

RAPID SOLIDIFICATION OF FRITS

Tadej Lešer



1. INTRODUCTION

2. MAIN TOPIC

3. CONCLUSION

EMO



FRITE

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Slovenija EU

Who **WE** are?

EMO



FRITE

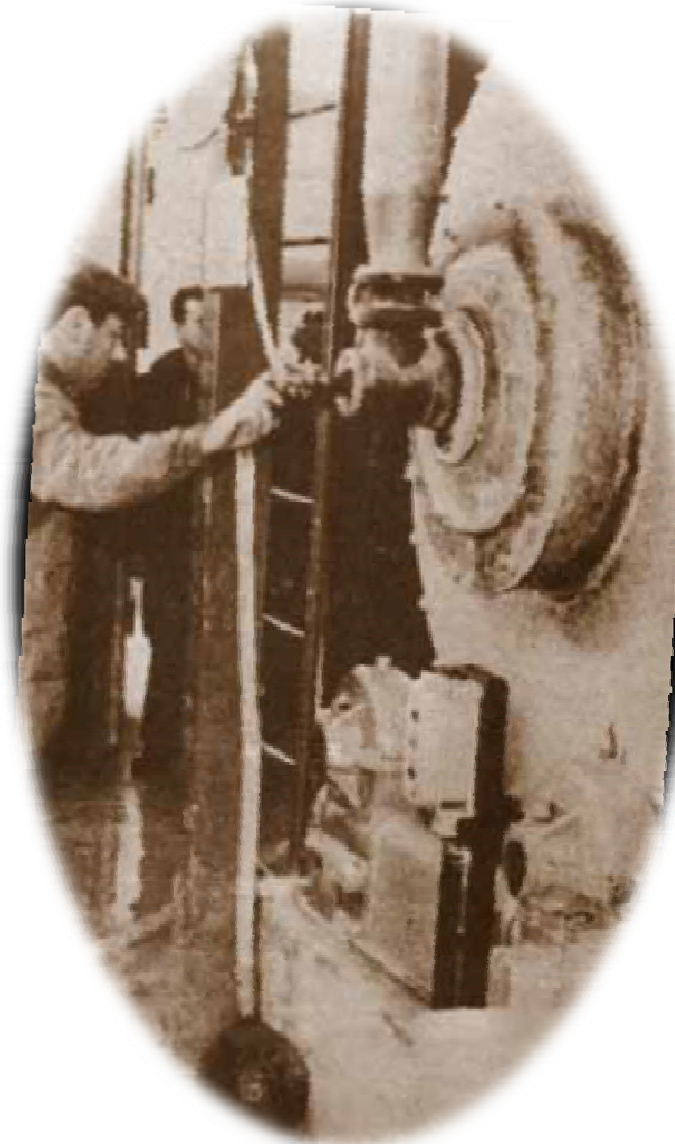
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MEDIUM sized PRIVATELY owned
company

and

A PRODUCER of frits

BEGININGS year 1930...

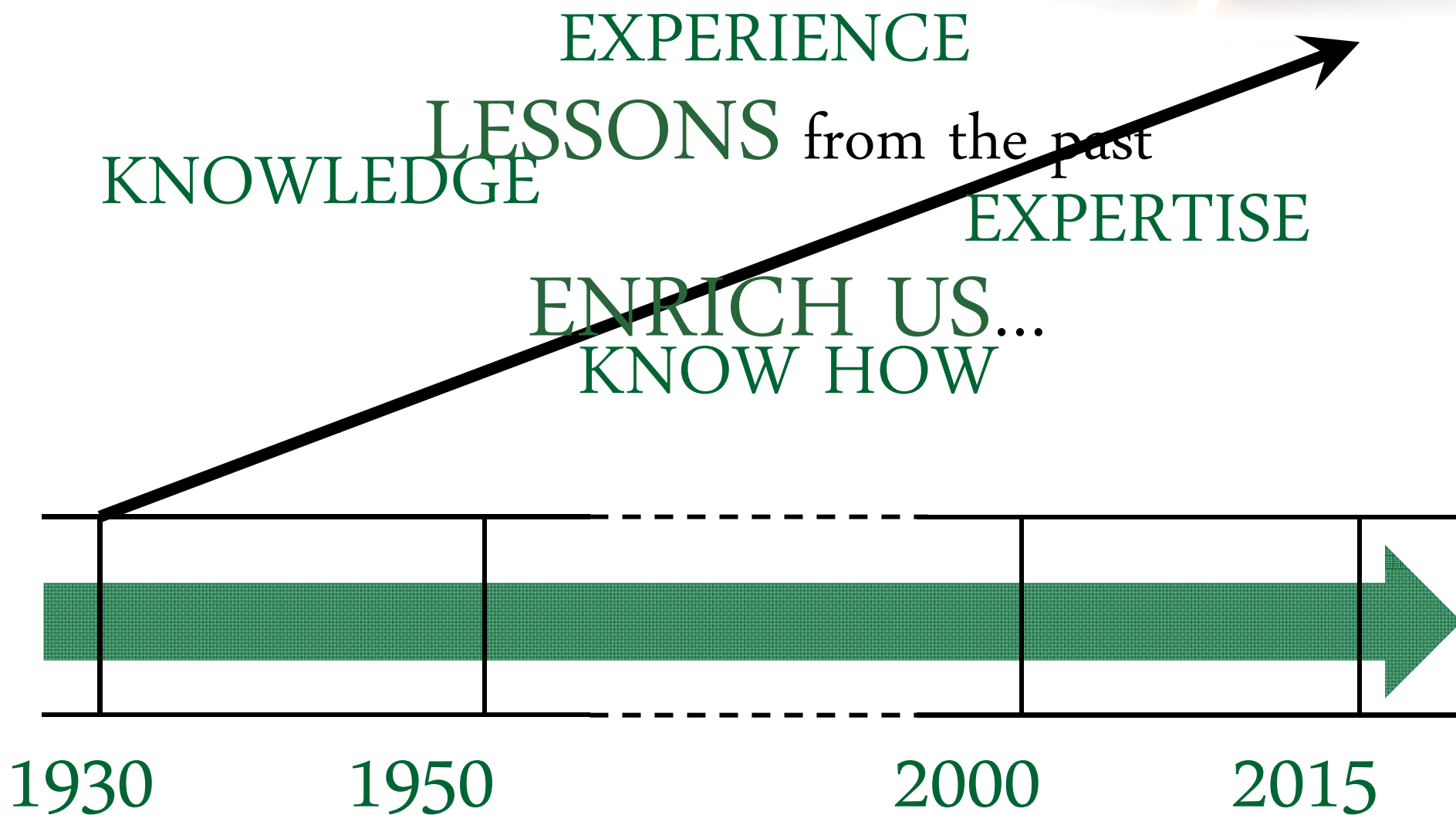


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WHERE

are

we?



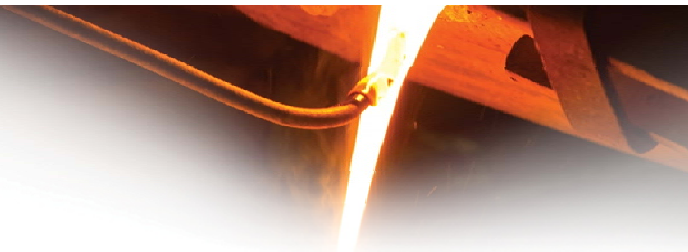
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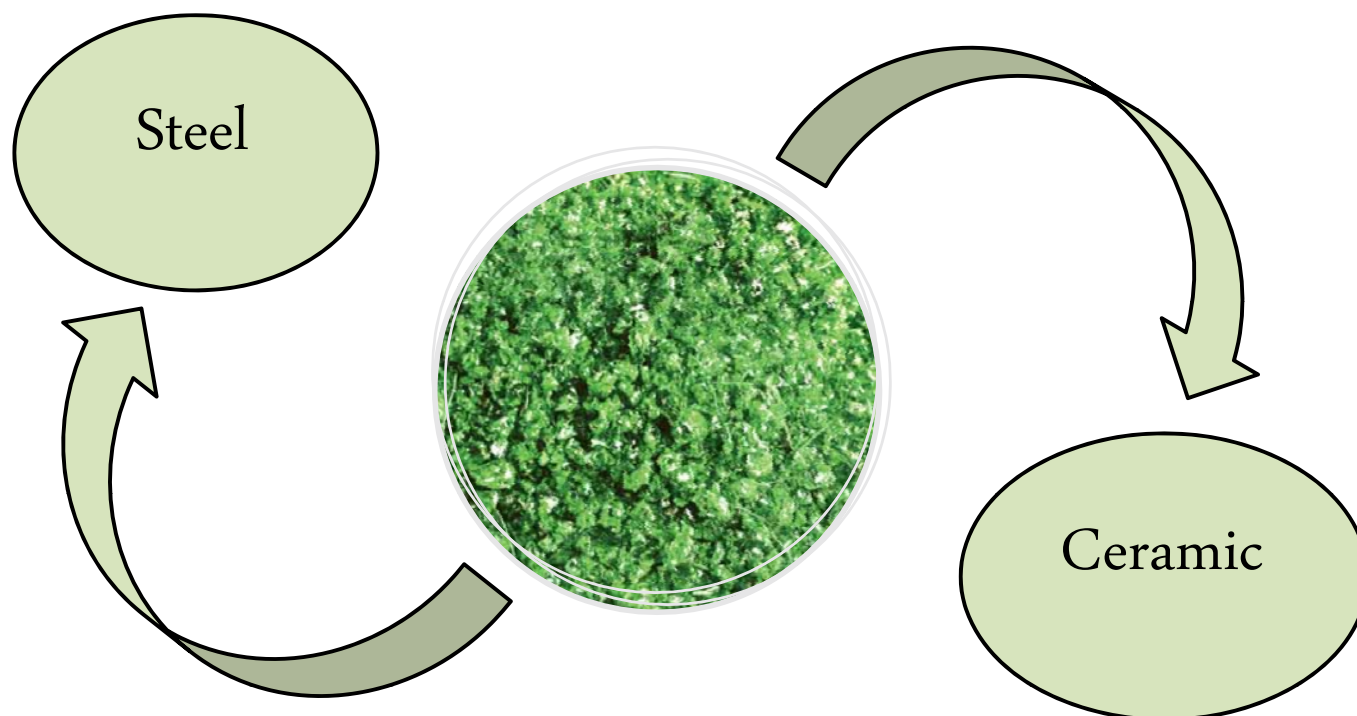
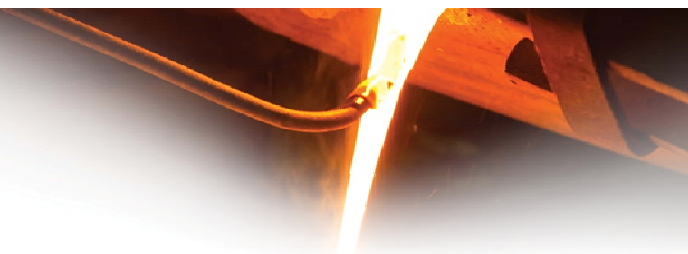


WHAT do we do?



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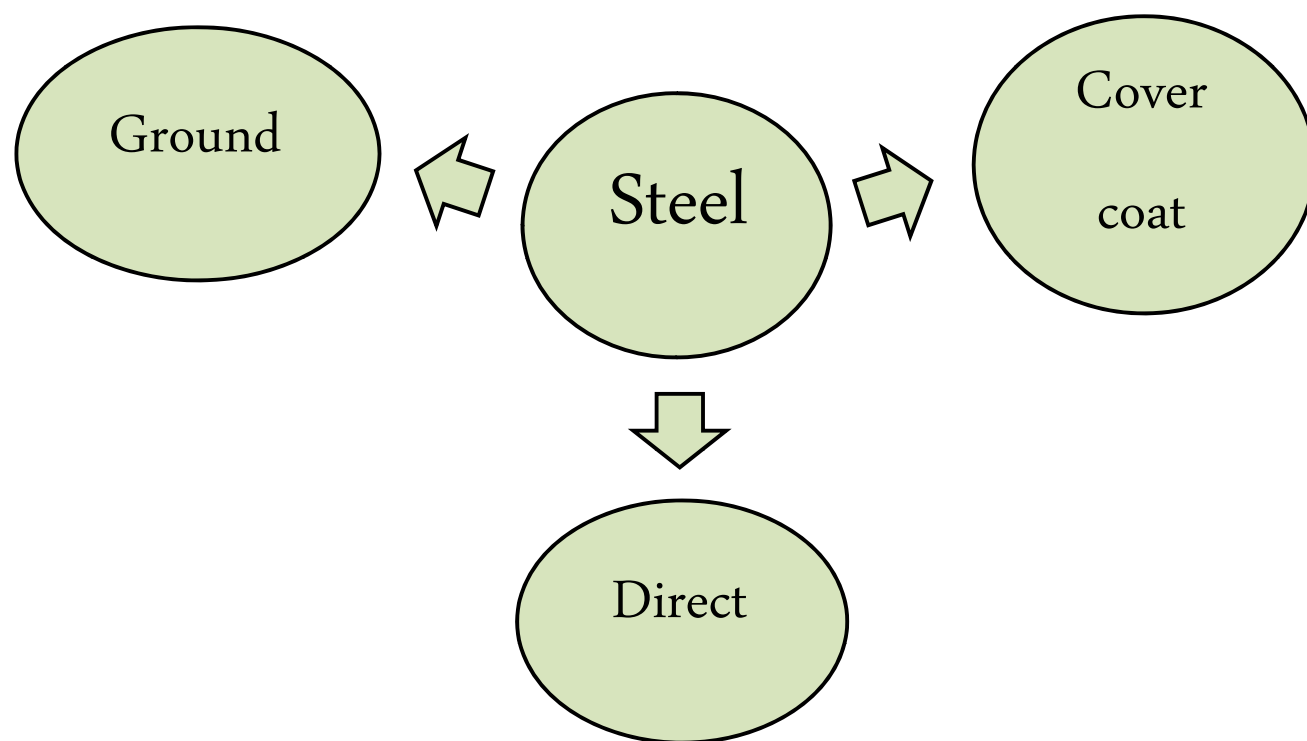
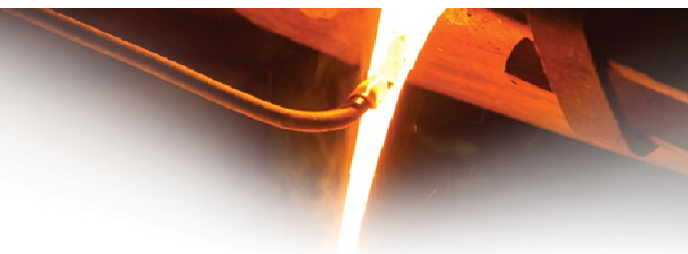
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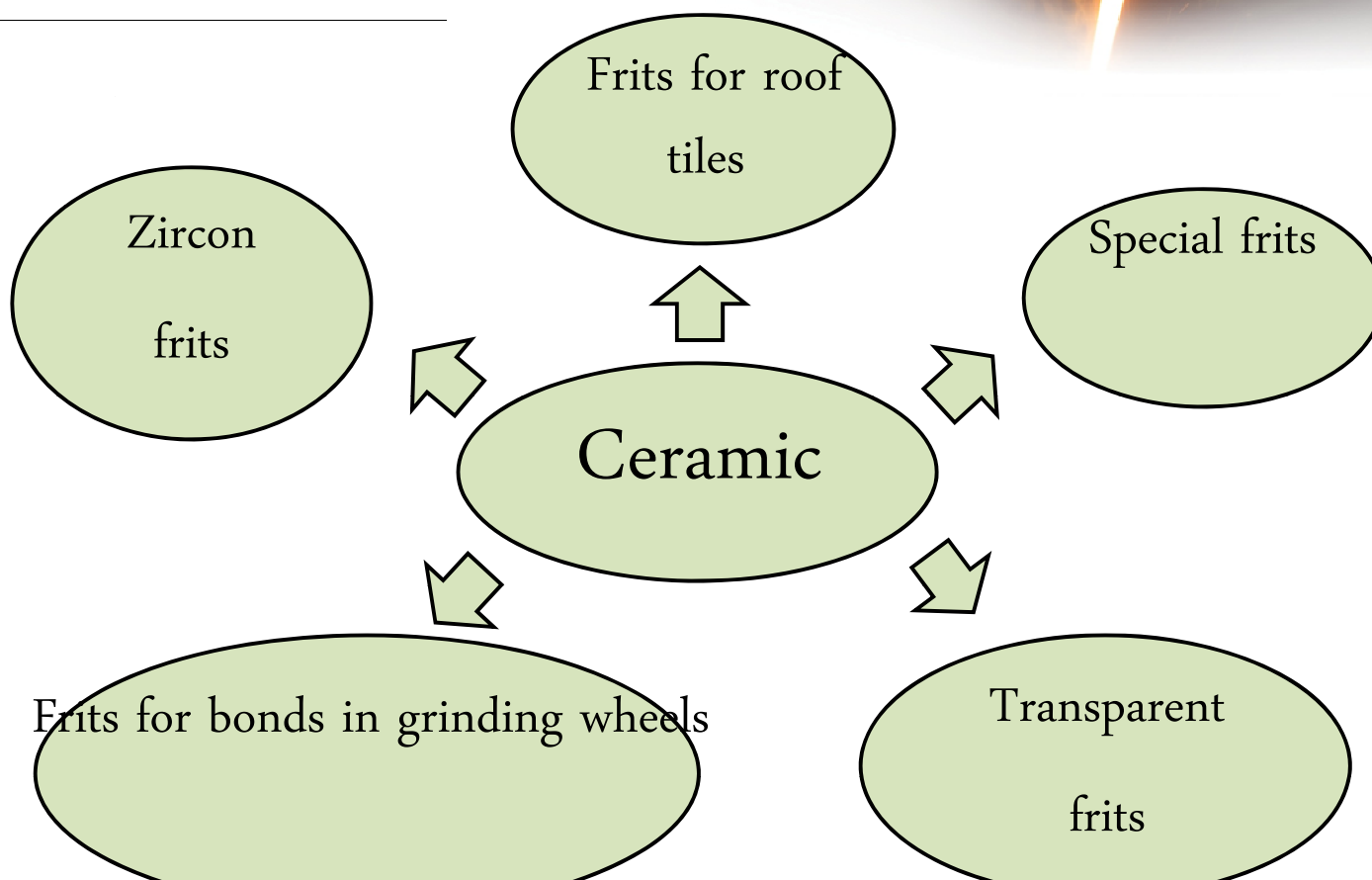
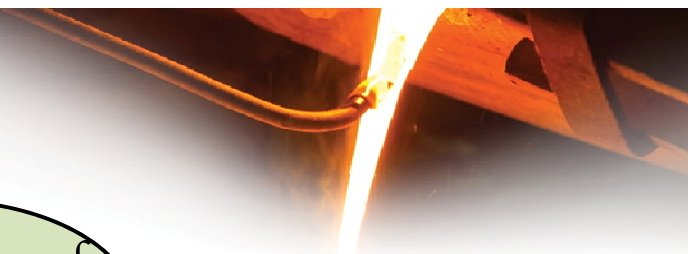
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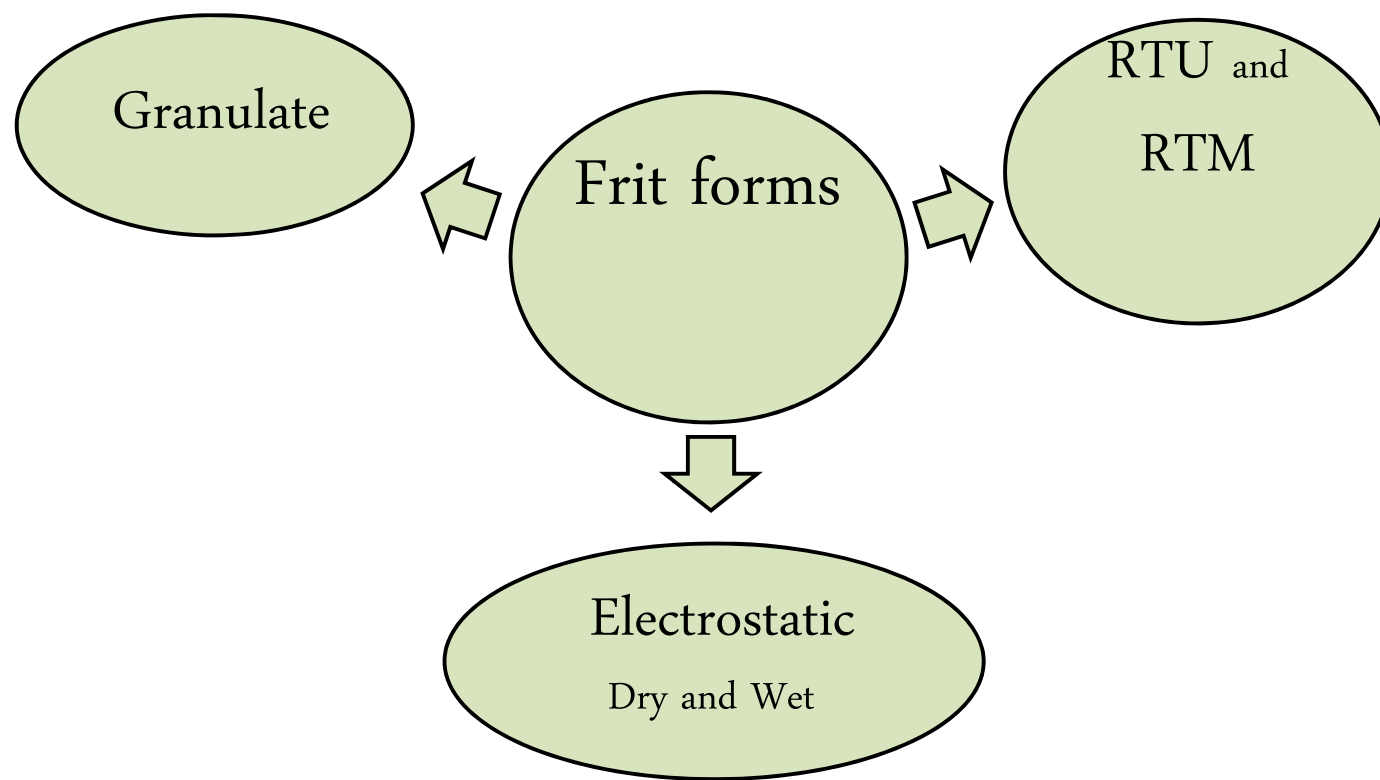
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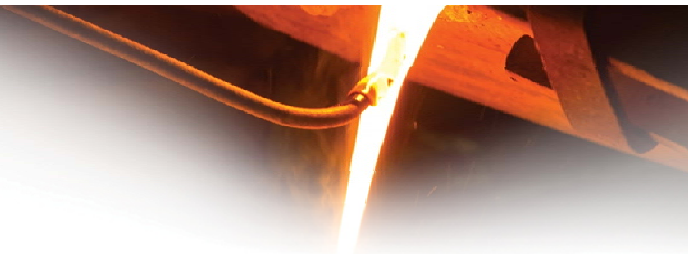




Our **ADVANTAGES...**

Every **CUSTOMER** receives
OUR individual **ATTENTION...**





WE have OVER 1700 products
CUSTOMERS can choose from...





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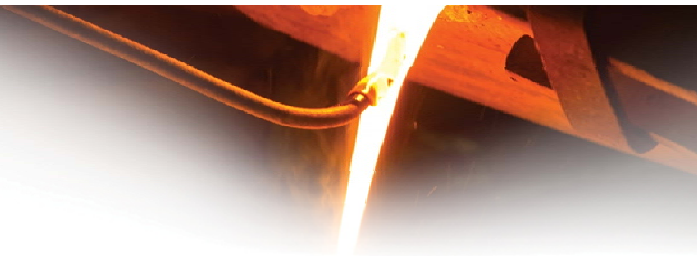
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FROM the year 1996...

ISO 9001

BUREAU VERITAS
Certification





SUSTAINABLE development...

and WASTE reduction...

ENVIRONMENTALLY

friendly company...





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PRODUCTS worthy of
your CONFIDENCE





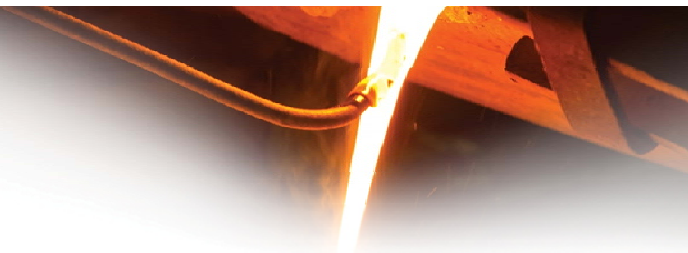
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Our **VALUES...**



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Flexibility

Reciprocity

Economy

Responsibility

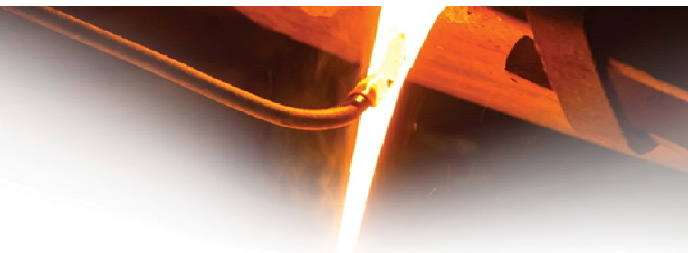
Research

Ambition



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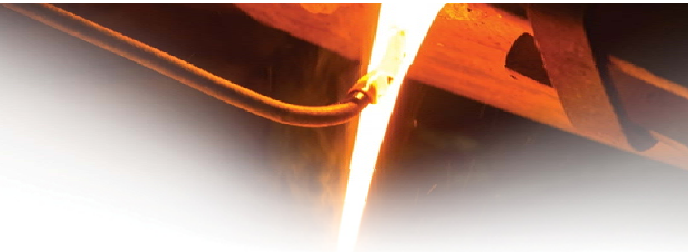
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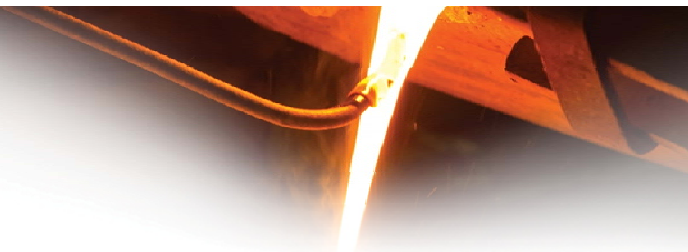


Wouldn't it be great if we could get
POWDERS OF FRITS DIRECTLY
from the molten state?



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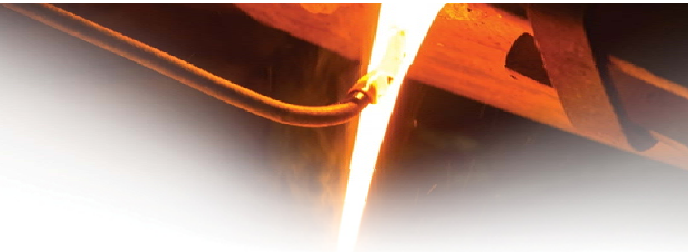


CAN this be DONE?

YES....

HOW?

By RAPID SOLIDIFICATION...

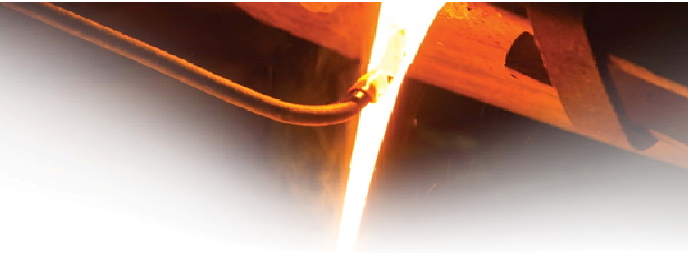


WHAT is rapid solidification?



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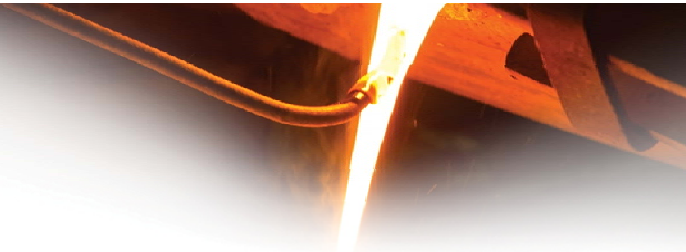


It is a process of **RAPIDLY COOLING** the
MELT...



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One way this is achieved is by using water

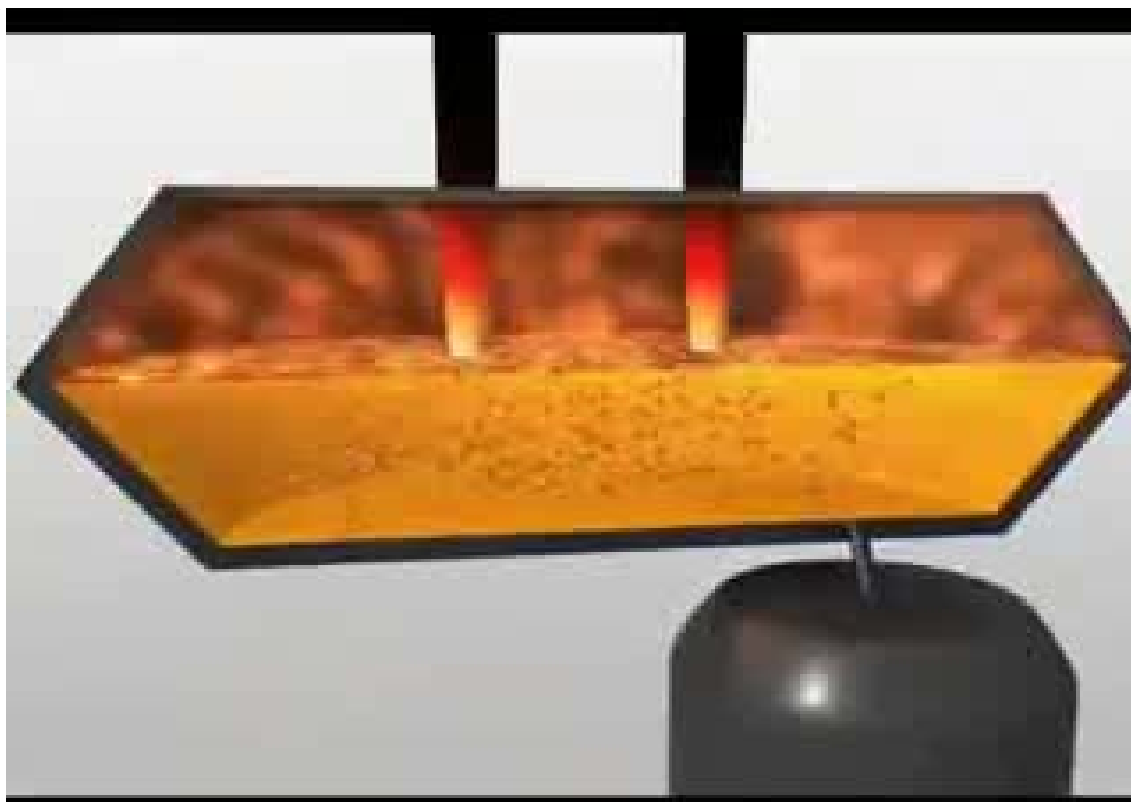
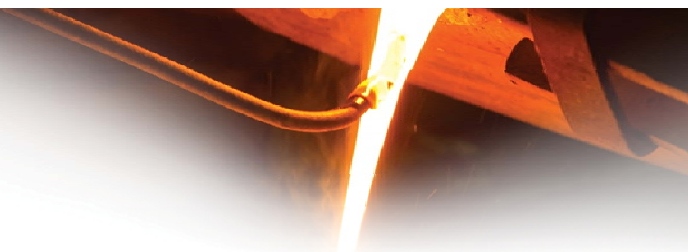
AT HIGH PRESSURE known as

WATER ATOMIZATION...



FRITE

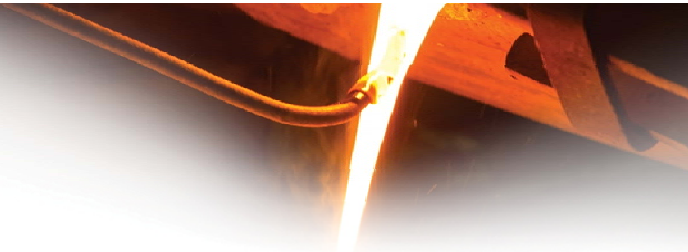
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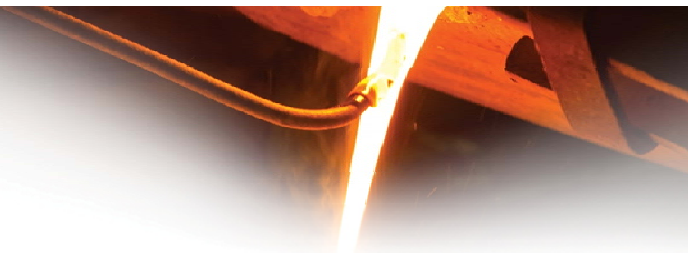


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Small MICRON SIZE particles (powder) are
INSTANTLY formed.

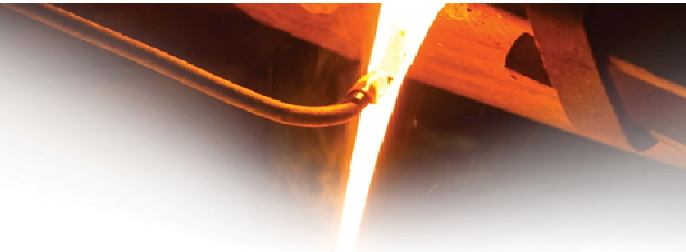


WHY is that BENEFICIAL?



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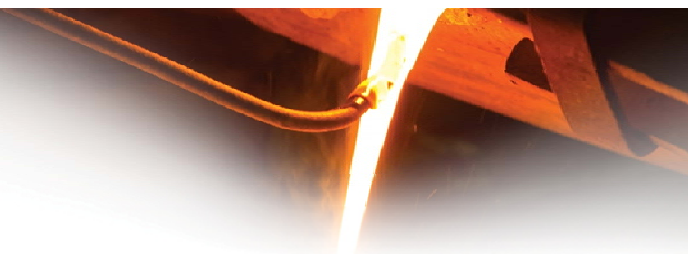


NO NEED for the grinding phase – powder is
produced **DIRECTLY** upon cooling the melt.



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WHAT we did?



University of Maribor

Faculty of Chemistry and
Chemical Engineering



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2 frits

A and B

2 procedures

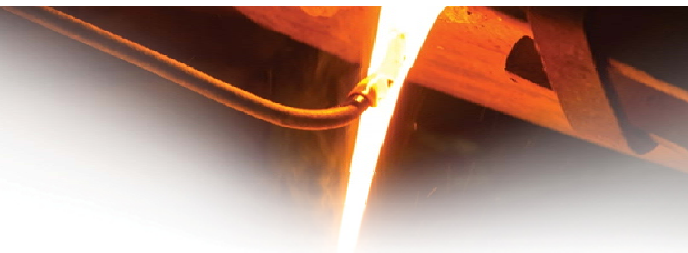
ATOMIZATION and MILLING

(NEW procedure)

(OLD procedure)



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Atomization SET-UP

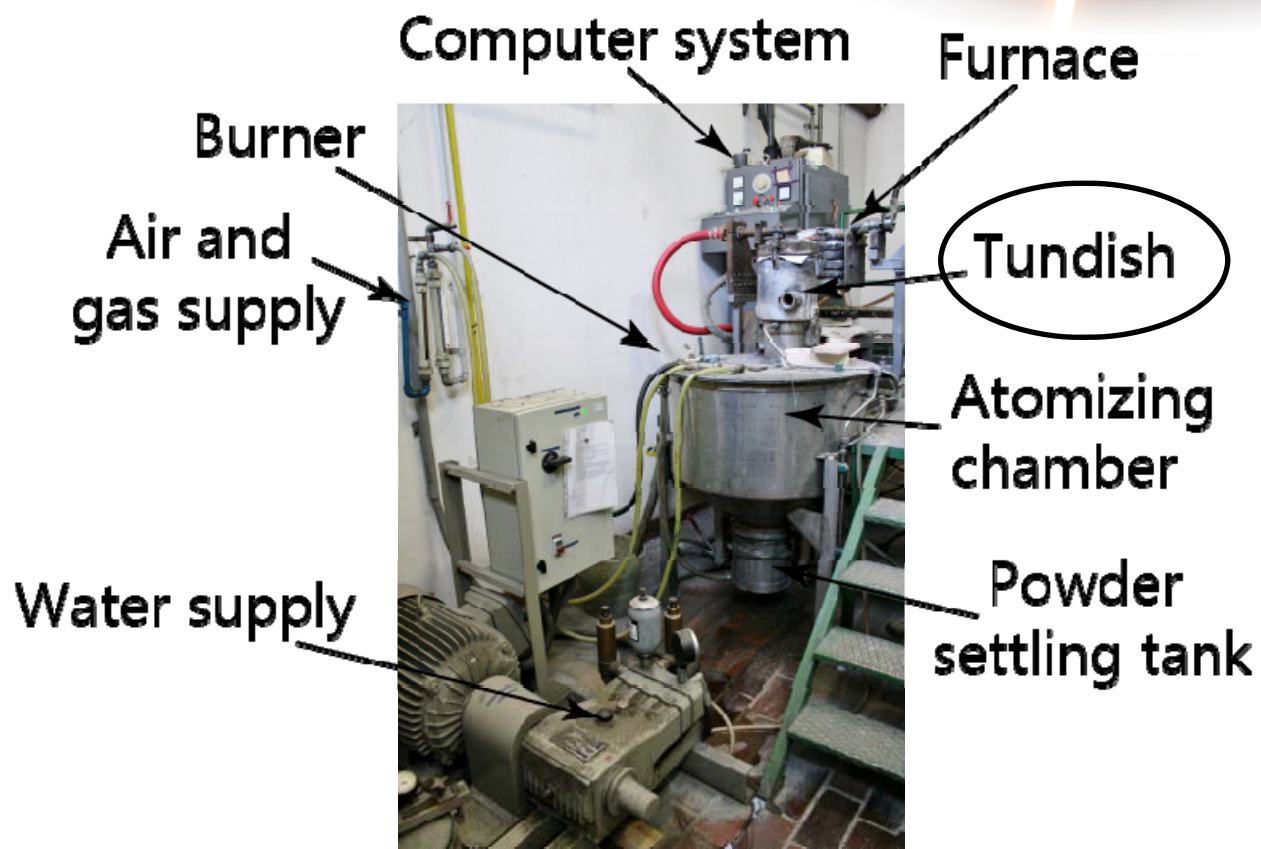
and

process PARAMETERS



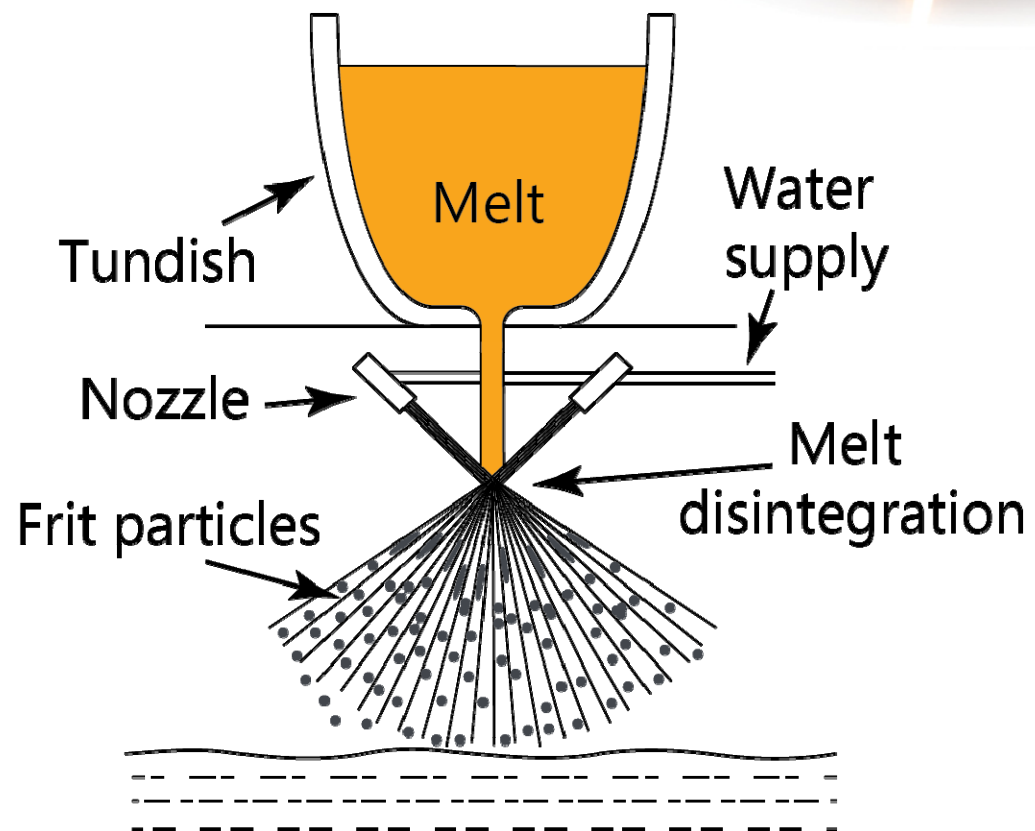
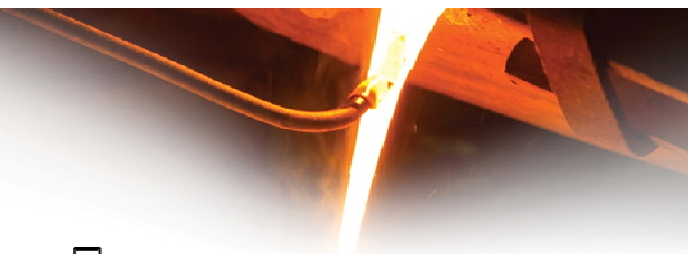
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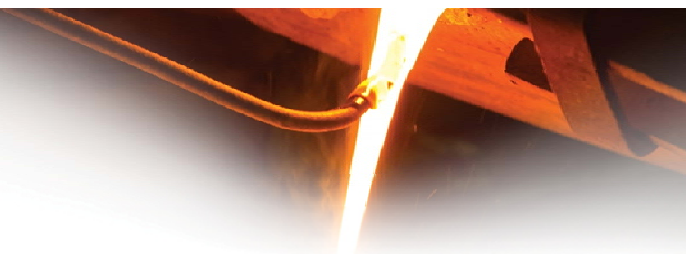
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FRIT	TEST	p_v/bar	$2r/\text{mm}$	$T_m/^\circ\text{C}$	
A	1	215	6	1 250	→ <i>2r</i> influence
	2	215	5	1 200	
	3	215	4	1 276	
	4	215	5	1 280	→ <i>p</i> influence
	5	100	5	1 249	
	6	50	5	1 271	
B	1	215	5	1 417	→ <i>T</i> influence
	2	215	5	1 324	
	3	215	5	1 205	
	4	215	5	1 067	
	5	50	5	1 296	
	6	50	5	1 298	



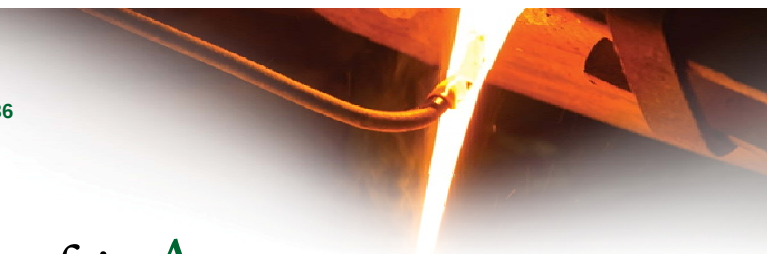
FRITE

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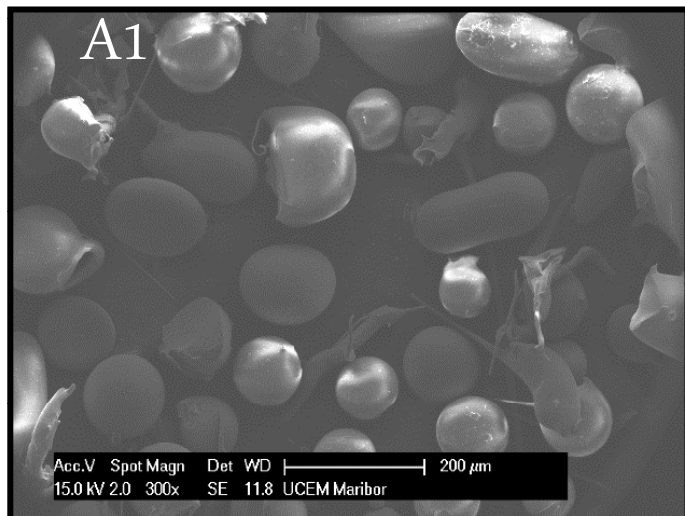
The RESULTS....



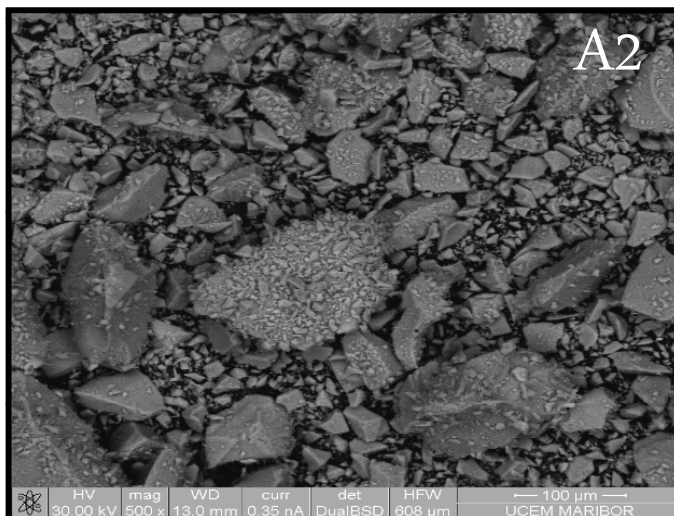
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Morphology frit *A*



Atomized

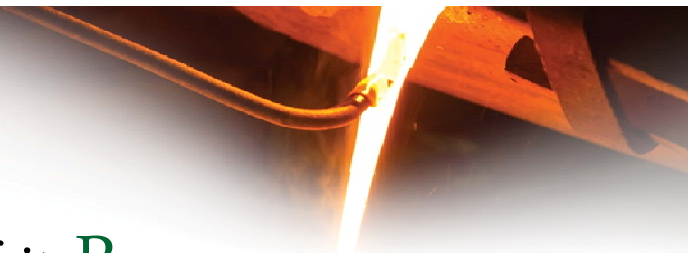


Milled

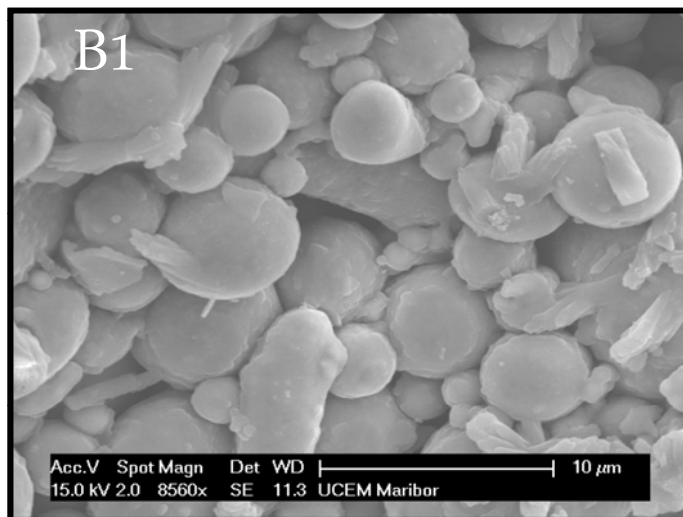


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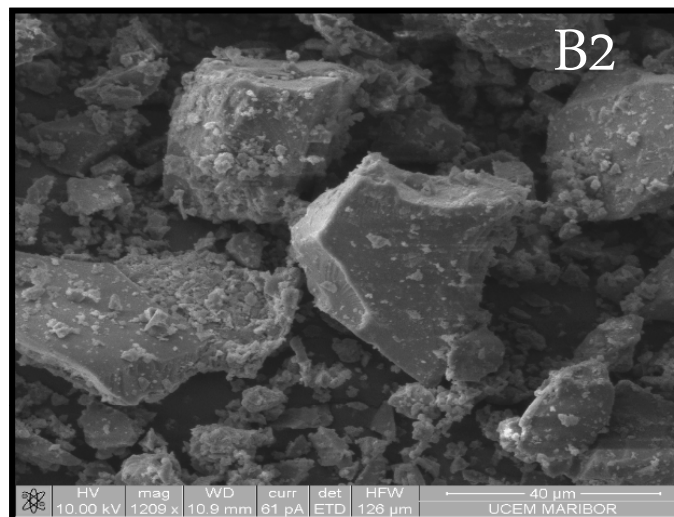
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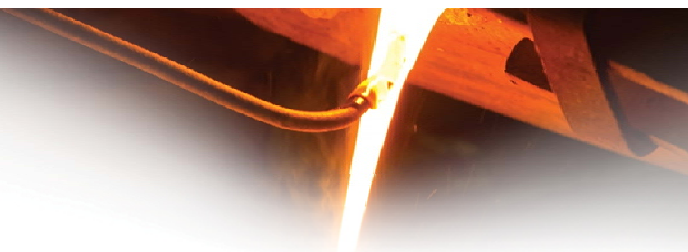
Morphology frit **B**



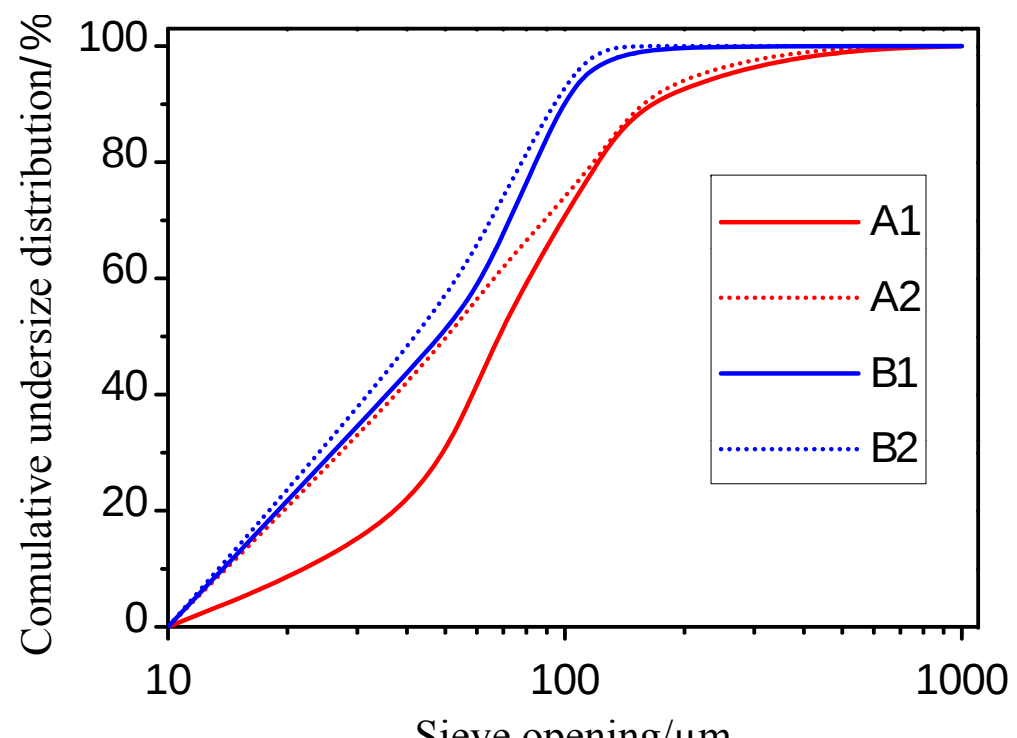
Atomized



Milled

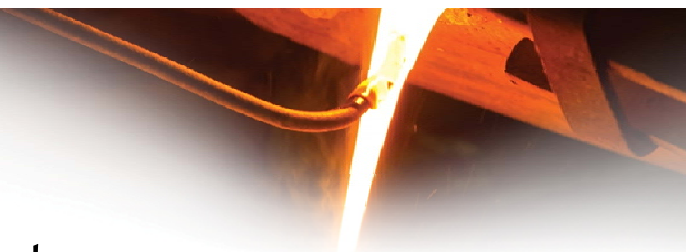


Particle size

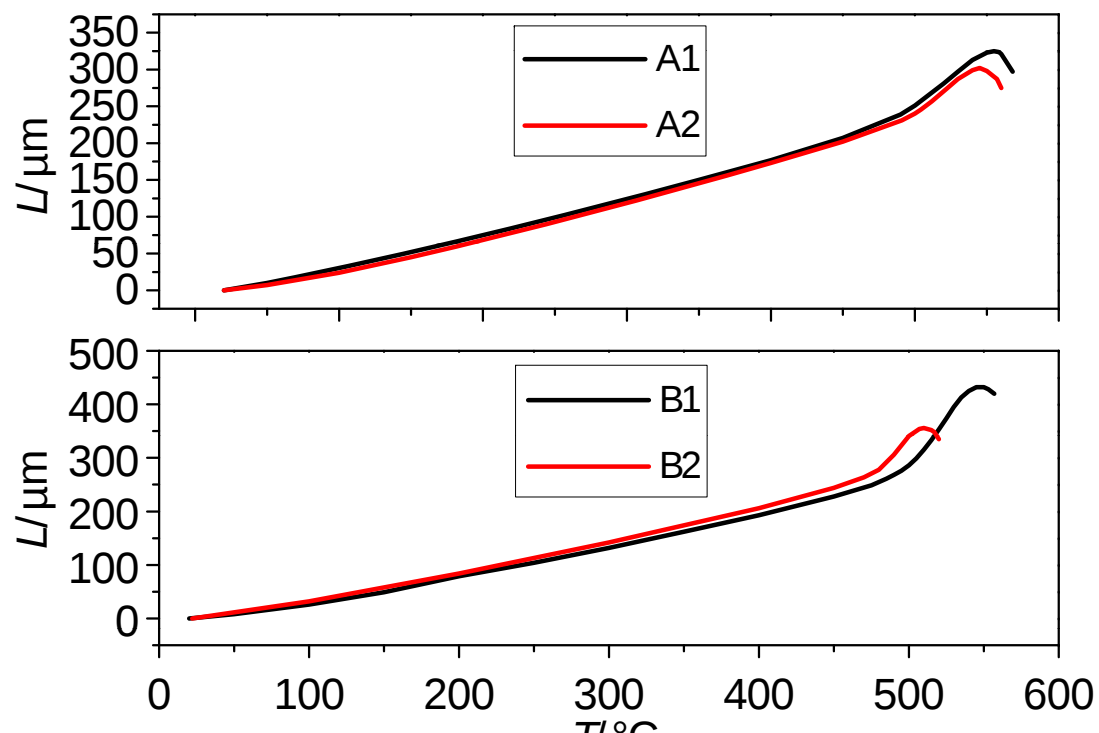




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Dilatometry

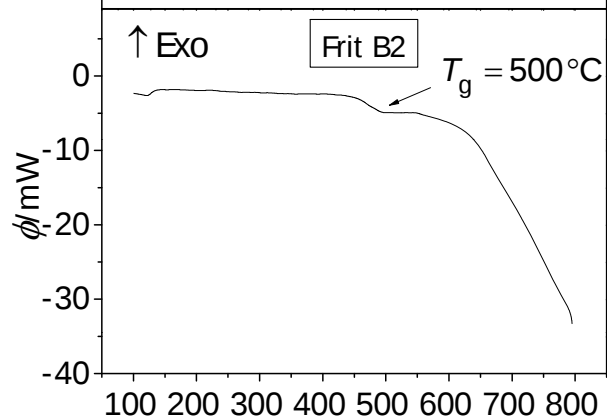
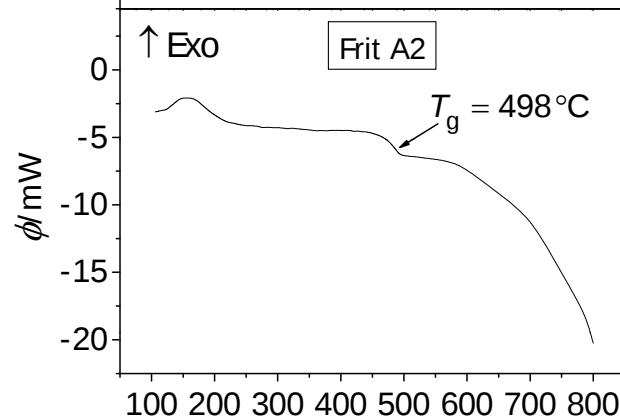
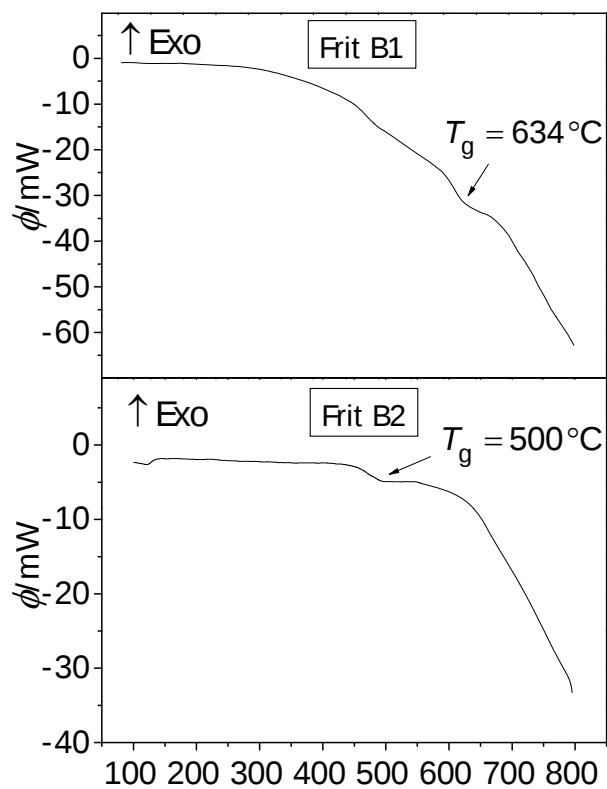
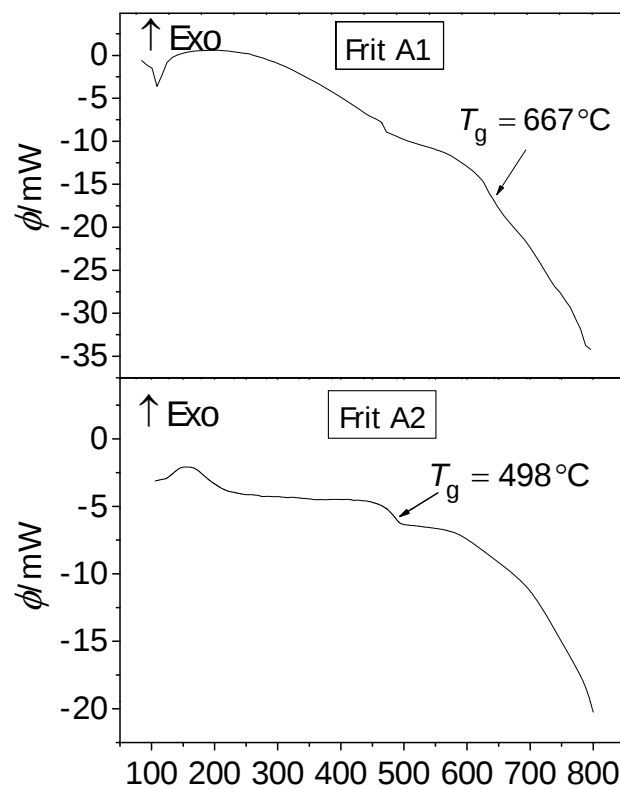
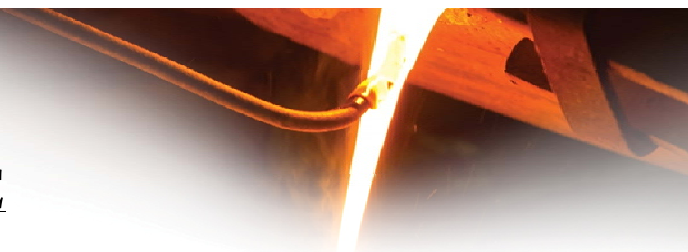




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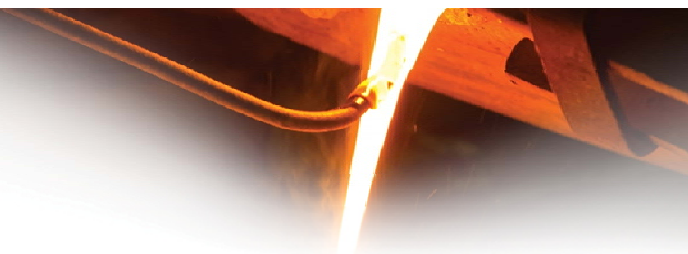
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DSC





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Hot stage microscopy

Frit	S/°C	M/°C	HB/°C	F/°C
A1	550	665	715	745
A2	540	620	660	700
B1	545	620	695	760
B2	540	610	685	740



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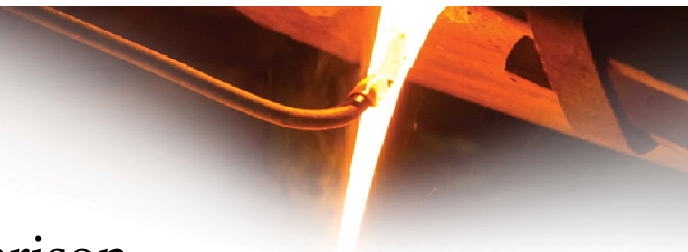
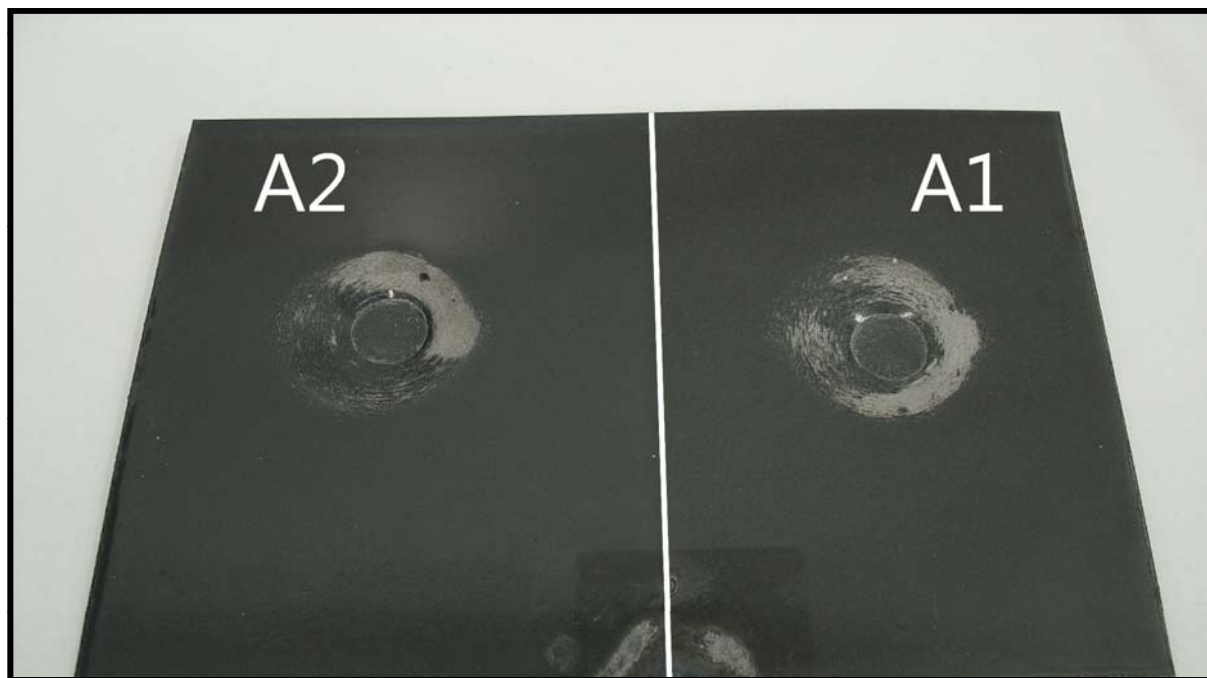


Plate comparison





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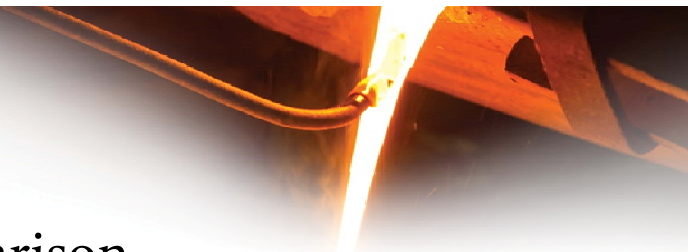
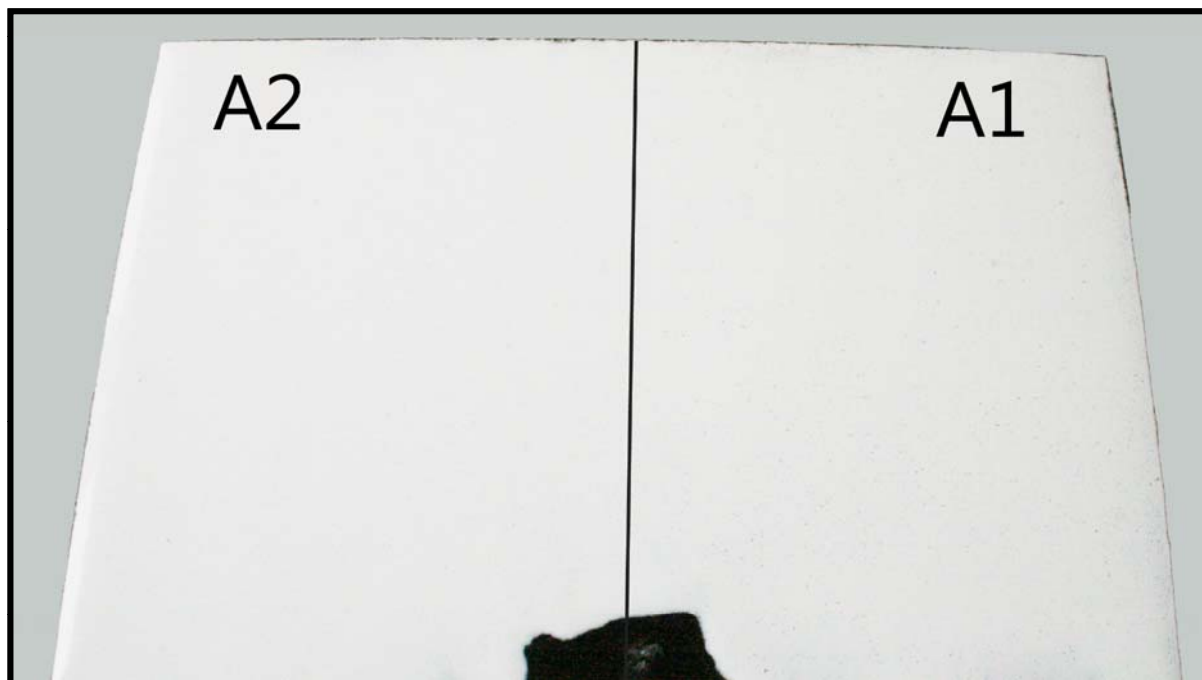


Plate comparison





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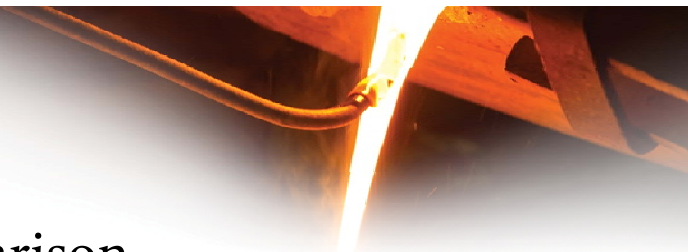
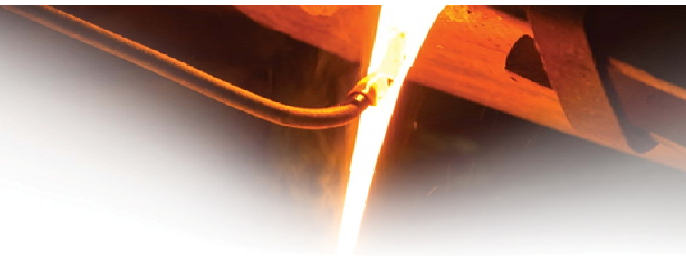


Plate comparison





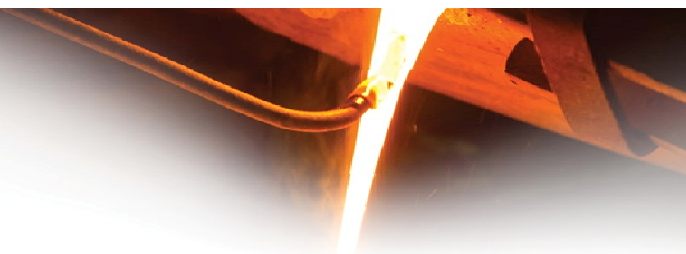
Other RESEARCH and COLLABORATIONS...



University of Maribor

Faculty of Chemistry and
Chemical Engineering





Boiler PRETREATMENT...



Shot blasting technology for processing of boiler internal surface
before enameling

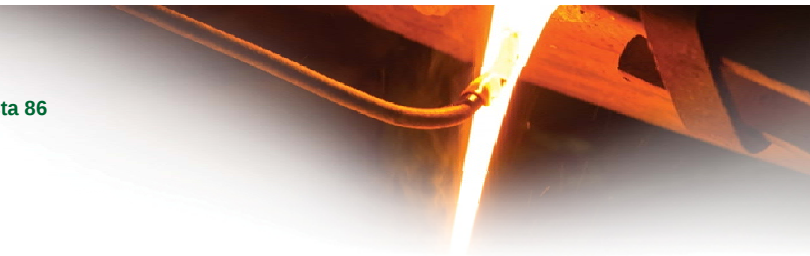
TÜV certificates (RTU and
electrostatic

powder) for **WATER**

HEATERS...

↓
SALES all

over **EUROPE...**



TEST - CERTIFICATE

client : EMO FRITE d.o.o.
Mariborska cesta 86
3000 Celje
Slovenija

receipt of sample : 2010-02-05

report No : 20100646

type of enamel : EMO FRITE E-4414 which is composed of frit:
E-1401 (25 %)
E-1402 (35 %)
E-1403 (39 %)

type of test : DIN 4753-3:2011-11, point 6.4.2

Resistance against hot water

test 1	2.9	g/m ²
test 2	3.2	g/m ²
test 3	2.0	g/m ²
test 4	2.8	g/m ²
average	2.7	g/m ²

CONCLUSION

Regarding the resistance against hot water the enamel tested conforms to the requirements of DIN 4753-3:2011-11.

Munich, 03/03/2010
Department of Analytical Chemistry

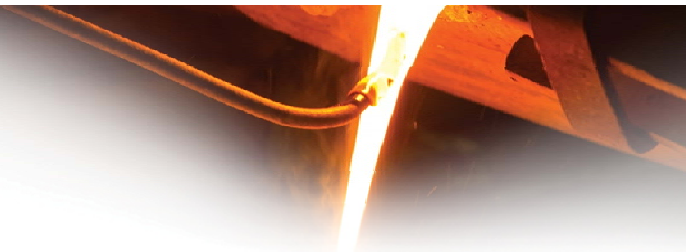

Gabriele Chomada

TÜV EMO Industrie Service GmbH, Rüdernstraße 66, D-85339 München
Telefon: 089 37 01302, Telefax: 089 37 01 3236, E-Mail: Service@emotuv.com
Auftraggeber/Bestellender: Karlhan Kautsch, Guss- und Schweißerei, Zug, bei Fiedler/Hörmann/Schuchert,
D-14469 Miel, Thunberg-Röhre
Stm.: Heizungsanlagentechnik@fiedler.com, 030 456 3010-1010, Informationsdienst: info@fiedler.com, 1.04.10101010
www.fiedler.com

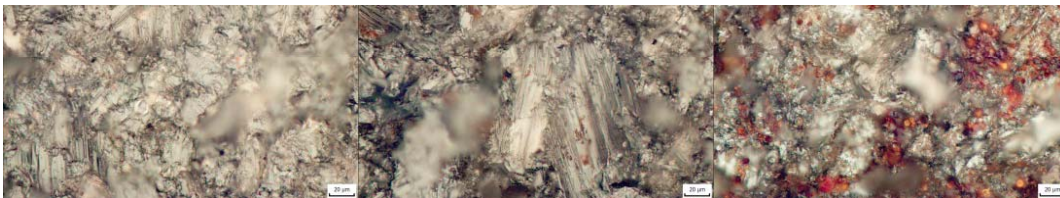


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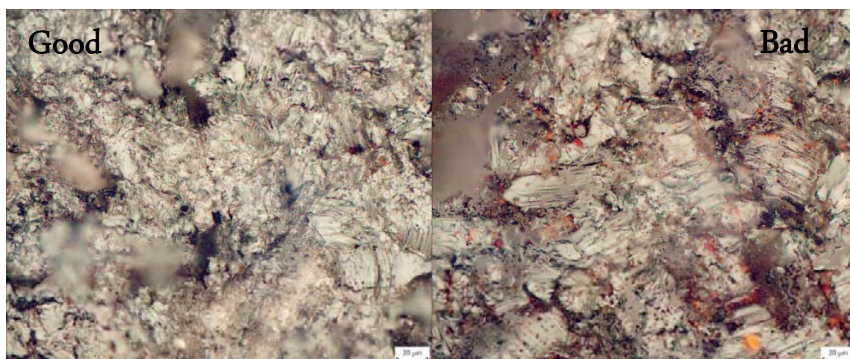
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Controlling CORROSION and CONTAMINATION



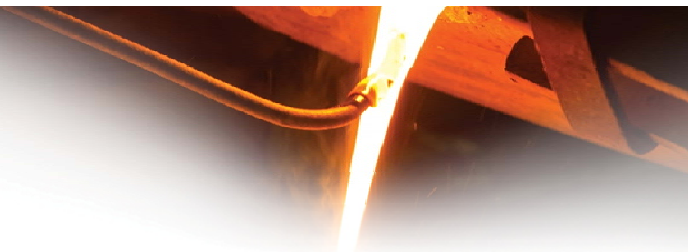
Bad abrasive quality or abrasive with oil&grease promote corrosion...



!!More information at
FerroČrtalič poster!!



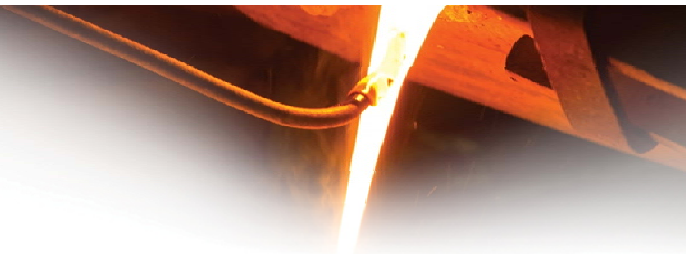
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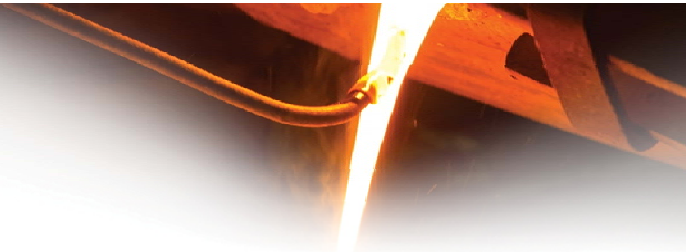
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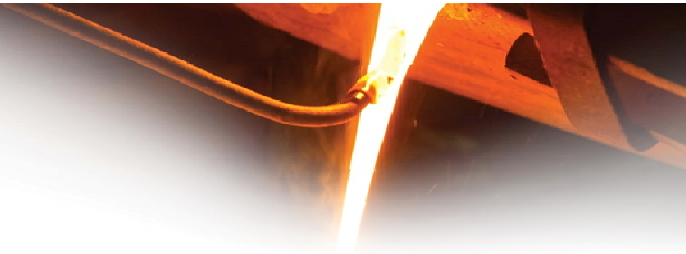
3. CONCLUSION



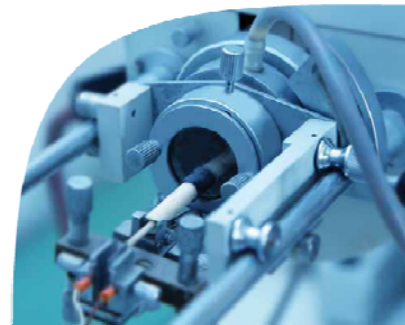
Rapid solidification or water atomization proved
to be a very **USEFUL TECHNOLOGY** for
PRODUCTION of **FRITS** in their
POWDER FORM...

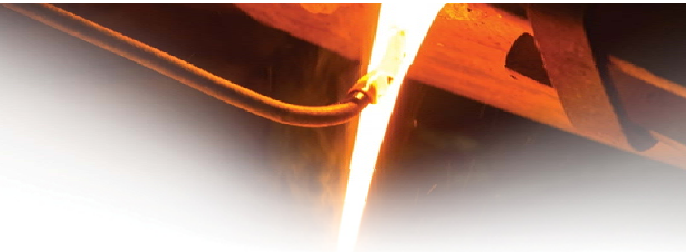


1. Powders of frits were produced **DIRECTLY** from the **MOLTEN STATE** – **NO NEED** for the grinding phase.
2. **ENERGY, TIME** and **LABOUR** are thus substantially **REDUCED**.



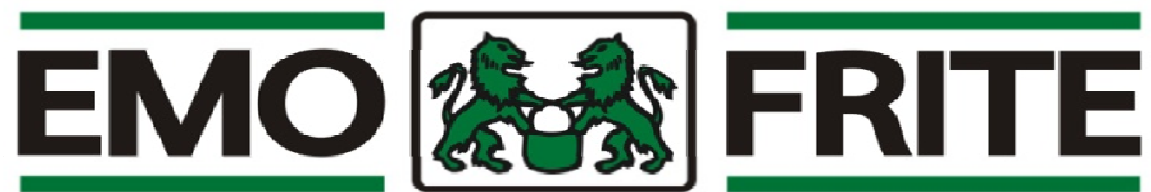
3. IDENTICAL PROPERTIES of atomized and milled FRITS furthermore confirm the USABILITY of the USED TECHNOLOGY and...





4. **HIGHER** glass transition temperatures and
SPHERICAL MORPHOLOGY are usually
BENEFICIAL, for the end product as well...





Products worthy of your confidence