Radar testing of fused cast refractory

TC11 Meeting
Düsseldorf, 22.10.2018

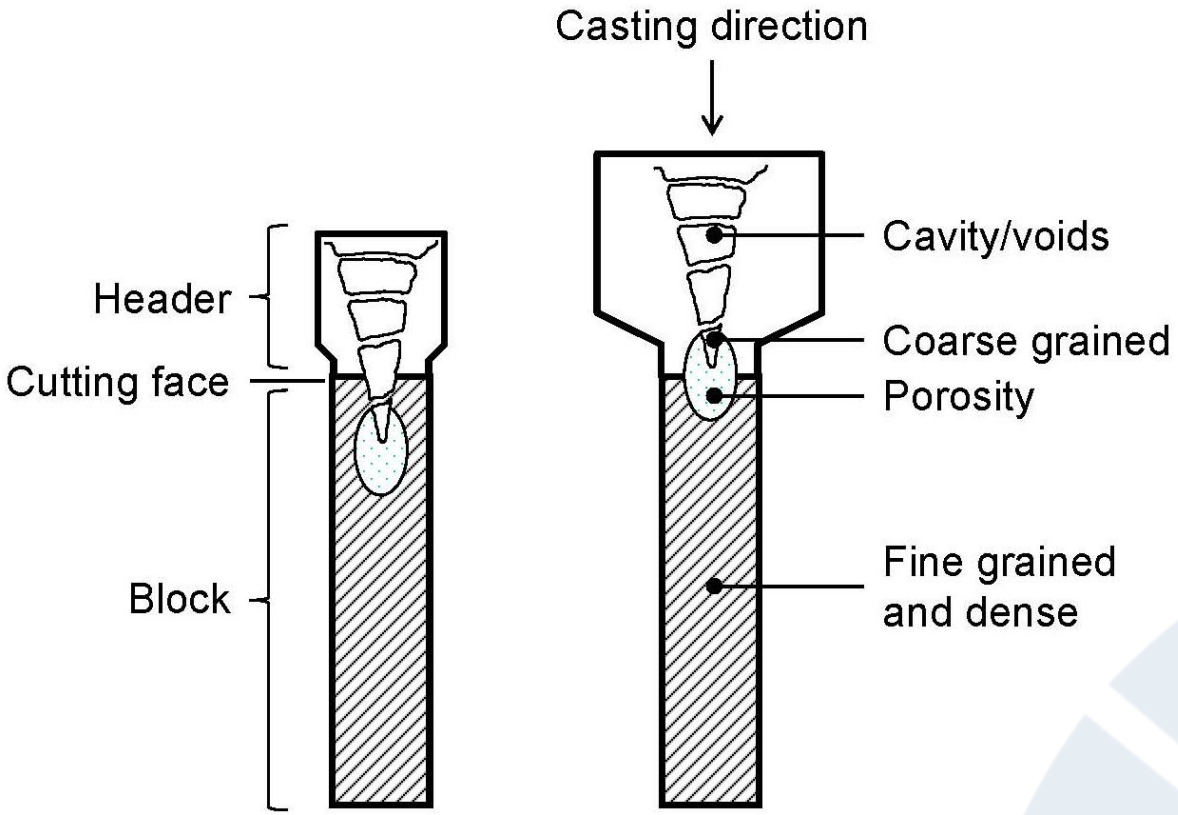
REFEL

FUSED CAST REFRACTORY

Introduction

This presentation describes the application of **non-destructive testing** of fused cast refractory for glass melting tanks using radar technology.

Introduction



Introduction

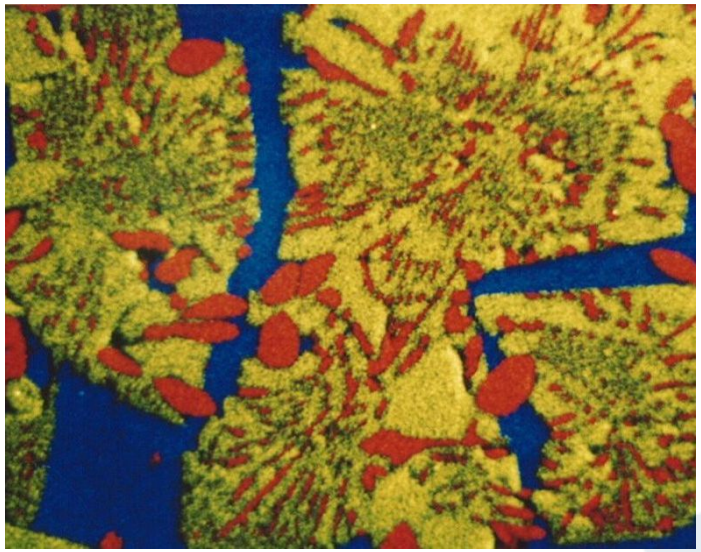
Example: Cavity reduced block (CR) vs free-void block (FVB).

Cut face between the block and casting header. The residual cavity is visible, which is typical for CR. Cross section 250 × 460 mm²

Cut face between the block and casting header of the FVB without any cavity. Cross section 250 × 500 mm².

Relative permittivity

Relative permittivity ε_r
(dielectric conductivity):
Corundum Al_2O_3 (yellow) = 9,3
Zirconia ZrO_2 (red) = 12,5
Vitreous phase (blue) = 6
Fused cast AZS = 8,5



Fused-cast ASZ, scanning electron micrograph as pseudo-colour image with co-precipitated zirconia (red) and corundum (yellow), surrounded by glassy phase (blue). Image width 400 µm.

Procedure

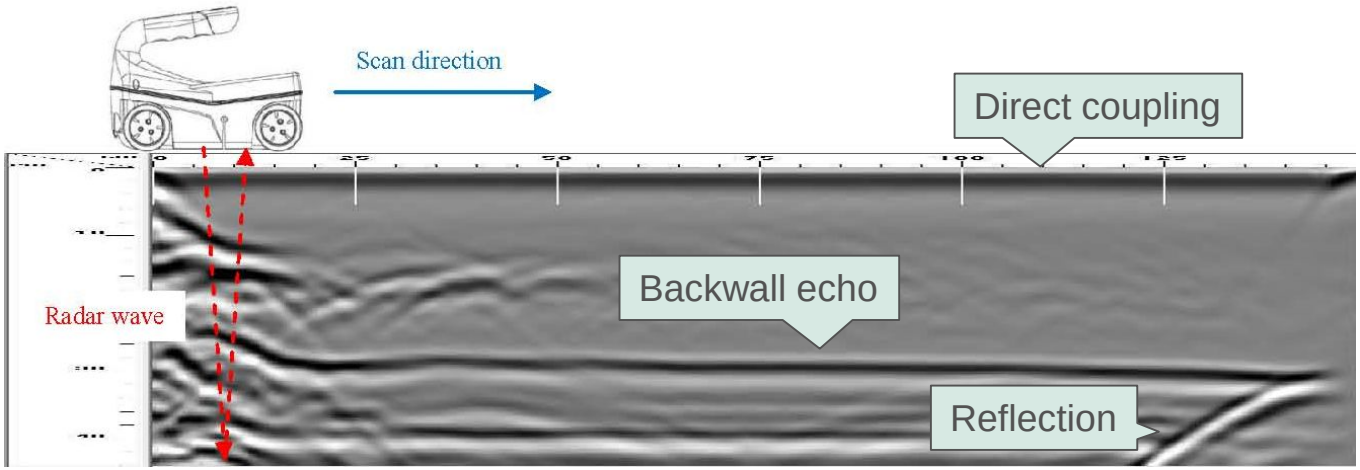
Blocks ready for testing (left). During testing the radar instrument is wheeled along the block surface (right).

Procedure

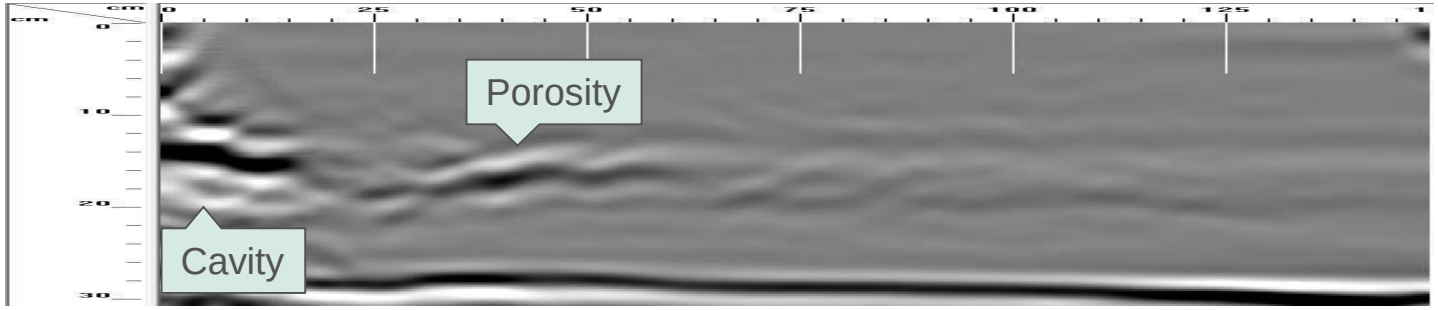
Using the radar instrument a two-dimensional **2D** cross section along the centre line of a block is performed. It is reasonable to evaluate the block internal structure with only one single radar scan, with respect to the almost symmetrical structure of fused cast blocks in correlation to the symmetry plane.

With crosswise multiple scans (scan grid has to be prepared) also a tomography-like **3D** measurement is possible —however— increasing the time expenditure significantly.

Radar image



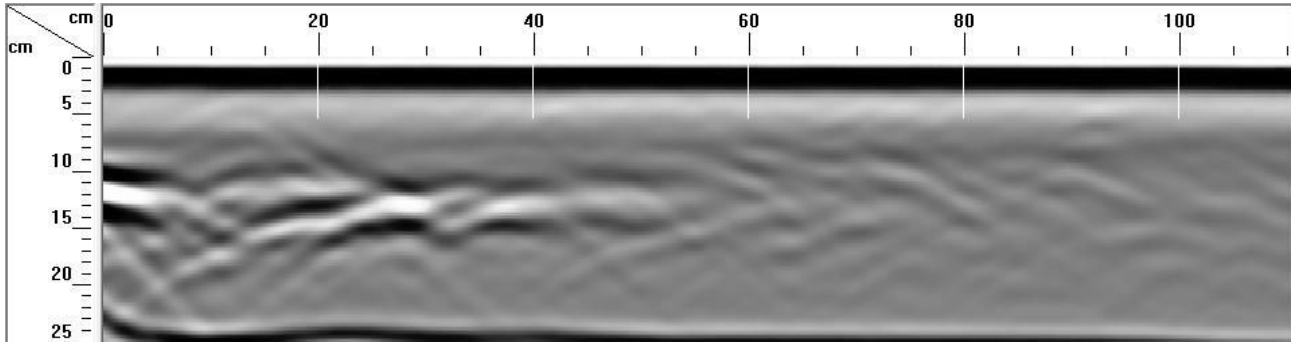
Radar image vs real block



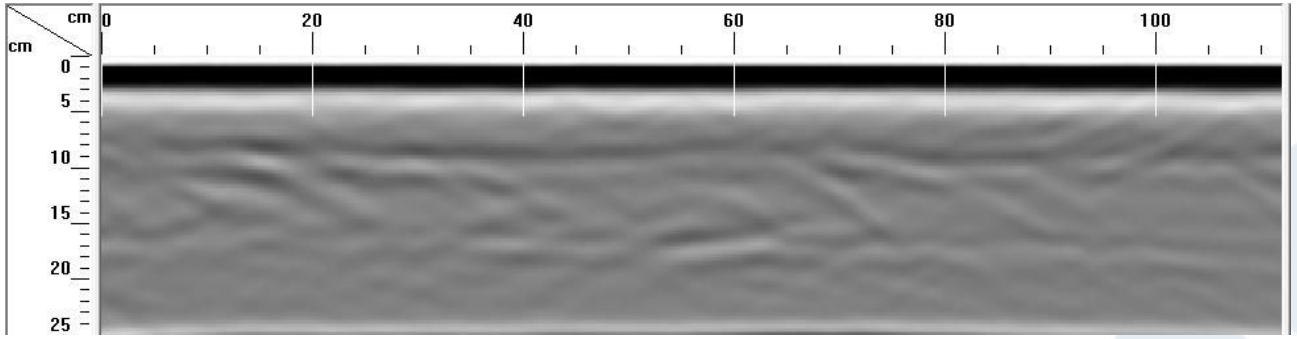
Radar image without backwall echo.

The referring original CR block with view on cutting face.

Radar images



Radar image of the CR. Visible black-white interferences indicate the location of the typical void and porosity.



Radar image of the FVB. A smooth image without signal interferences indicates the absence of any cavity.

Detection of spongy areas

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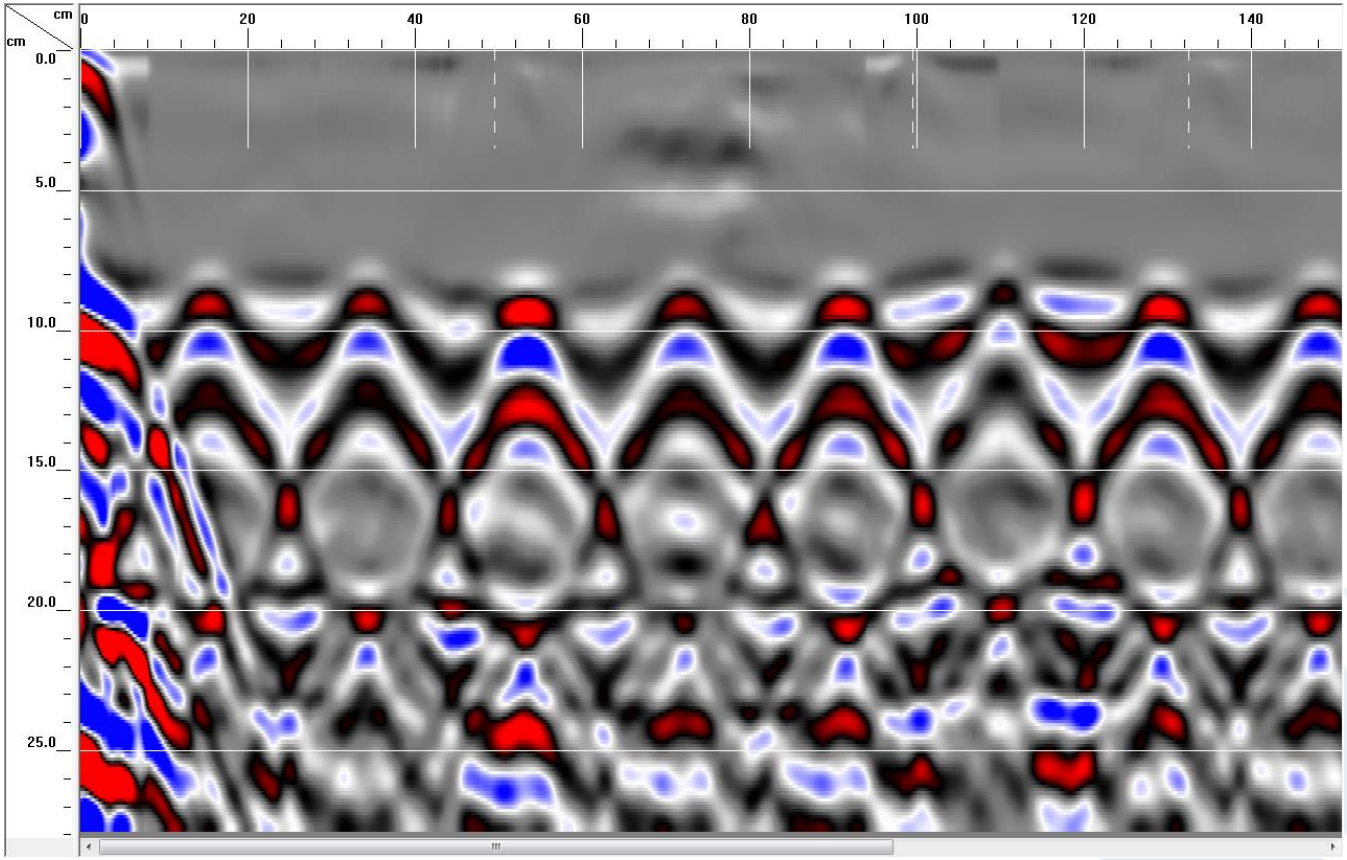
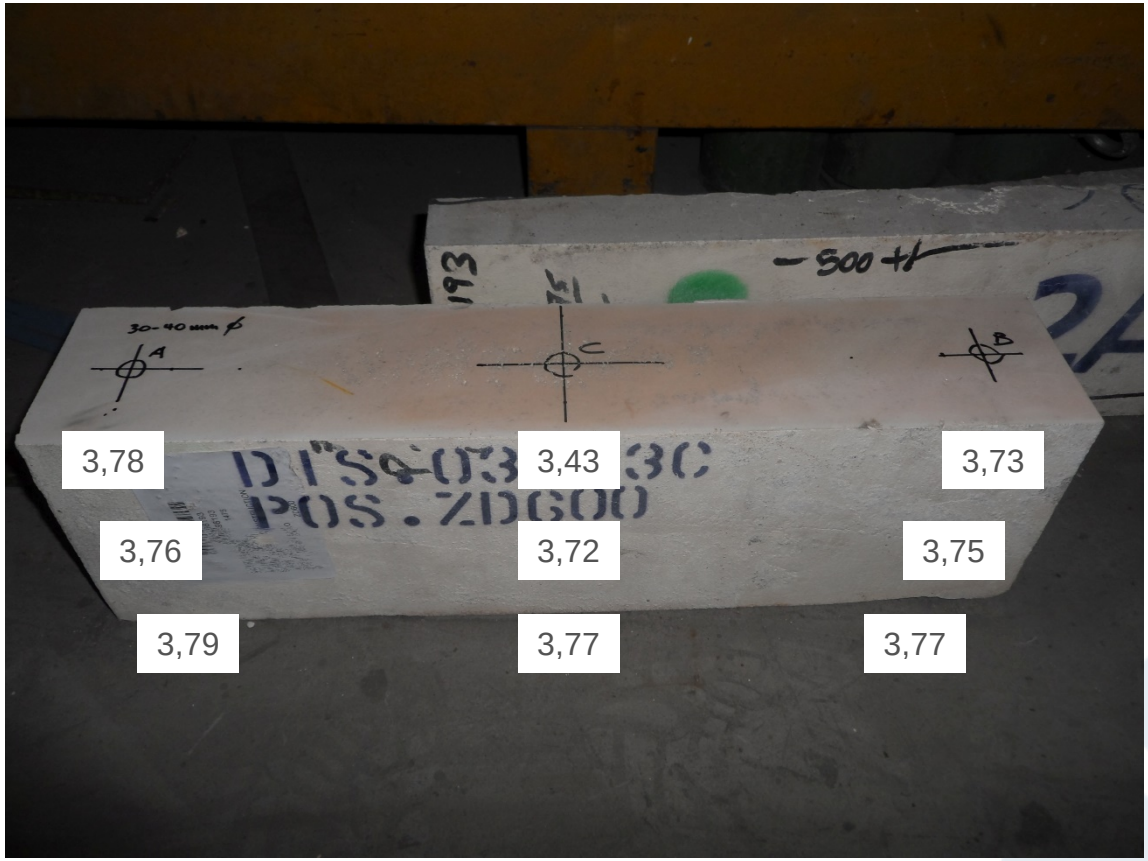


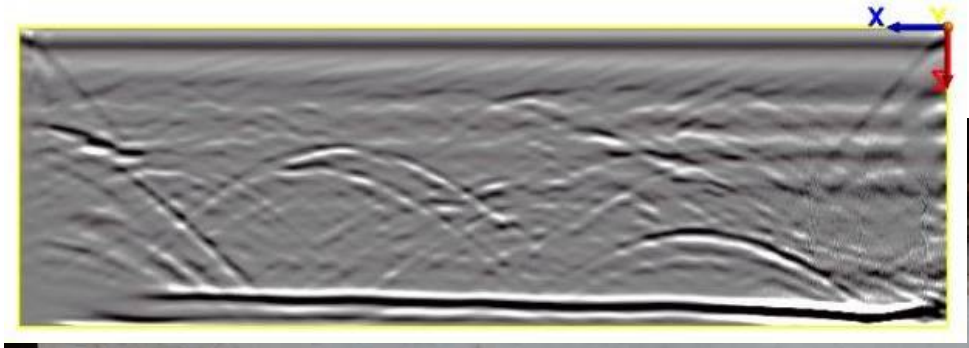
Detection of spongy areas



Interpretation of radar images

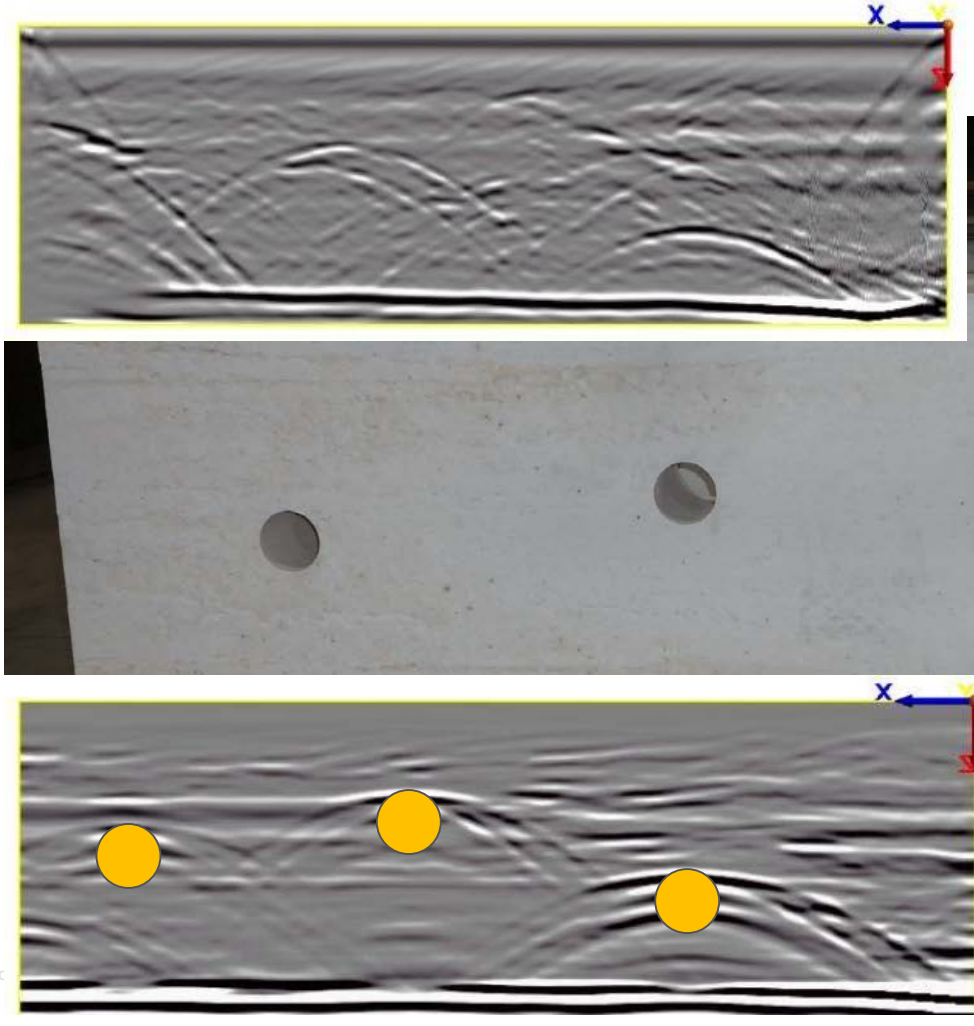
Example: Electrode block.

Interpretation of radar images



Example: Electrode block.

Interpretation of radar images



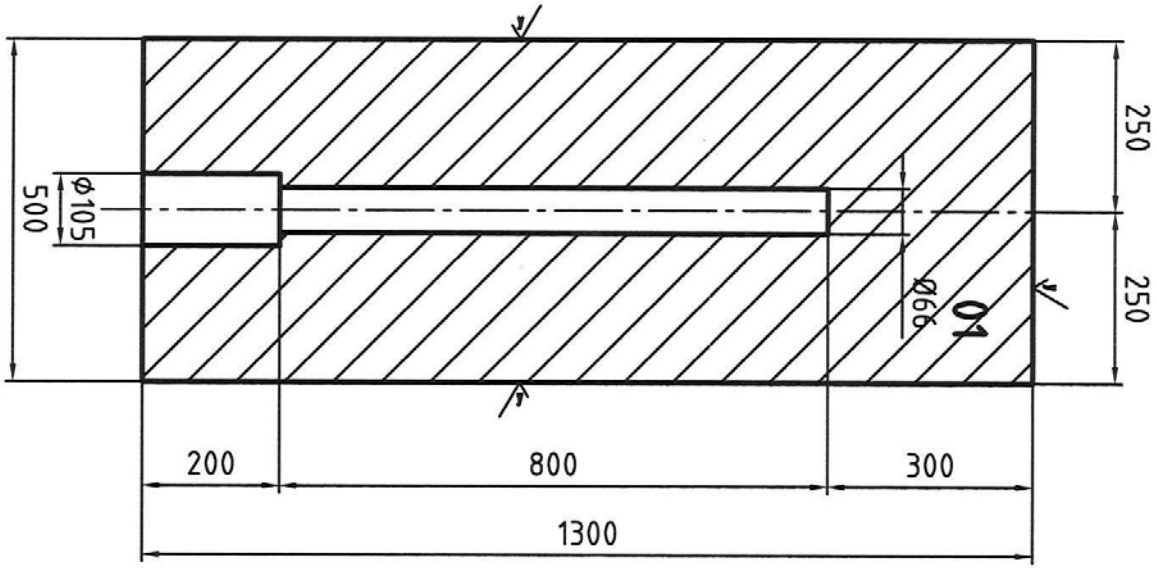
Example: Electrode block.

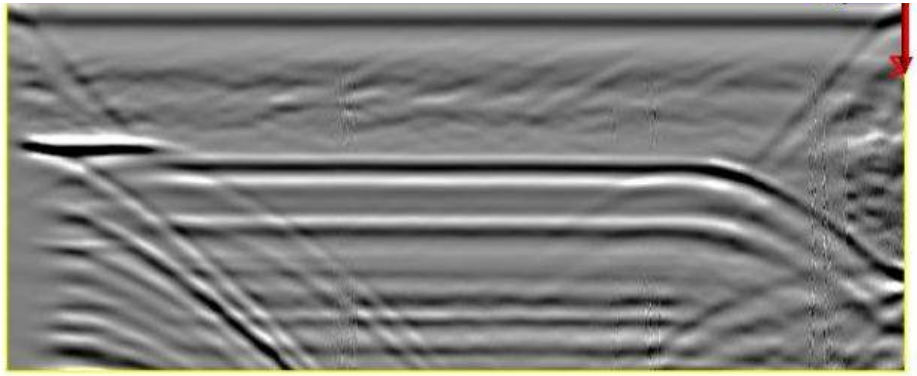
Interferences between radar reflections hinder the identification of the very left drill hole —which is doubtless visible in the picture below. This indicates, that data processing cannot always be avoided.

Interpretation of radar images

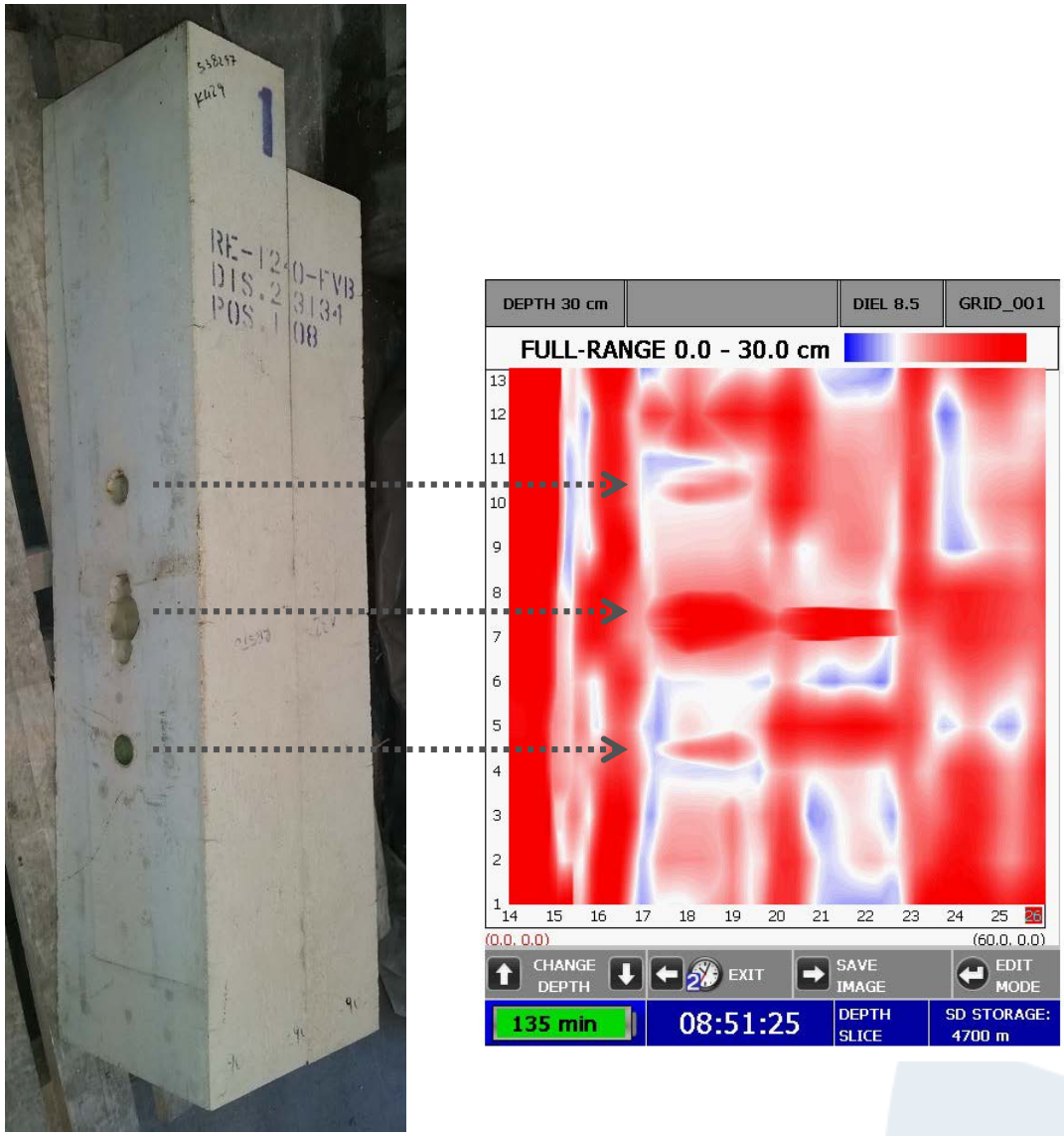
Example: Weir wall block with drilling.

The comparison between block drawing and radar image demonstrates the presence of secondary signals and reflections, which complicates interpretation.





Interpretation of radar images in 3D



Interpretation of radar images in 3D

Vertical cut regular cast block.

Horizontal cut regular cast block.

Summary

- The structural integrity of glass melting tank blocks is of particular importance for the service lifetime.
- For quality assurance the requirement is to detect block heterogeneities, such as voids and porosity.
- The radar analysis can verify whether flaws (voids, porosity) are present inside the block and —when indicated— their spatial extent.
- Using the radar instrument two-dimensional 2D scans and (more time consuming) three-dimensional 3D scans can be performed.
- All blocks with even surfaces can be handled.
- Radar technology enables to test single or pre-assembled blocks.
- Data processing with careful interpretation is recommended to create radar images with distinct signals to distinguish between **real** block flaws and measurement **artefacts** (secondary radar signals) with various data filters.

The competence in fused cast AZS

We are the world's leading supplier of high-grade ceramic refractory products and services.

As a reliable and competent partner it is our constant aim to add value to the processes of our customers by achieving the best price-performance ratio with our refractory systems solutions.

Any questions?

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