Optical Microscopy

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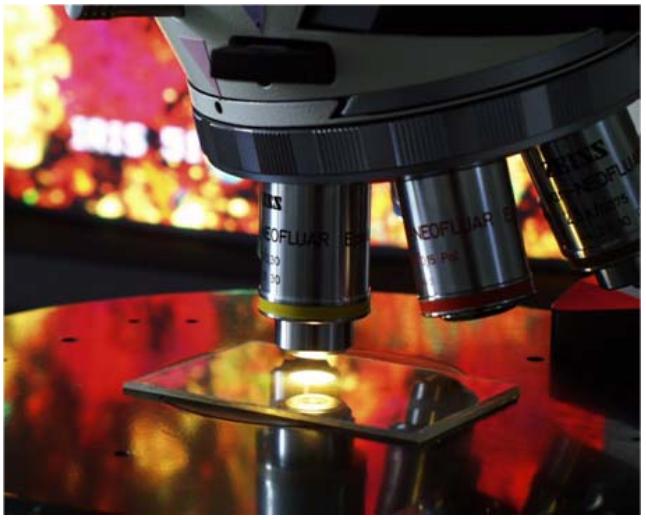
Introduction

Optical microscopy of thin sections produced from concrete samples is a versatile tool in concrete analysis. Information about the microstructure and the mineralogy can be gained.

Thin sections are ~ 25 µm thin slices of impregnated concrete (using epoxy with dyes) glued to a glass carrier (Figure 1).

Figure 1: Thin section

Method



Thin section can be viewed with two different light modes.

Using transmitted light, the mineralogy and microstructure of the concrete are visible.

Using reflective light, light with a specific wavelength is used to excite the fluorescent dye. The resulting image shows a density distribution of the concrete.

Figure 2: Thin section under investigation in transmitted light

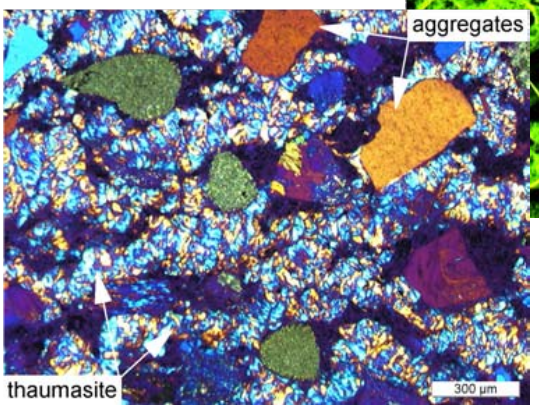
Relevance for Our Field

Optical microscopy is often used to complement data obtained with other methods like mechanical tests. It is especially useful for the analysis of damages like sulfate attack, crack formation due to fire, etc..

Optical microscopy can be used to identify areas of interest in concrete that can be analyzed later in more detail with the electron microscope.

Examples

Figure 3: Sulfate attack on concrete with formation of thaumasite using transmitted light (Belchen tunnel)



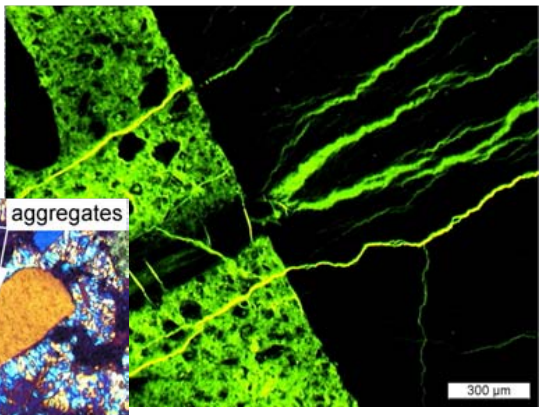
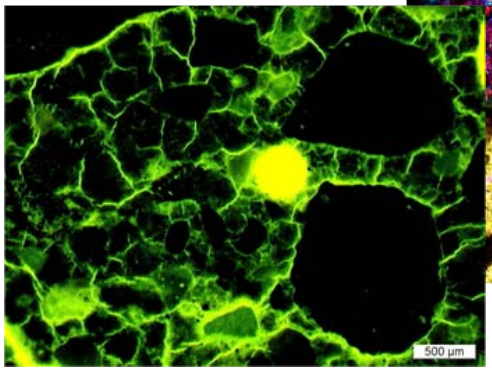


Figure 4: AAR induced cracks in aggregate with gel formation in paste using reflective light (motorway bridge, Mels)

Examples

Figure 5: Heavily cracked concrete exposed to fire



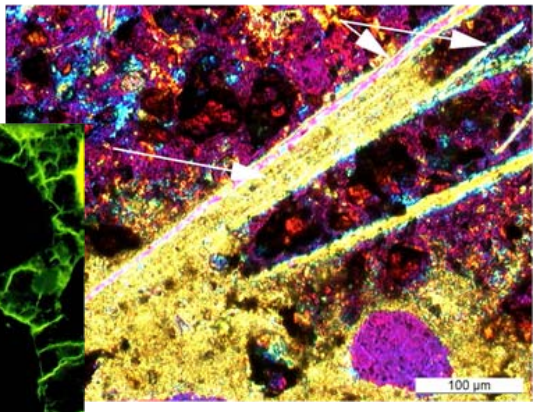


Figure 6: Accelerated carbonation of cement paste (yellow) between two mica plates (arrows)

Limitations

The resolution of the optical microscope is limited due to thin section thickness and the wavelength of the light itself.

Although information about the mineralogy of concrete and aggregates can be obtained, no chemical analysis is possible.

Yearlong experience is needed to use the method to its full potential.