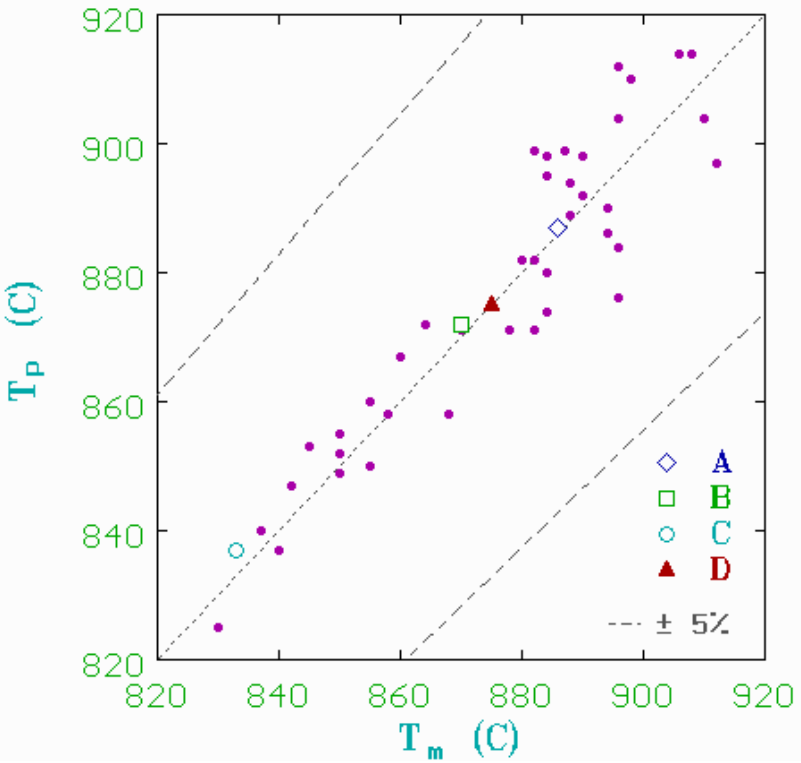
Steel processing







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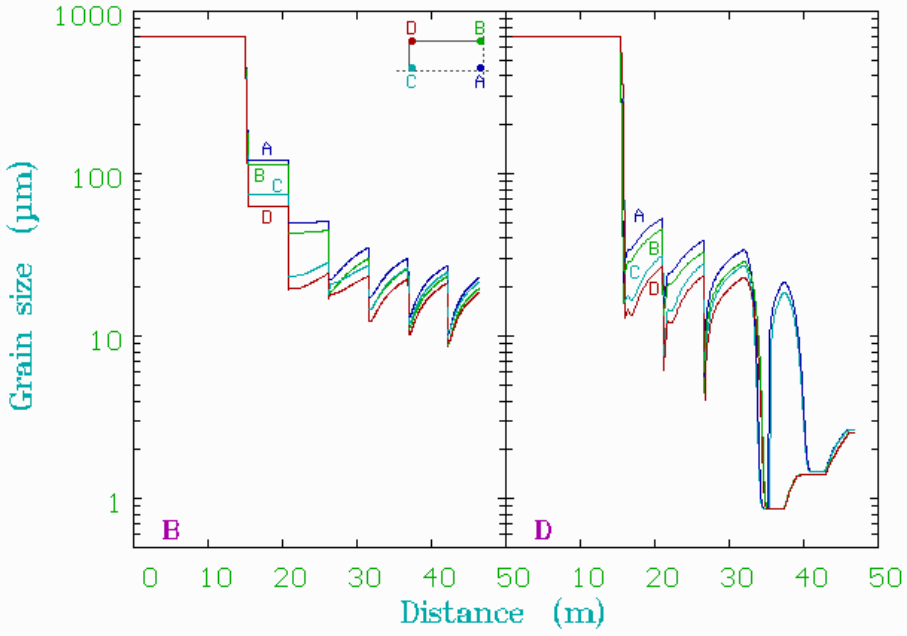
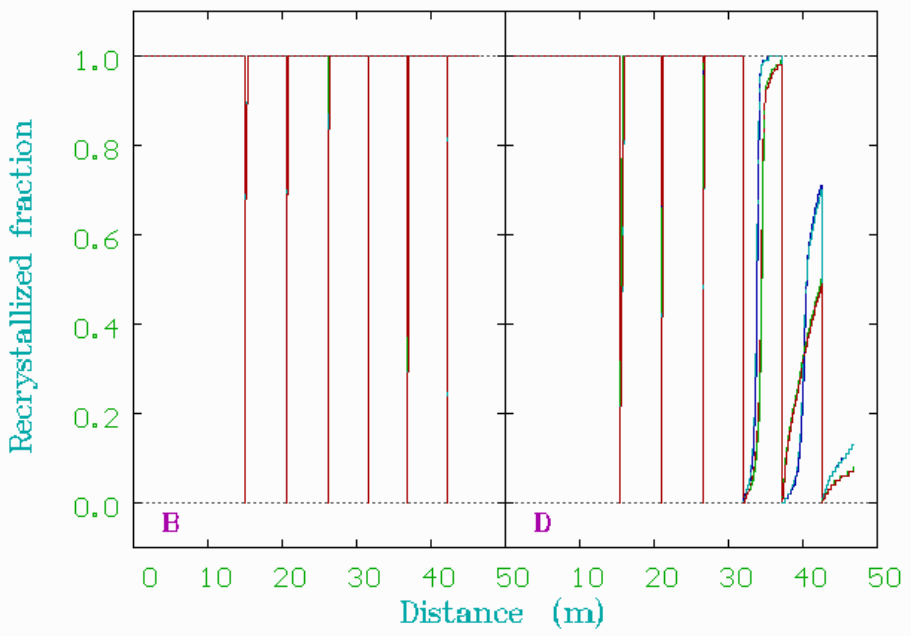
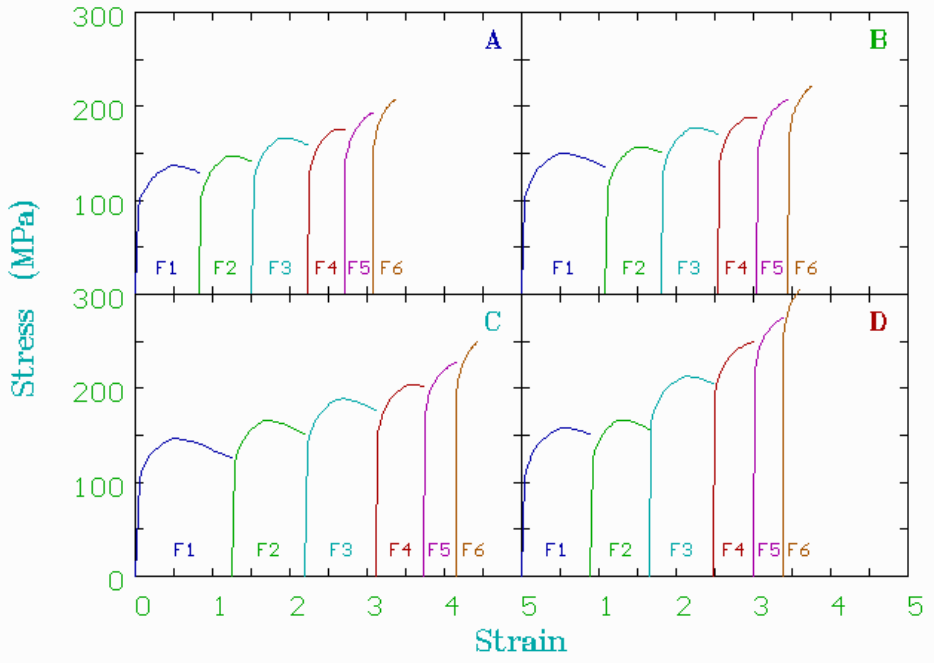
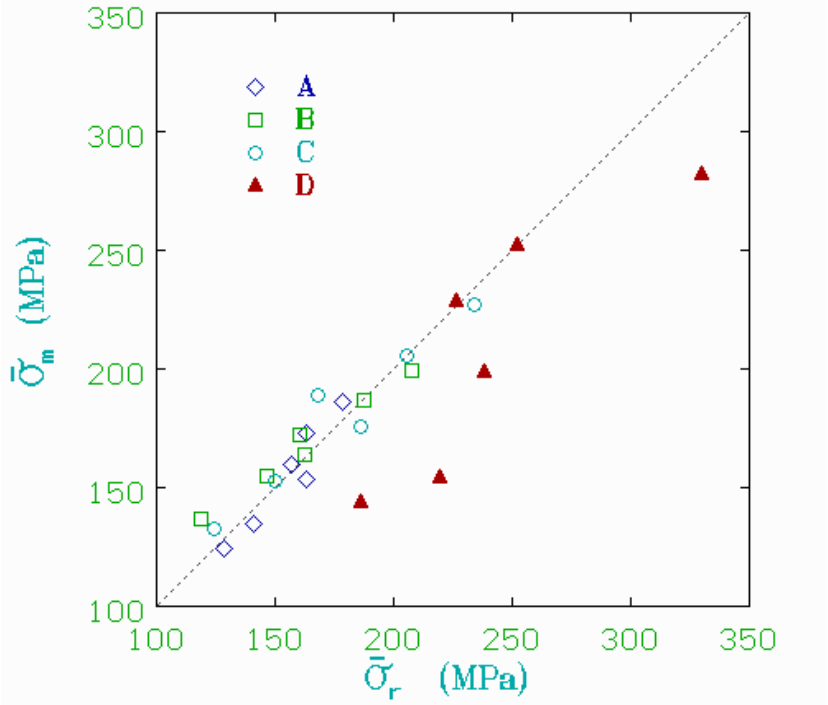
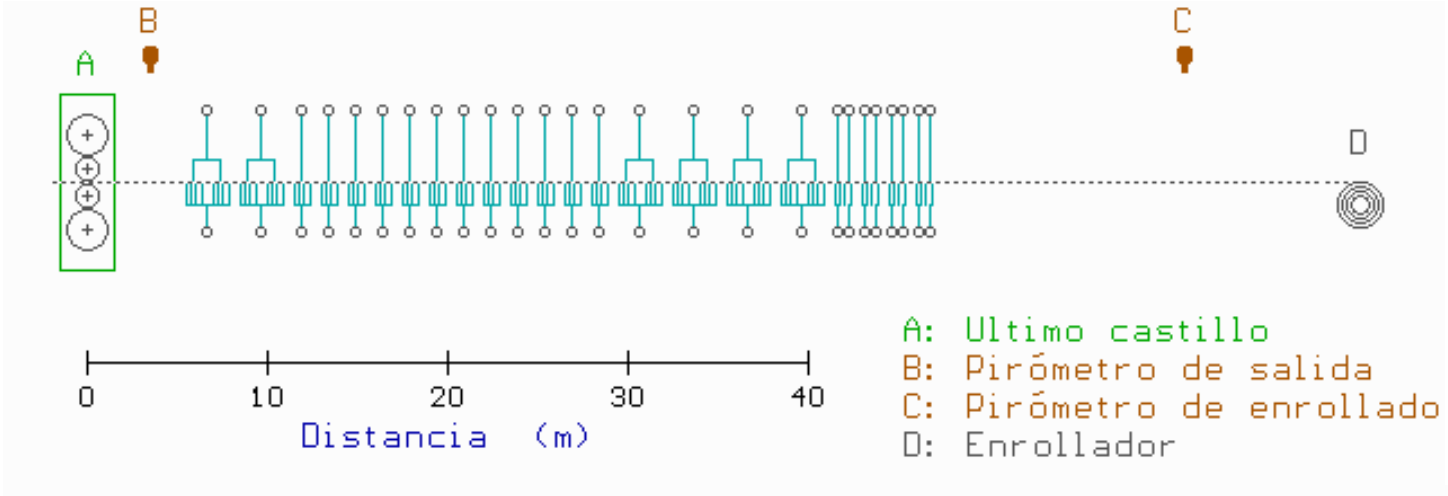
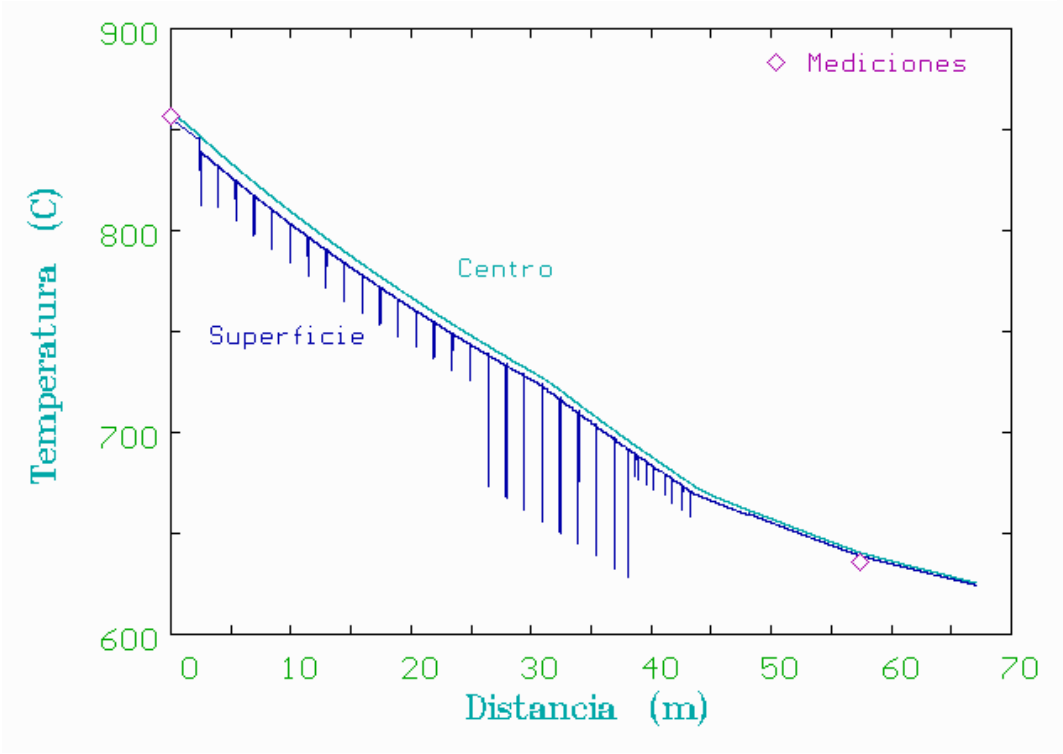

Grain size (μm)
1000
100
10
1
A
B
C
D
B
D
0 10 20 30 40 50 10 20 30 40 50
Distance (m)

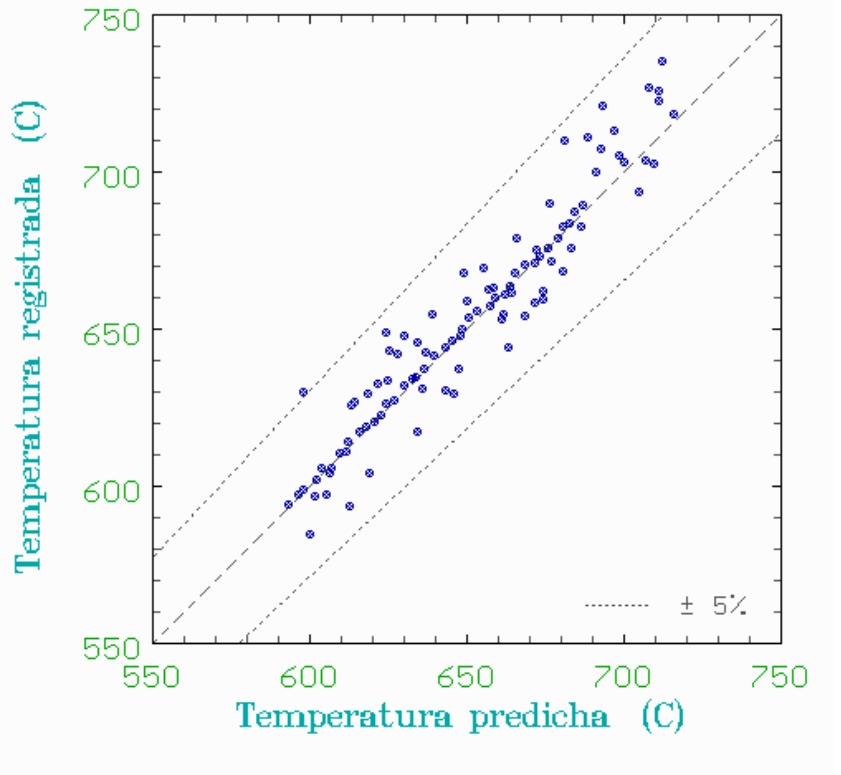

Recrystallized fraction
1.0
0.8
0.6
0.4
0.2
0.0
B
D
0 10 20 30 40 50 10 20 30 40 50
Distance (m)


Stress (MPa)
300
200
100
0
A
B
C
D
F1 F2 F3 F4 F5 F6
0 1 2 3 4 5 1 2 3 4 5
Strain


$\bar{\sigma}_m$ (MPa)
350
300
250
200
150
100
A
B
C
D
100 150 200 250 300 350
$\bar{\sigma}_r$ (MPa)







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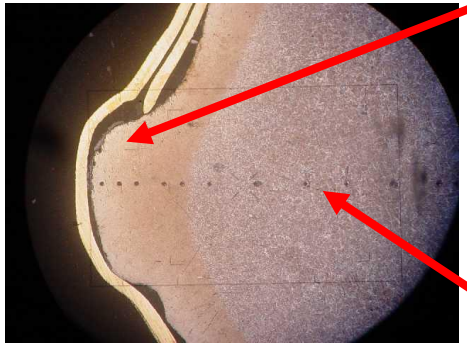
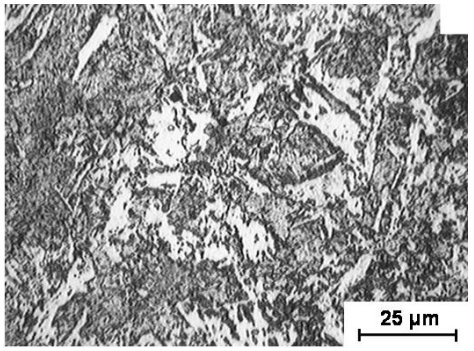
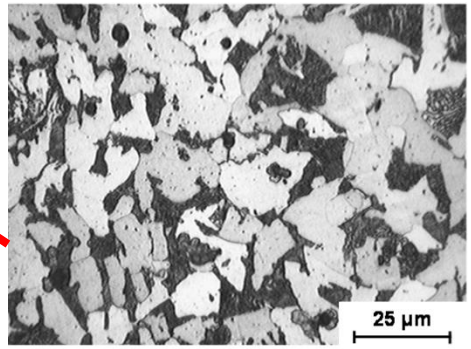
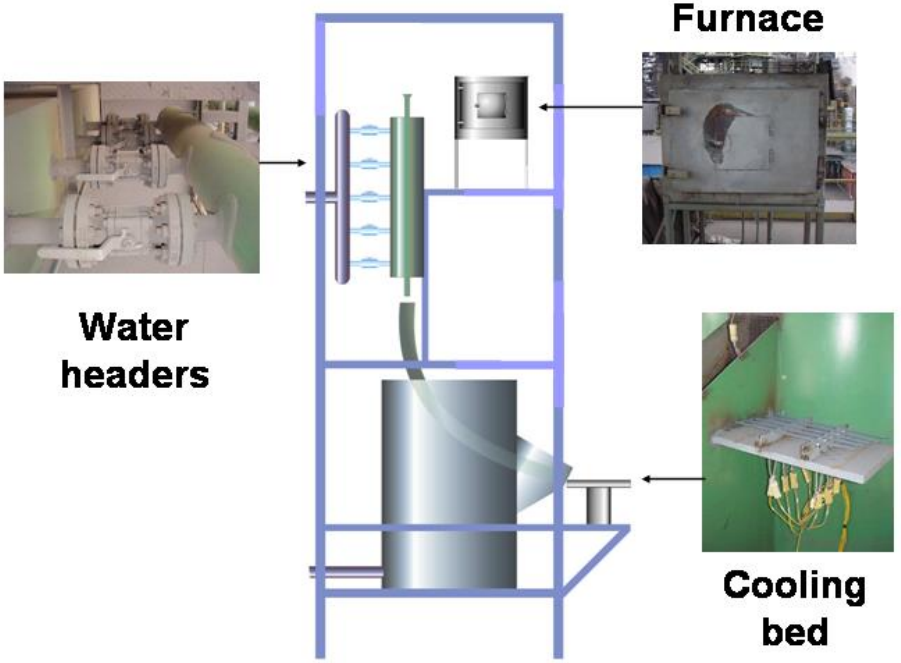
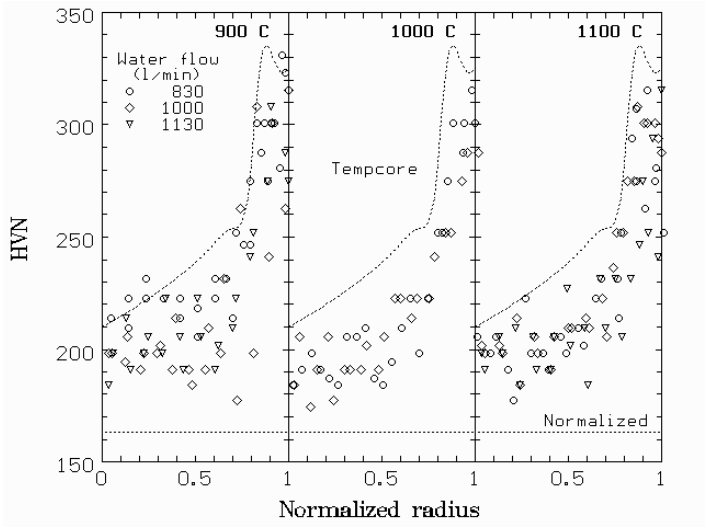
Tempcore process











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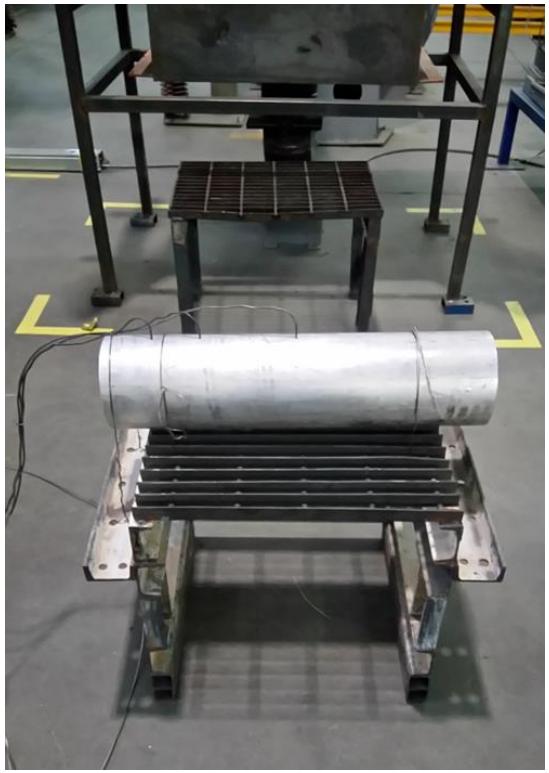
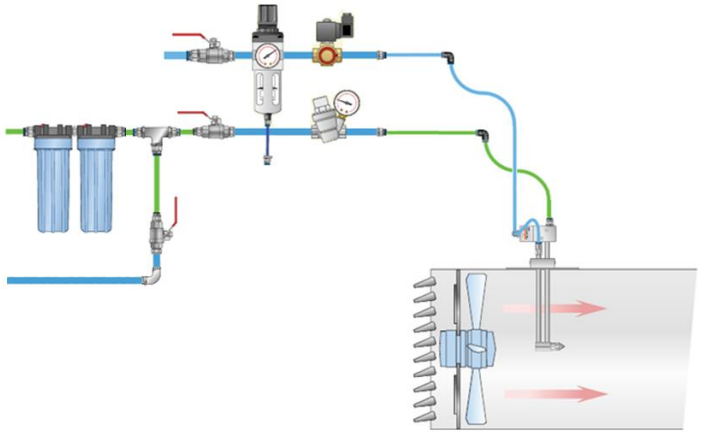
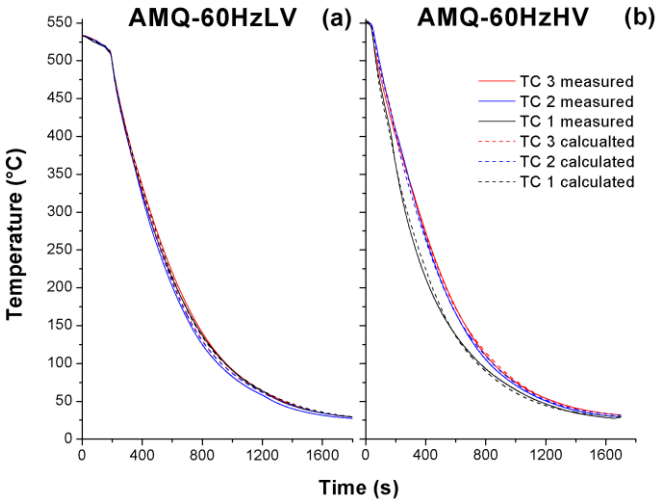
Mist cooling







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Concluding remarks

The results of the work presented have been proved to be valuable for industry and university.

Most of the results have been published in scientific journals.

The students working with industry understand the working conditions once graduated.

Industry hire students that have participated in this scheme.

Other institutions have been in contact with us to adopt similar strategies.

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