

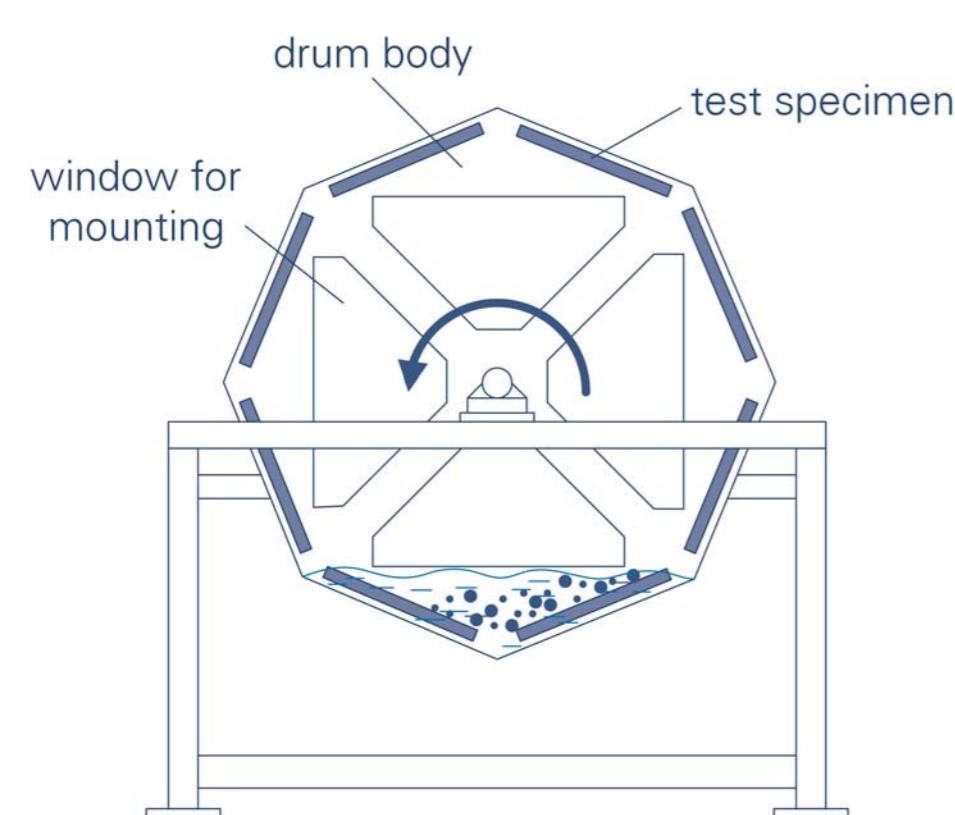
EXPERIMENTAL INVESTIGATION INTO THE DETERIORATION OF CONCRETE SUBJECTED TO HYDRO-ABRASION

1 OBJECTIVES

Attaining better understanding of basic deterioration mechanisms in concrete structure by:

- characterization of surface wear and internal damage,
- detection of morphological and deteriorative changes,
- visualization of damage patterns,
- qualitative indication of damage type and manifestation,
- evaluation of concrete micro-structure on quantitative data basis.

2 HYDRO-ABRASION DRUM TEST



Sketch of abrasion test facility

- slab size: 300 x 300 x 50 mm³
- abrasion regimes: upper reaches (R1), middle reaches (R2), lower reaches (R3)
- rotation velocity: 10 – 17 rot/min

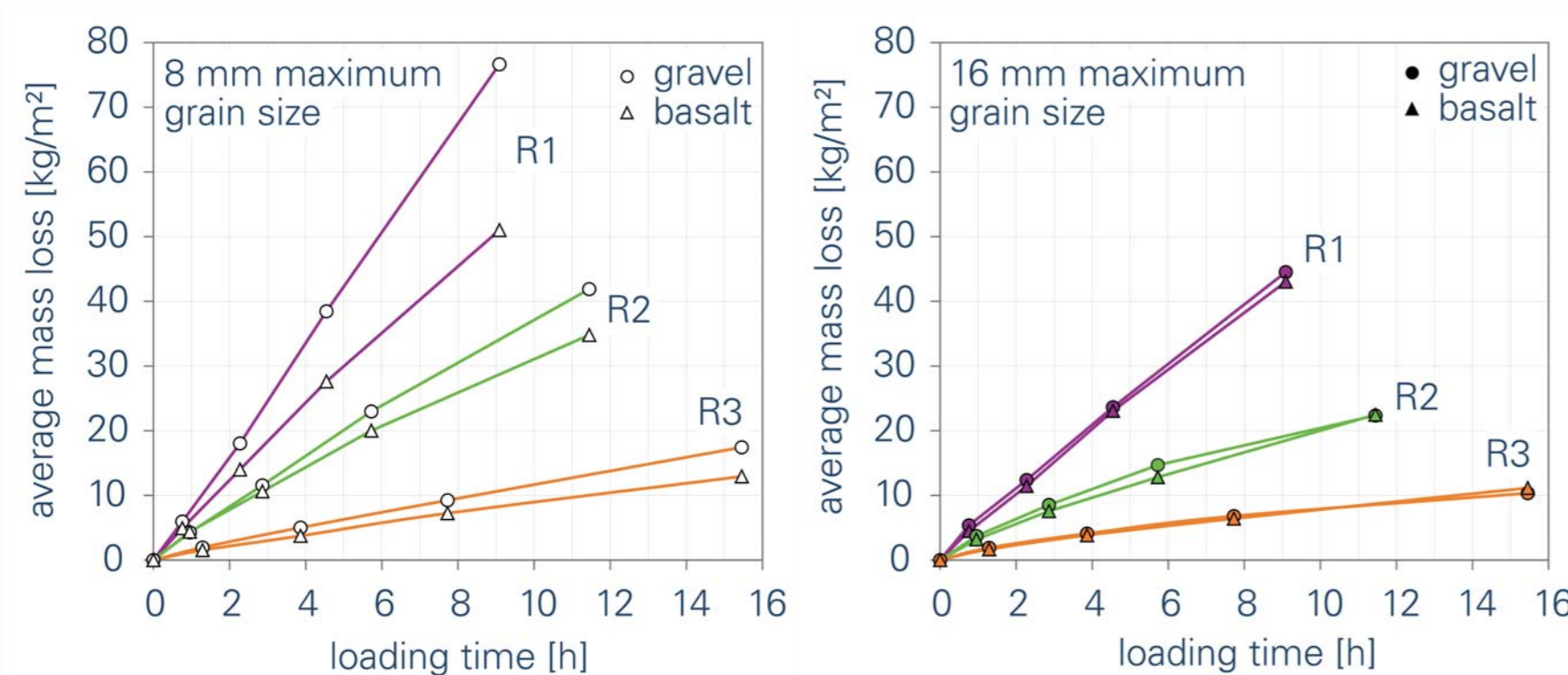
- abrasive material: 10 kg steel balls

$$\frac{\text{mass of steel balls}}{\text{mass of water}} = \frac{1}{1}$$



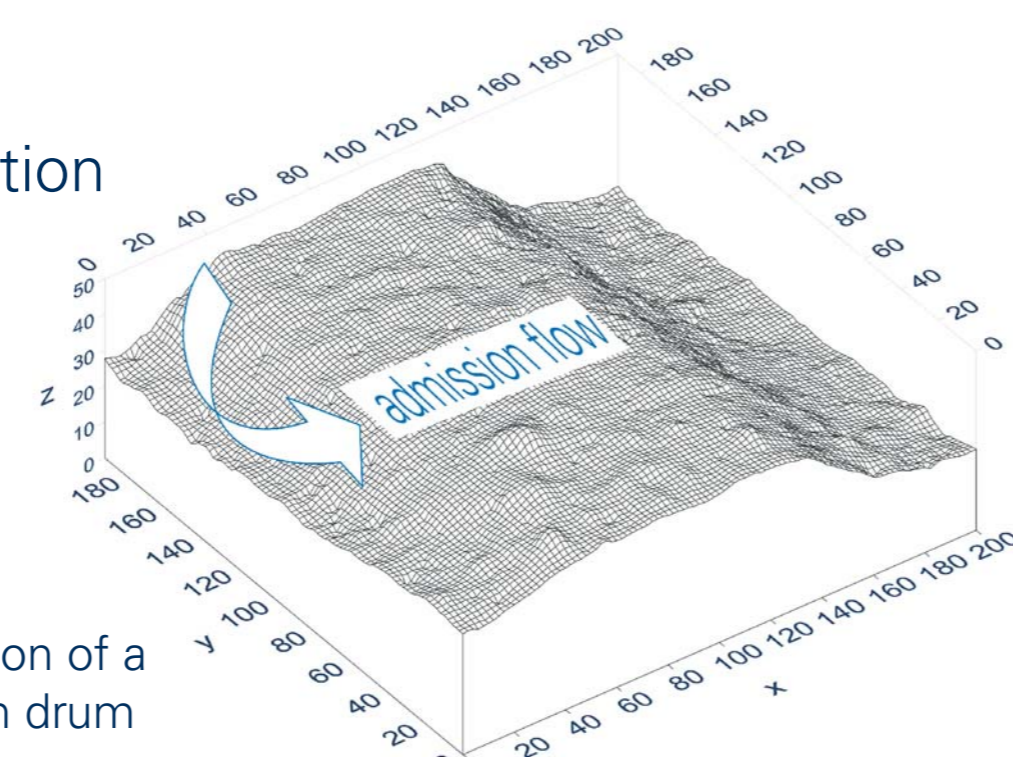
Size of abrasive material in abrasion regime R1

- wear resistance strongly affected by type and maximum size of the aggregates and energy input



Typical results of average mass loss; 8 mm (left) and 16 mm (right) maximum size of the aggregates

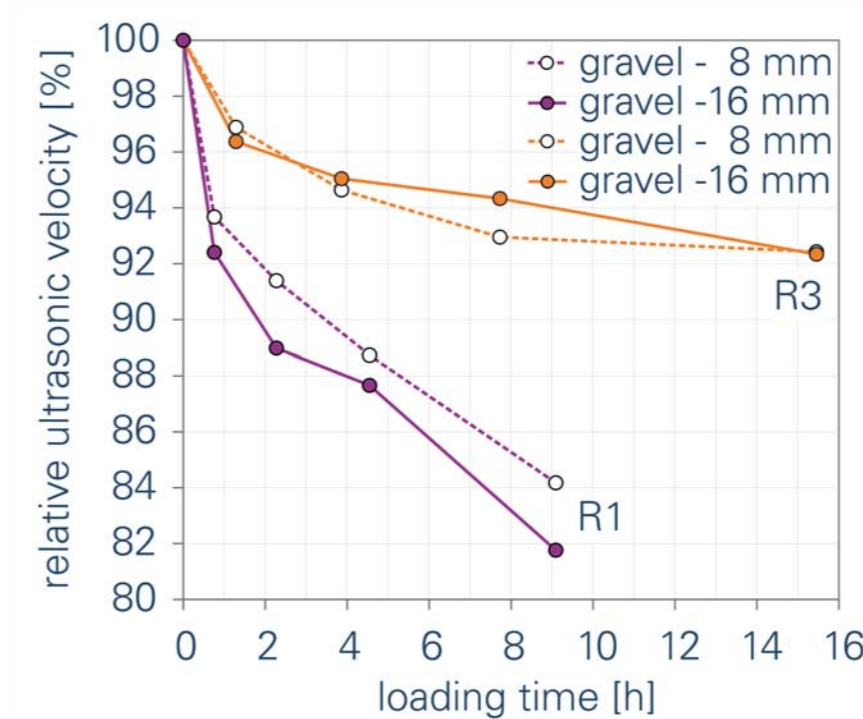
- supplementary information on surface condition
- detection of system-inherent phenomena



Surface condition with rib formation of a concrete slab after hydro-abrasion drum test in upper reaches regime

3 ULTRASONIC TESTING

- underwater surface measurement



Typical results of ultrasonic testing on damaged slab surface

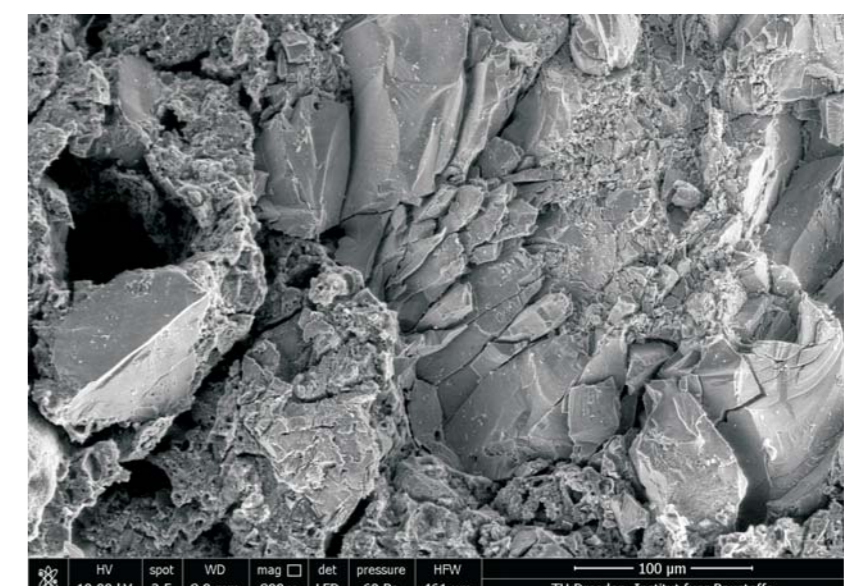
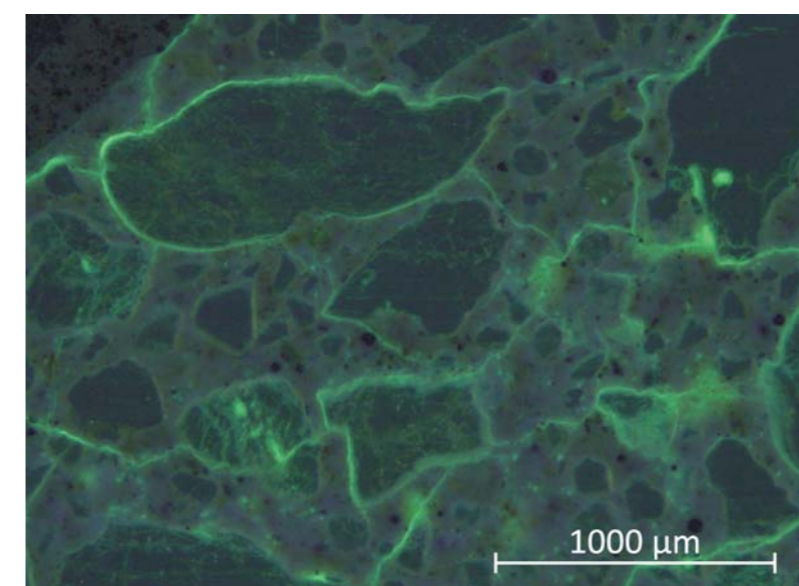


Experimental setup for ultrasonic testing

- transit time determination of longitudinal wave
- encoder frequency: 80 kHz
- sampling rate: 10 Mhz

4 MICROSCOPIC ANALYSIS

- light microscopy of fluorescent thin section samples
- Environmental Scanning Electron Microscopy (ESEM) of damaged surface
- typical damage of concrete subjected to hydro-abrasion:



Left: crack pattern of concrete meso-structure 15 mm beneath the slab surface
Right: smashed aggregates on the damaged slab surface

5 CONCLUSION

- abrasion resistance affected by type and size of aggregates
- characterisation of structural deterioration by means of ultrasonic measurements
- microscopical visualization of damage caused by hydro-abrasion
- crack formation and spalling of concrete fragments

6 OUTLOOK

- methods development for micro-crack analysis using multiple image alignment
- damage quantification before and after hydro-abrasion drum tests
- derivation of deterioration mechanisms

FUNDING



COOPERATION

