

Experiences with the crucible blister test

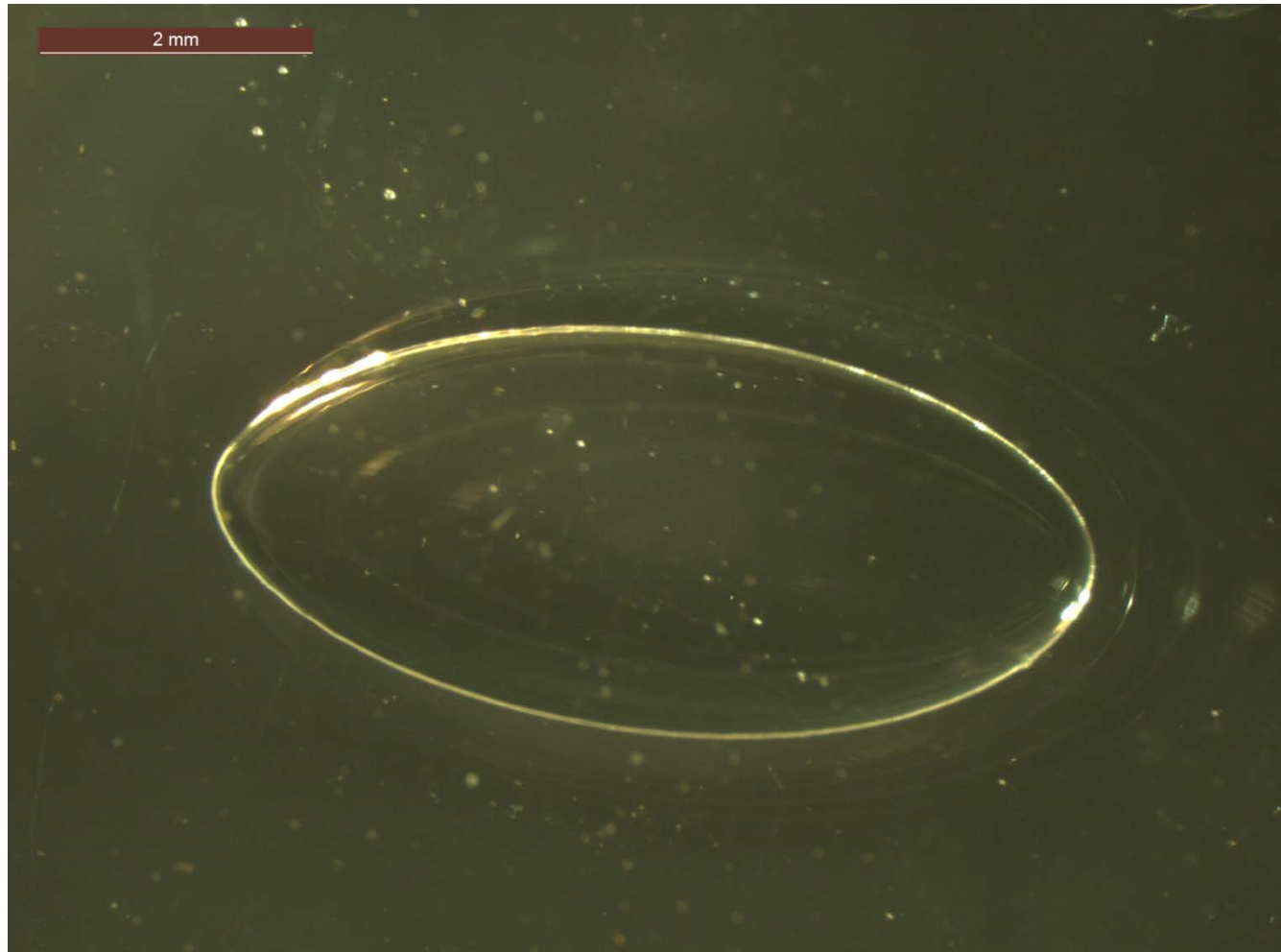
TC11 Meeting
Düsseldorf, 22.10.2018



FUSED CAST REFRACTORY

- Glass quality and glass tank lifetime are determined by refractory properties:
- Corrosion
- Exudation
- Blistering

- Bubbles are the visible appearance of gases in the final glass products.
- Severe glass defect, because they impair the most important glass feature, the clear view.
- Compared to the solid state of glass, bubbles belong to the heterogeneities of glass.





Introduction

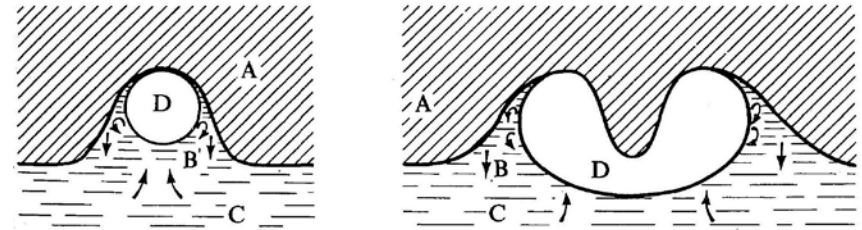
Feeder cover



Feeder cover detail



Schema of accelerated vertical corrosion caused by boundary layer convection, surrounding gas bubbles.



Ref. Trier 1987

- A — refractory
- B — solution of A in C
- C — glass melt
- D — gas bubble

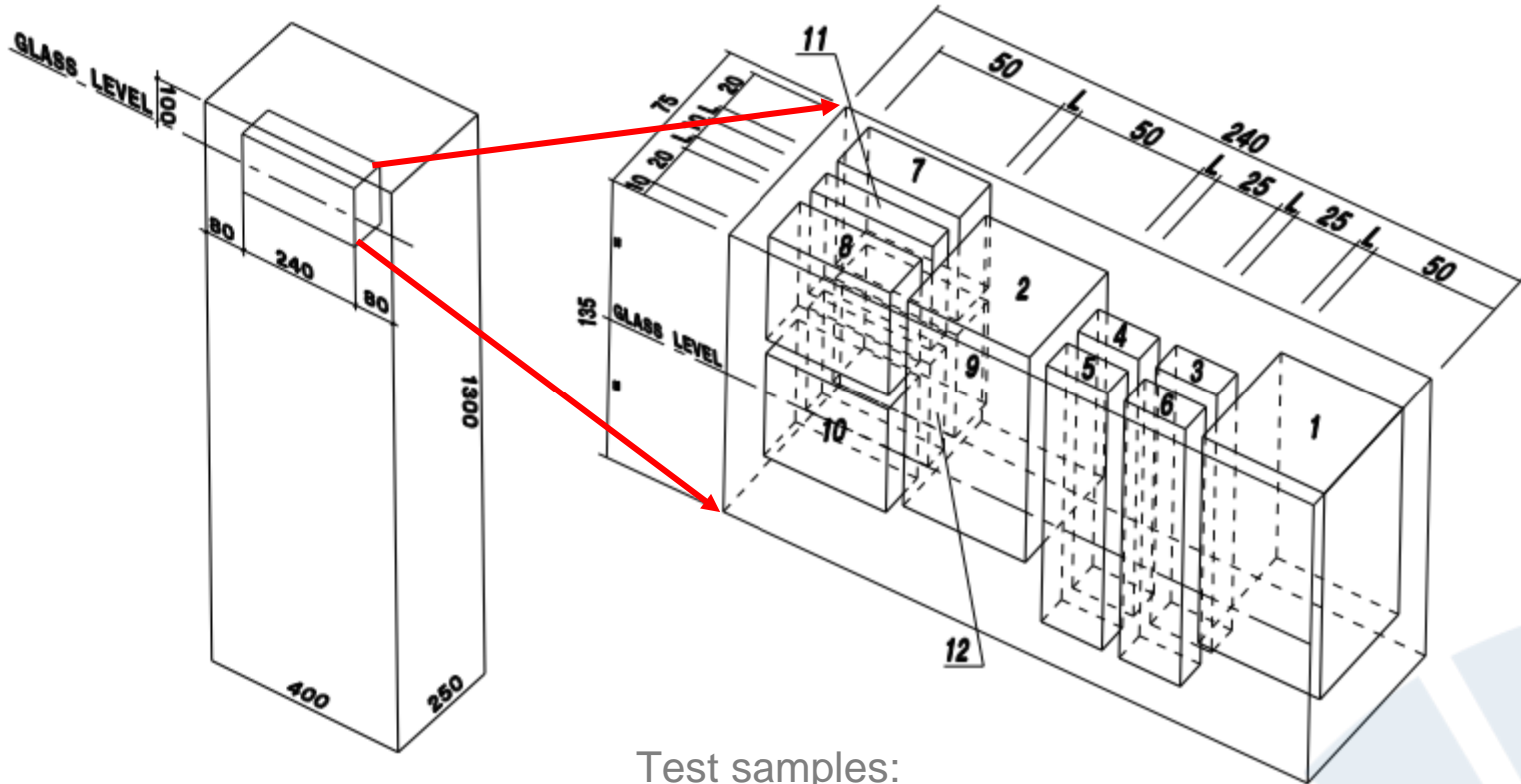
- The formation of bubbles can have various reasons.
- The different thermal and chemical reactions in a glass melting furnace (batch reaction, melting up to batch-free, refining) are responsible for the bubble content of the glass.
- There are also external causes. Bubbles are mechanically entrained by stirrers or plungers from the furnace atmosphere.
- Bubbles arise due to solid or liquid impurities inside the glass melt.

- Refractory materials used for glass melting tank construction can also develop bubbles upon contact with the molten glass.
- The causes of bubble formation are reactions of enclosed reduction products of the fused cast refractories (carbon, metals in elemental form, oxides of low oxidation state) with the molten glass, but also electrochemical reactions.



Intention

The question of the intrinsic potential for bubble creation and the suitable methods for representative and reproducible evaluation arises especially in the case of brand new fused cast refractories.



Test samples:

1-2: Exudation

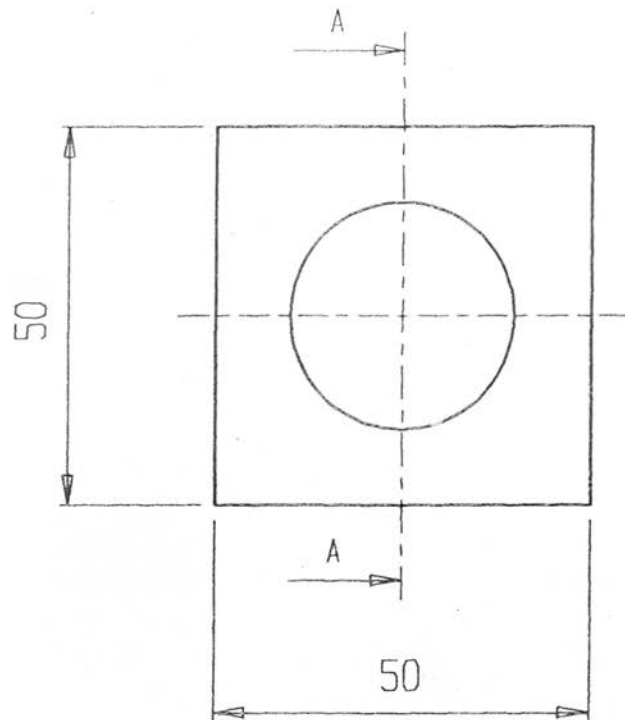
3-6: Corrosion

7-10: Blistering

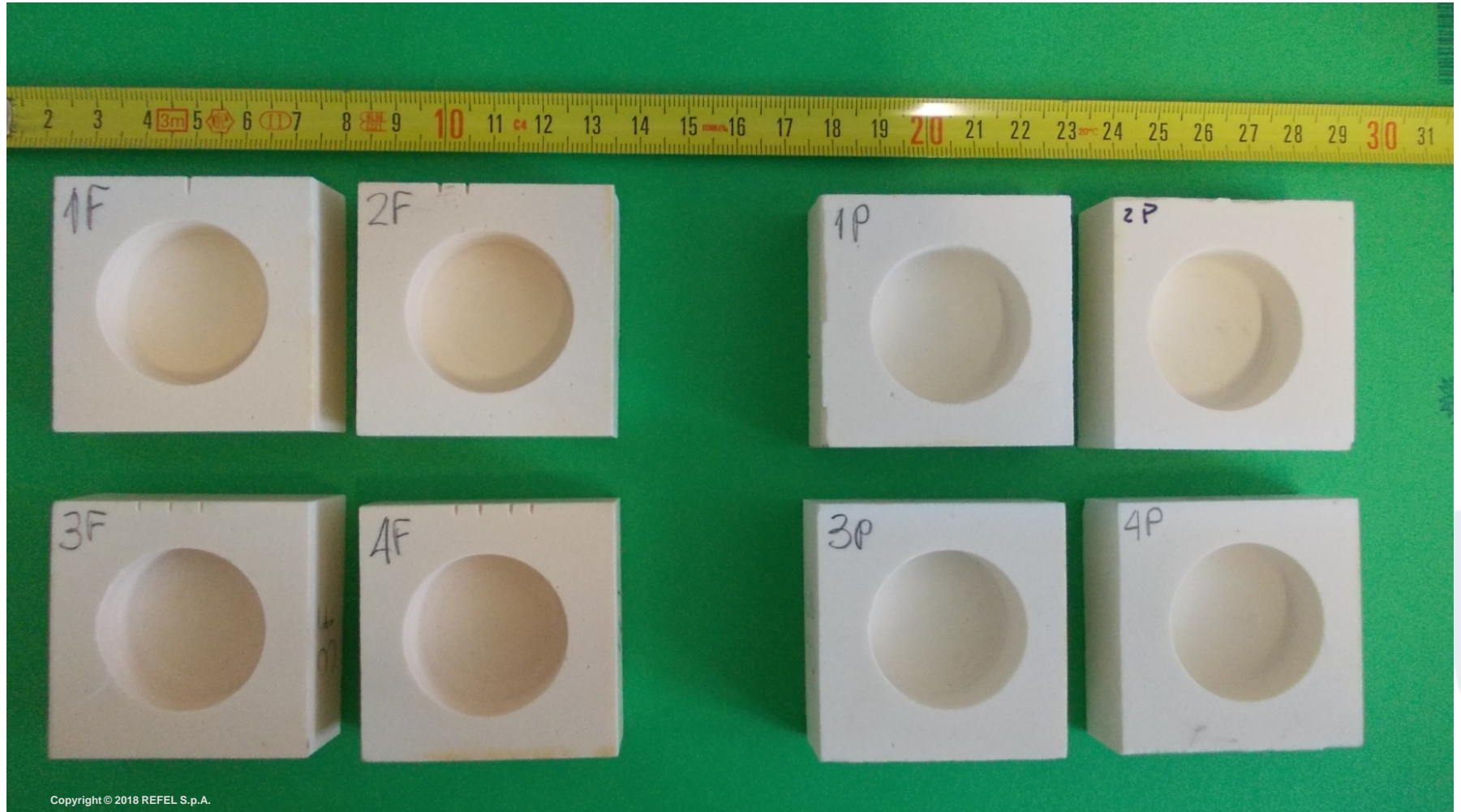
11-12: Chemistry, microstructure



Sample 50 x 50 x 20 mm
1.150 °C x 100 h



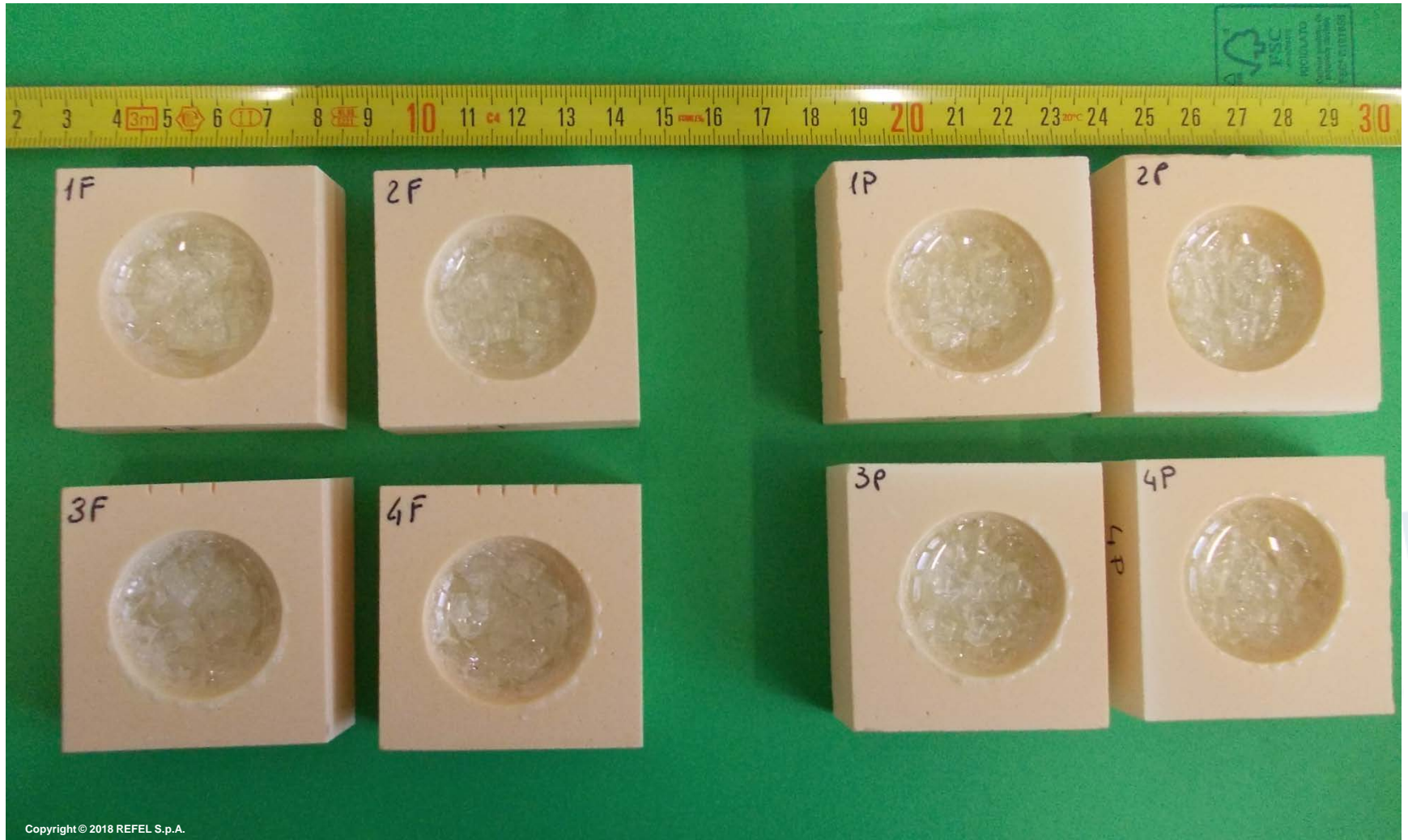




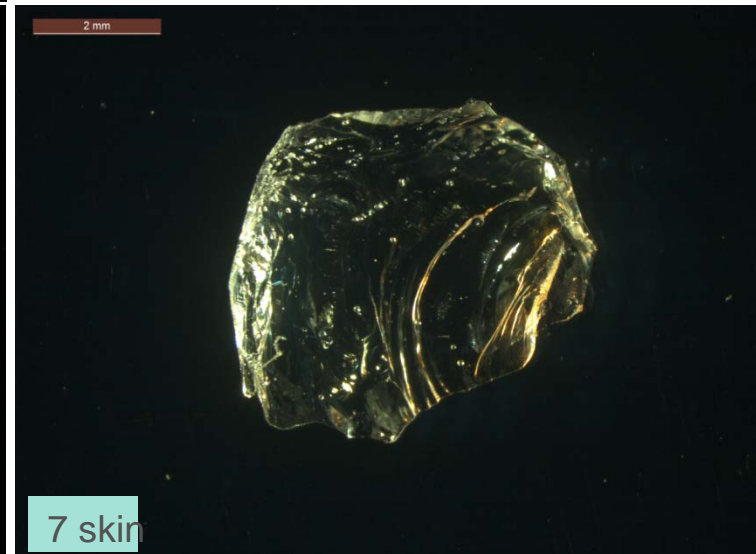
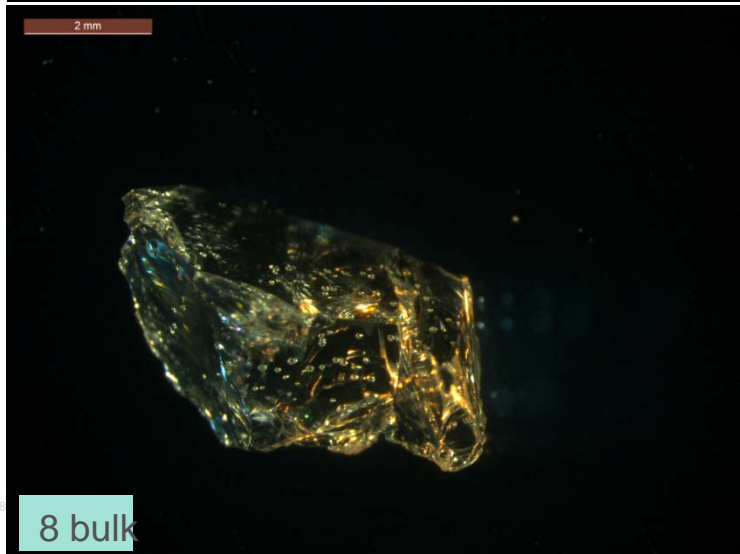
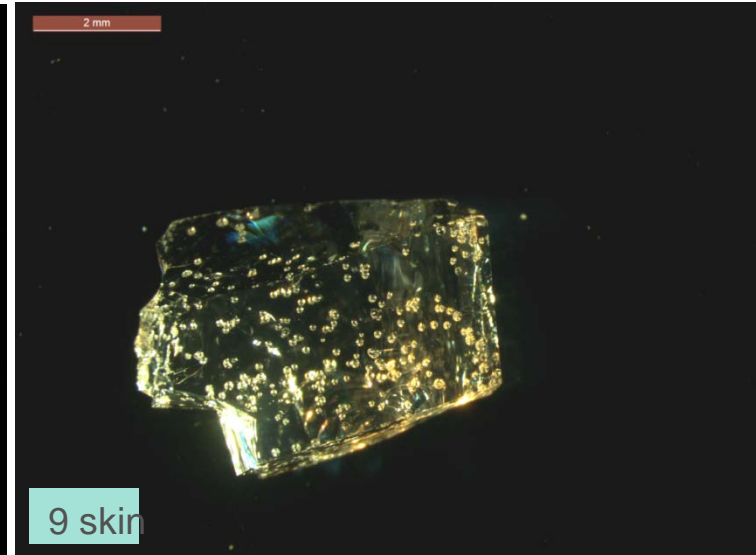
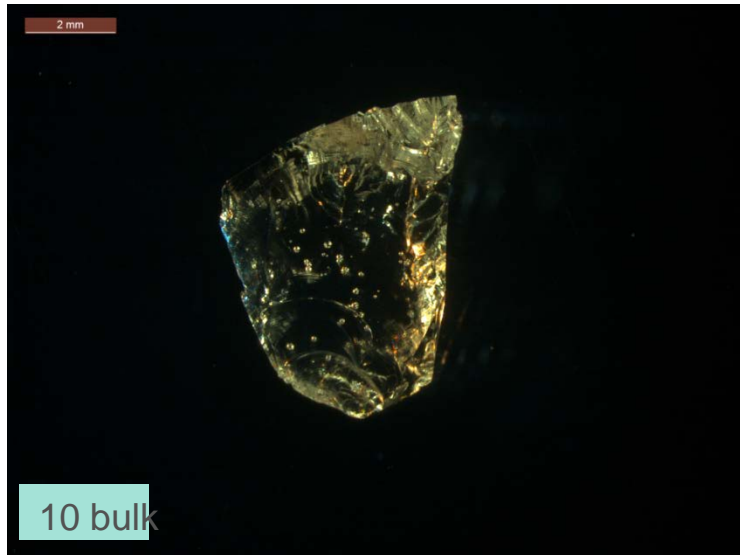
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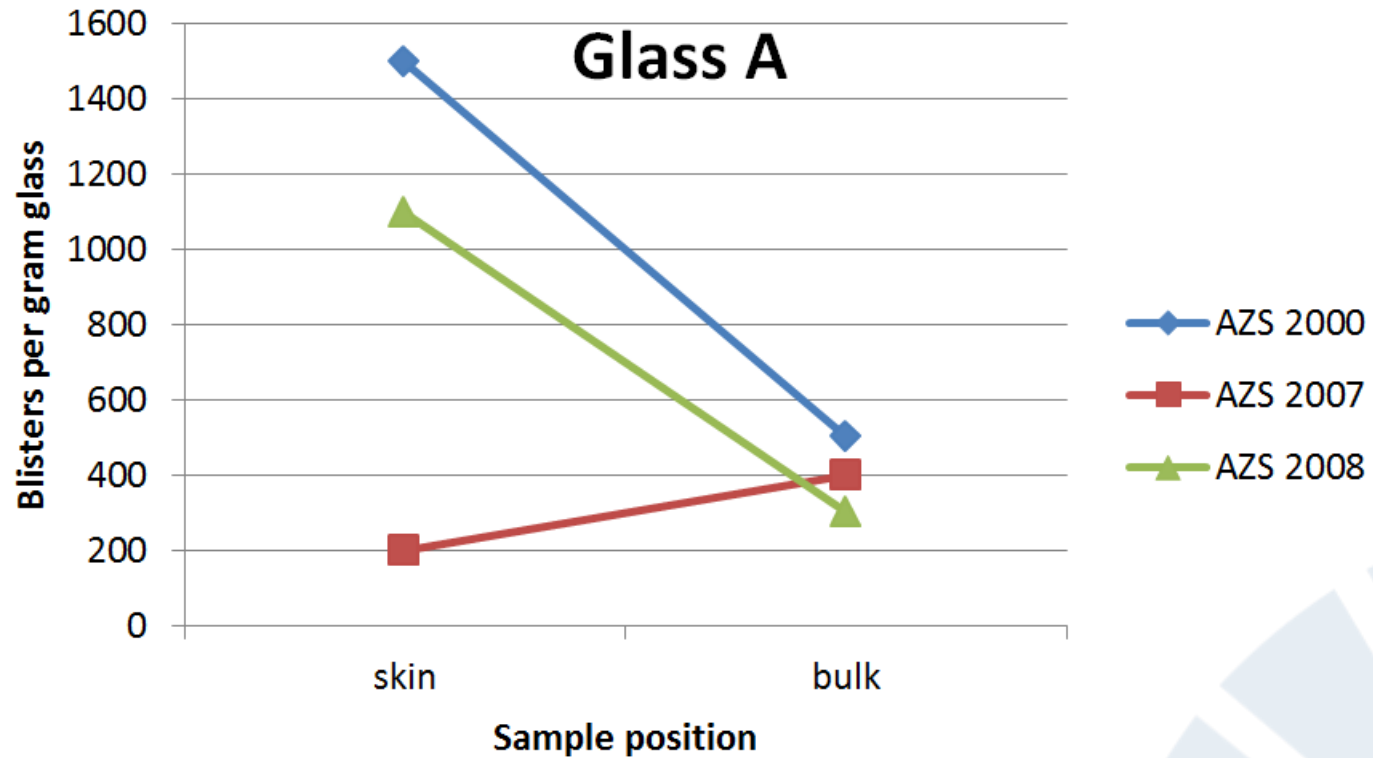
P 2088 1532 FVS : 1F-2F= EXTERN
3F-4F= INTERN

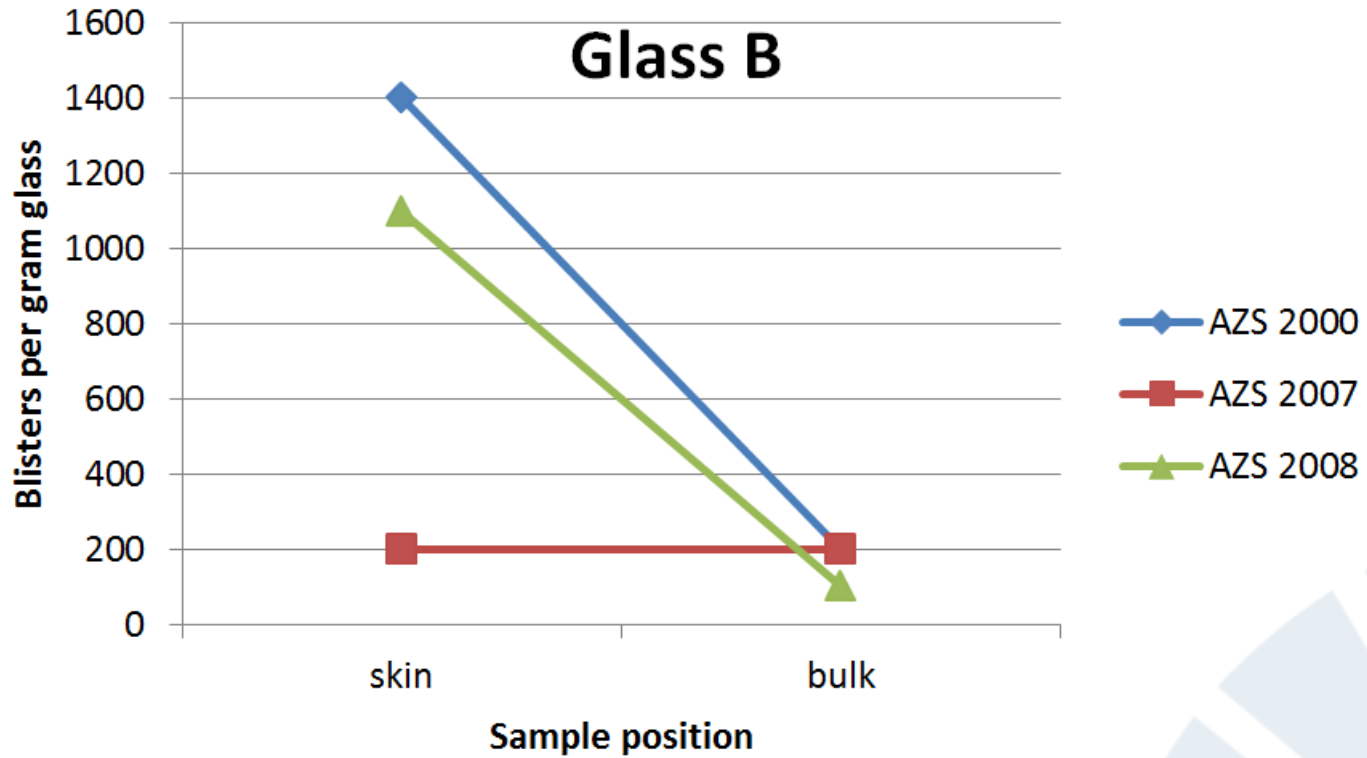
P 2087 1532 FVP : 1P-2P=EXTERN
3P-4P= INTERN

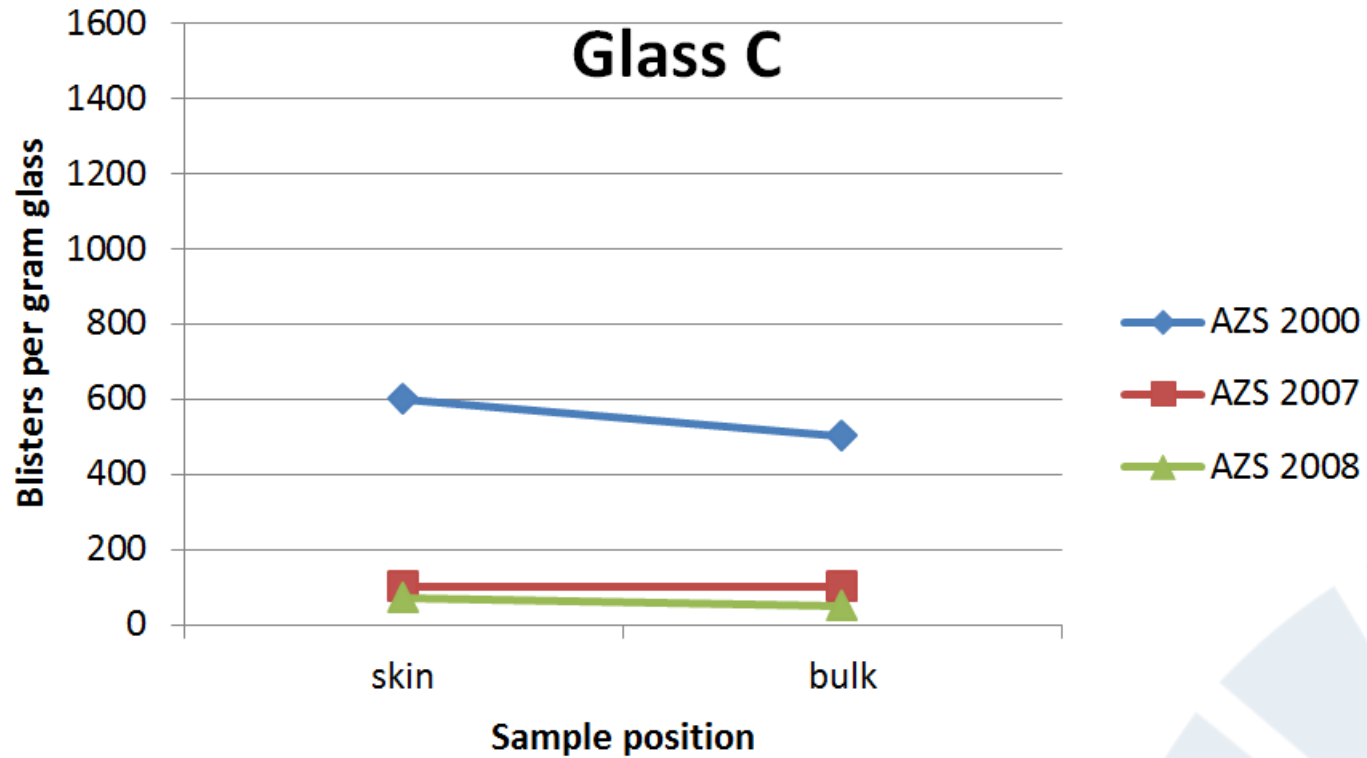


Cut samples after blister test











Test glass

	%Al ₂ O ₃	%SiO ₂	%Na ₂ O	%Fe ₂ O ₃	%CaO	%MgO	%K ₂ O	%Ba O	%SO ₃	%B ₂ O ₃
Glass A	3.62	68.41	12.23	0.07	7.85	3.83	2.95	0.73	0.23	-
Glass B	3.28	68.41	8.03	0.08	7.14	3.30	8.78	0.73	0.22	-
Glass C	3.96	68.90	12.56	0.01	4.98	2.65	3.21	2.21	-	1

The determination of the blister potential of fused cast refractories in contact with glass melts in laboratory tests is always a compromise.

The results are relative and apply only to the respective combination of glass and refractory.



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Any questions?

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