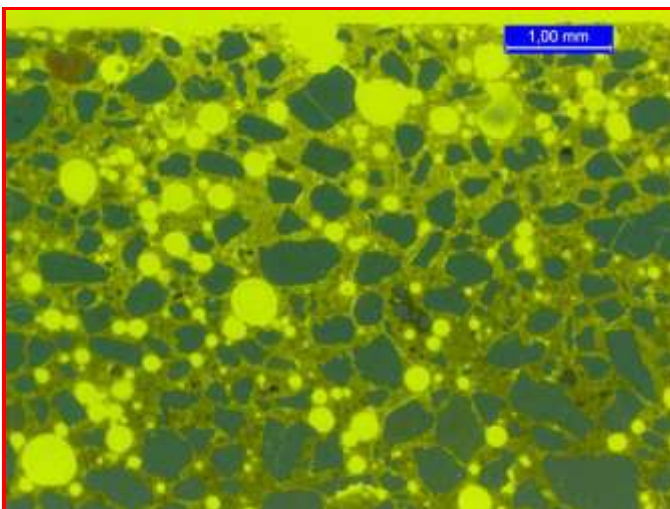


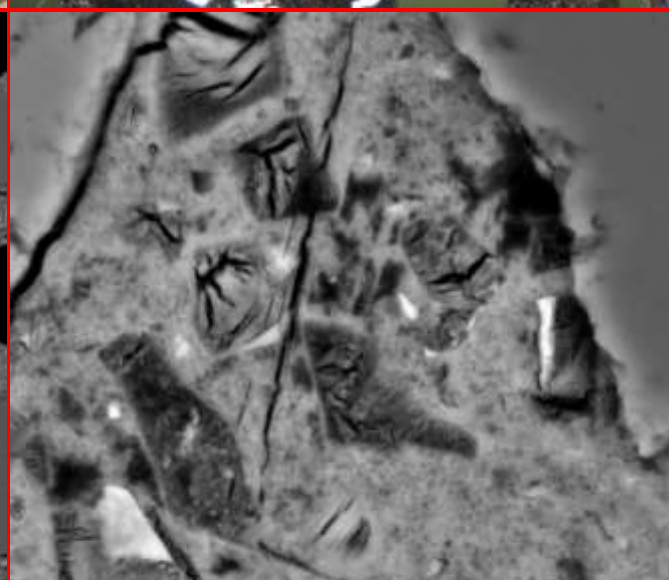
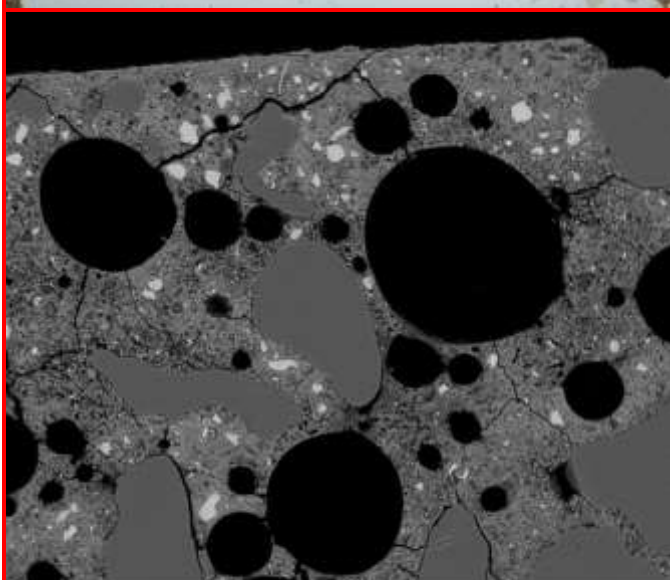
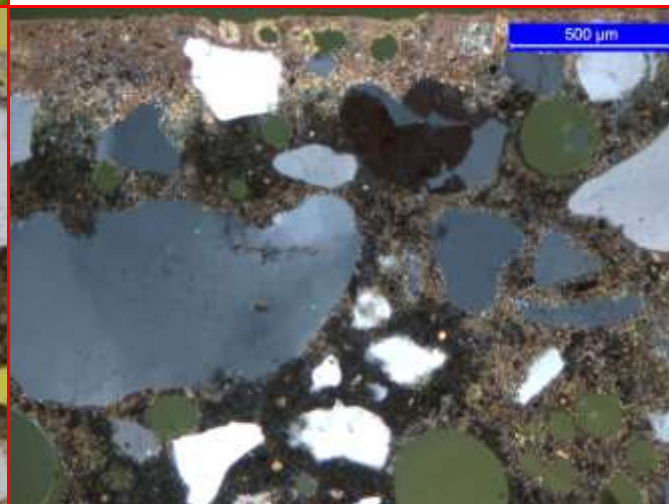
Concrete No.: Femern A; CEM I, w/c 0.40

Age: 2 years



Micro-observations (west)

Surface: Intact covered with calcite to slightly scaled.
 Carbonation: Upper 0.4mm. Calcite crystals in voids in carbonated zone.
 Leached, black zone beneath carbonation: Present, distinct, 0.3-0.4mm thick.
 Popcorn carbonation: 1.2mm thick.
 Leached paste behind popcorn: 0-1.2mm thick.
 Ettringite: Needles in air voids throughout but most intense in leached zone.
 Porosity: Increased porosity in outer 3mm.
 Cracks: Small brittle paste cracks in outer 0.6mm. One fine crack to max. 3mm's depth.
 Air: Relatively poor air void structure.
 Gypsum: Not observed.



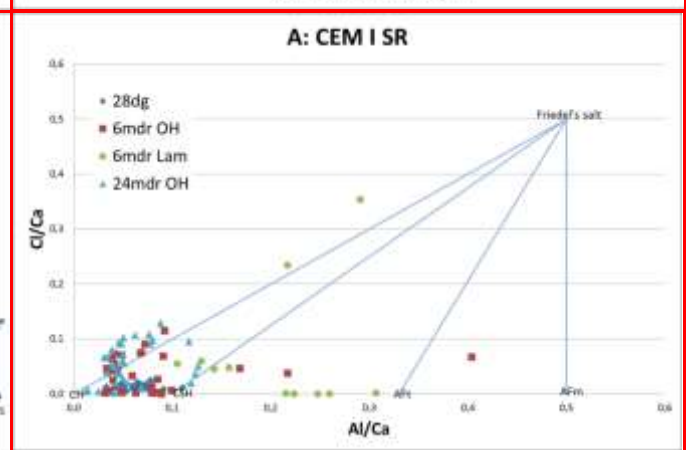
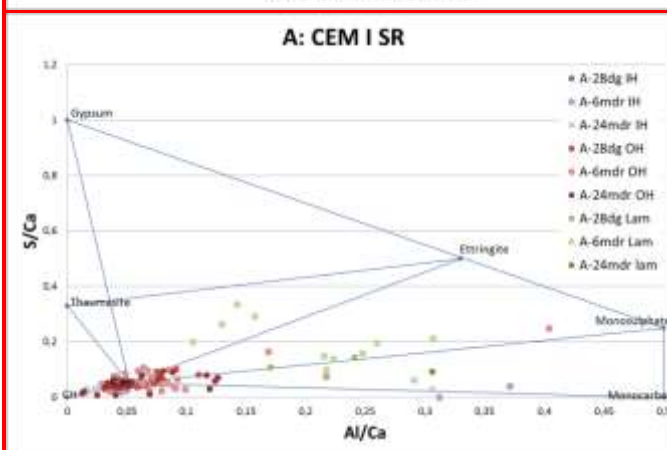
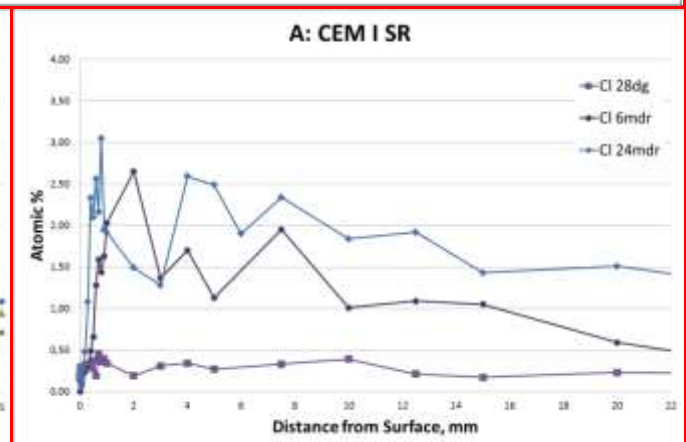
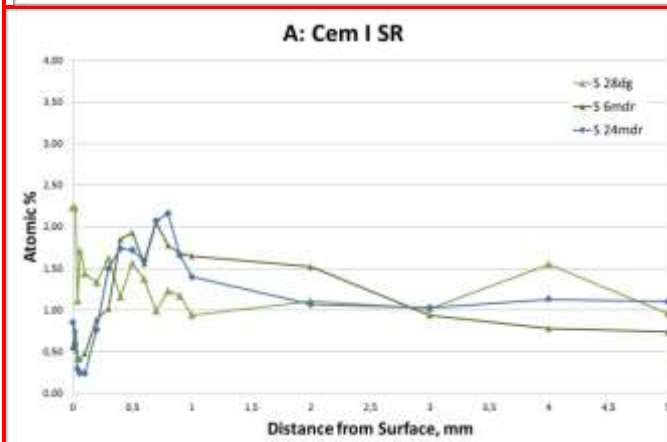
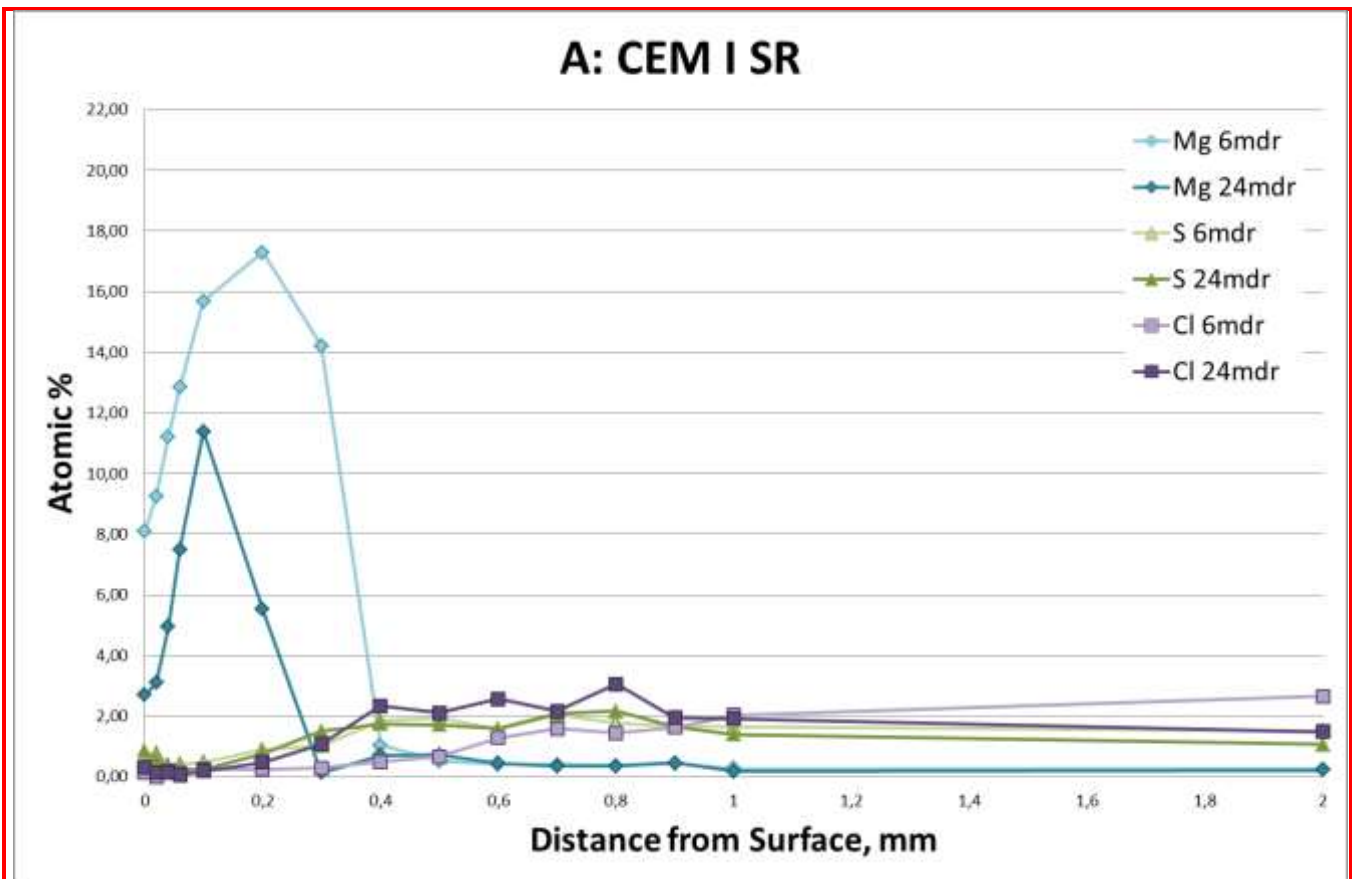
9/27/2012 HFW HV mag WD spot
 10:15:59 AM 1.42 mm 20.00 kV 210 x 9.4 mm 5.0

9/27/2012 HFW HV mag WD spot
 9:19:15 AM 49.8 µm 20.00 kV 5 895 x 9.6 mm 5.0



Concrete No.: Femern A; CEM I, w/c 0.40

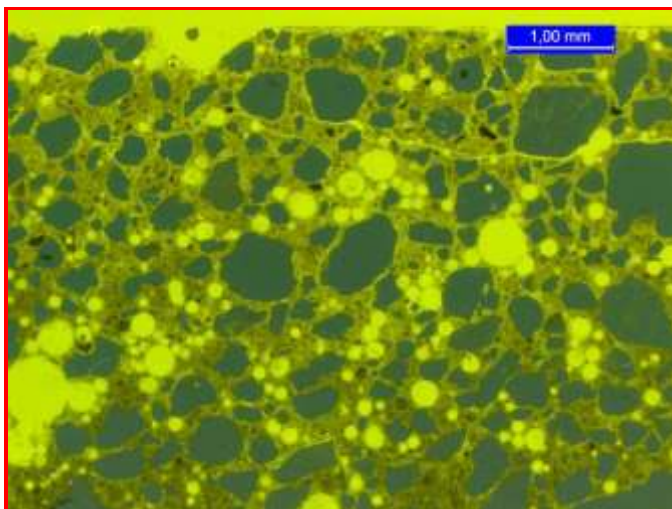
Age: 2 years



Concrete No.:

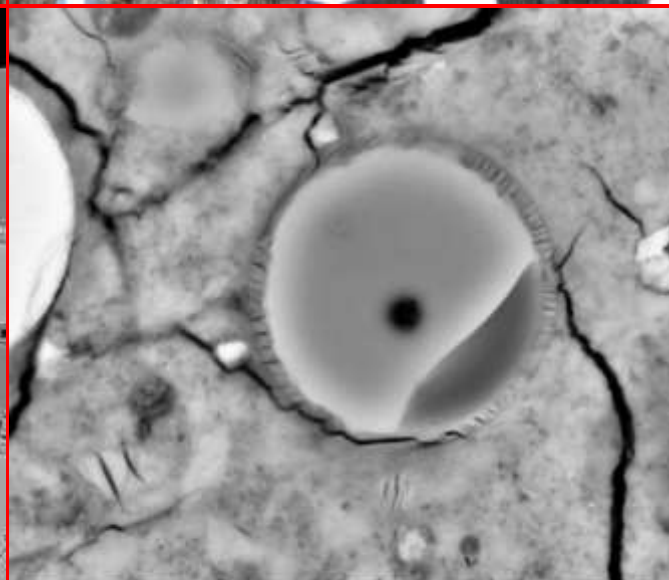
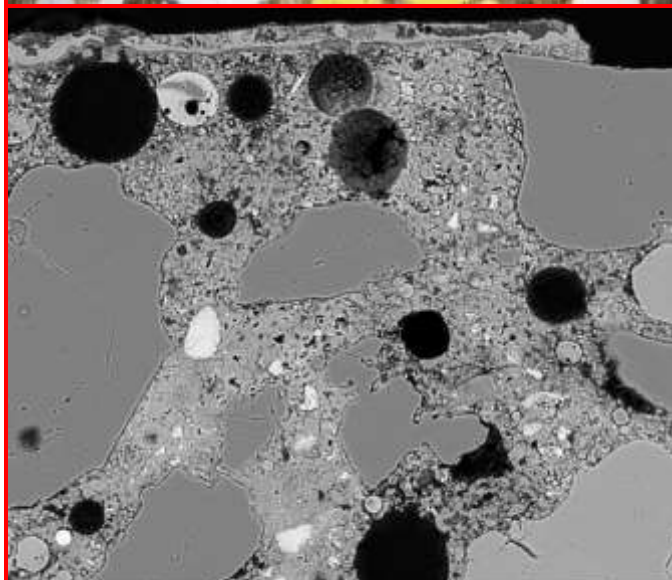
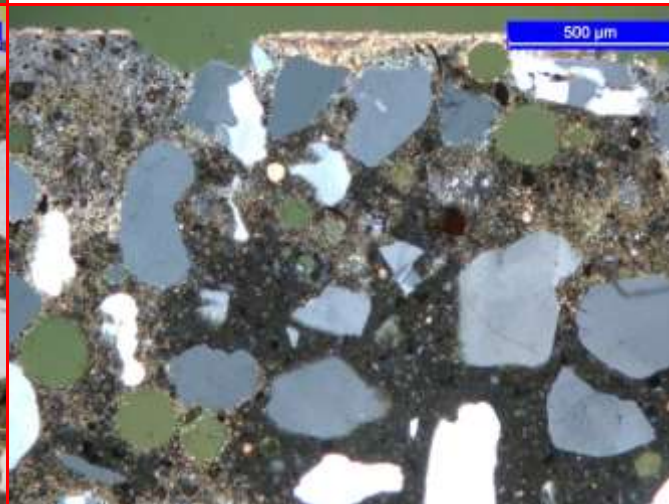
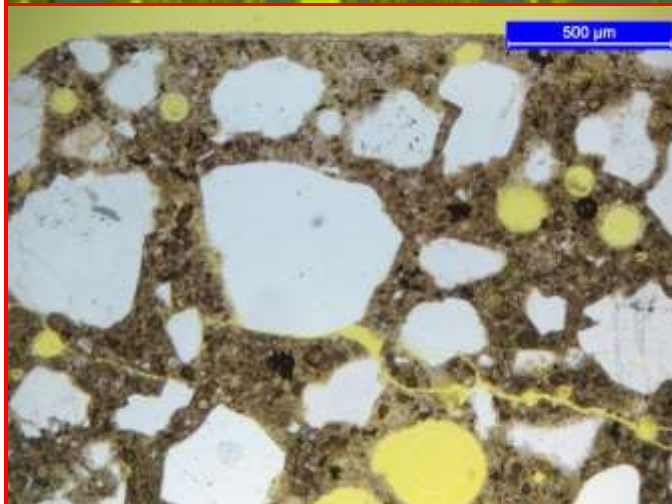
Femern B; CEM I, 15% FA, w/c 0.40

Age: 2 years



Micro-observations (west)

Surface: Intact to slightly scaled.
 Carbonation: Upper 0.8-0.4mm. Rather uneven zone.
 Calcite crystals in voids in carbonated zone.
 Leached, black zone beneath carbonation: Distinct, 0-1.2mm
 Popcorn carbonation: Not present.
 Ettringite: Needles in air voids throughout but most intense outer 24mm.
 Porosity: Increased porosity in outer 4mm.
 CH: Relatively large crystals in interior paste and in adhesion defects.
 Cracks: Small brittle paste cracks in outer 4mm. One fine crack to max. 4mm's depth.
 Air: Relatively poor air void structure.
 Gypsum: Not observed.
 Brucite: Lining air voids near surface and as a thin crust on the surface.



10/2/2012 HFW HV mag WD spot
 11:18:42 AM 748 µm 20.00 kV 400 x 8.9 mm 5.0

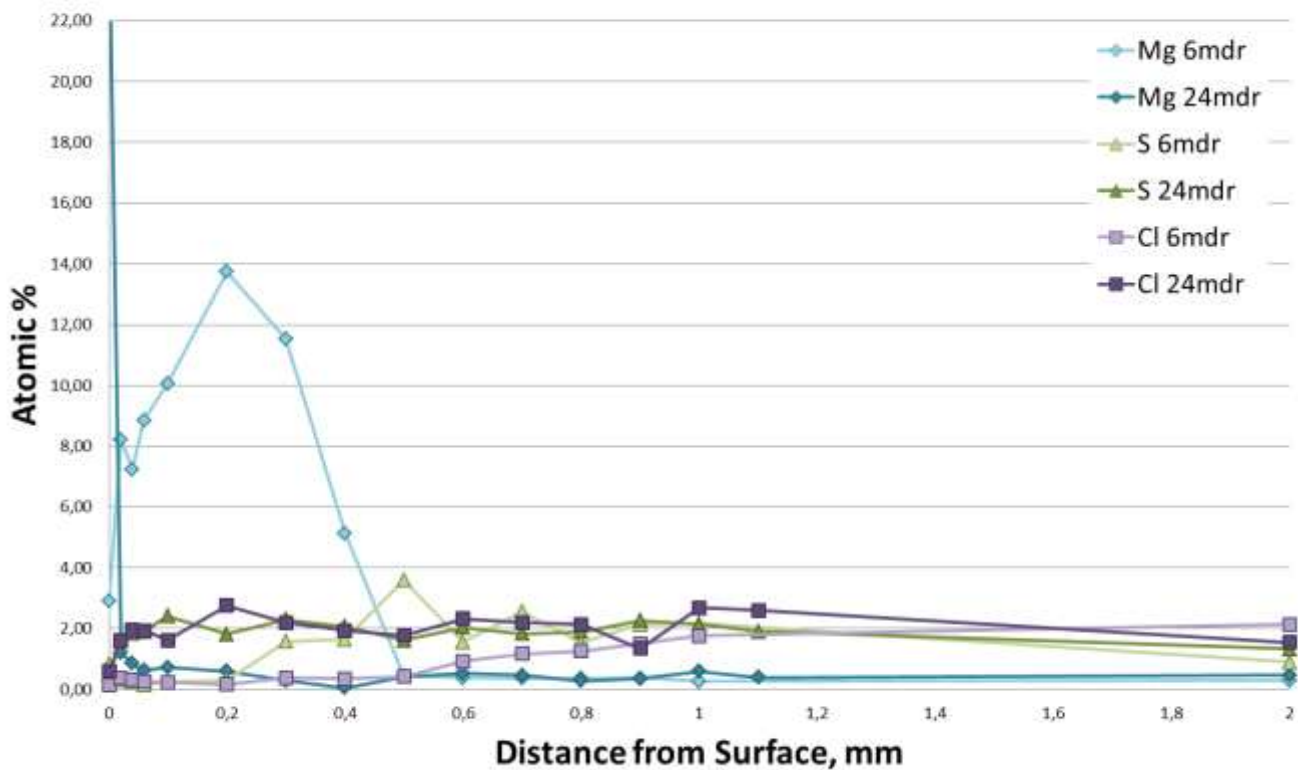
10/2/2012 HFW HV mag WD spot
 2:48:38 PM 37.3 µm 20.00 kV 8 000 x 8.9 mm 5.0



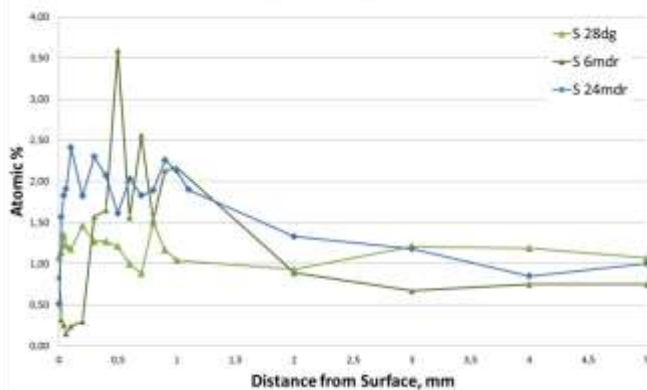
Concrete No.: Femern B; CEM I, 15% FA, w/c 0.40

Age: 2 years

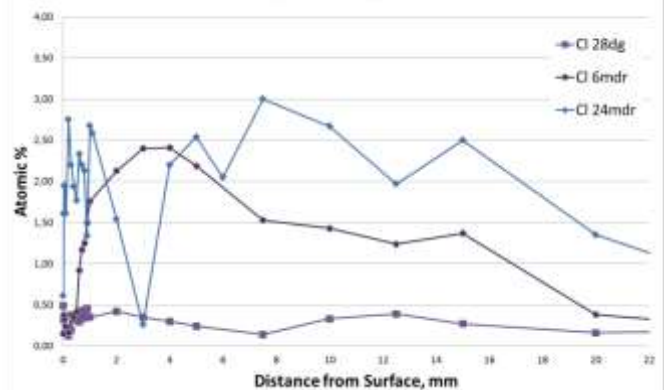
B: CEM I SR 15%Fa



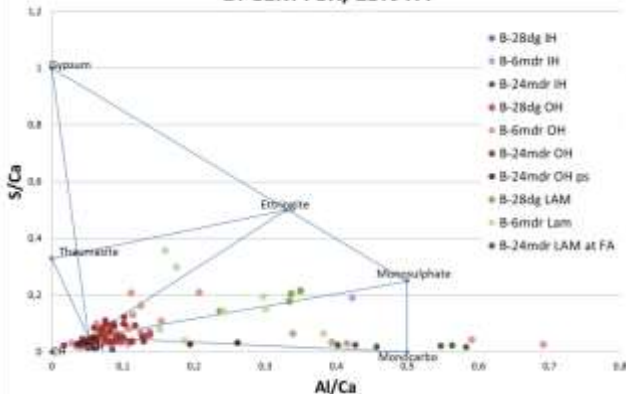
B: CEM I SR 15%FA



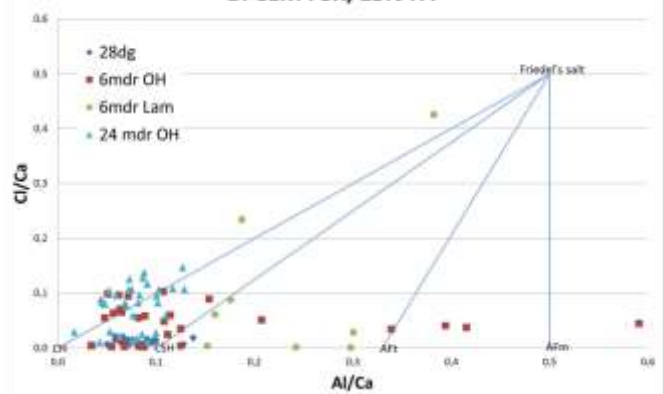
B: CEM I SR 25%FA



B: CEM I SR, 15% FA

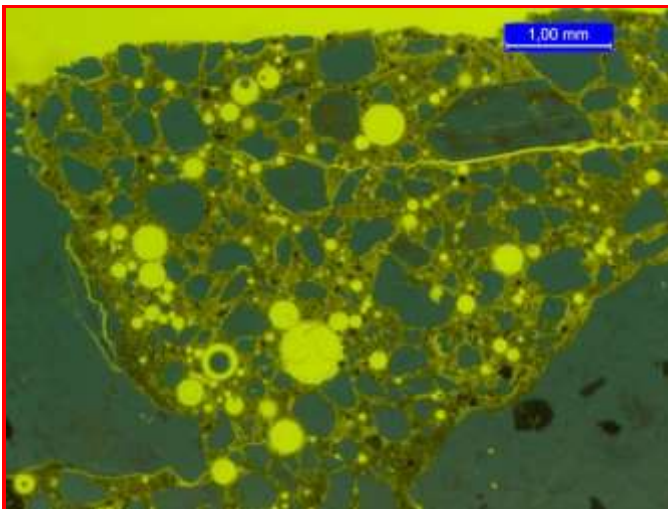


B: CEM I SR, 15% FA



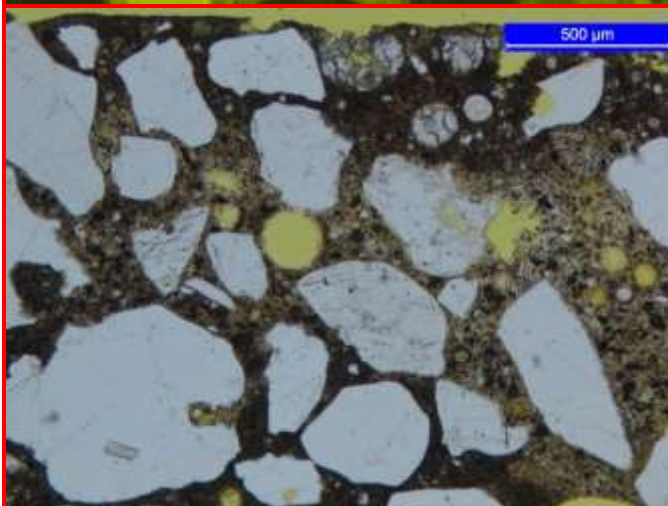
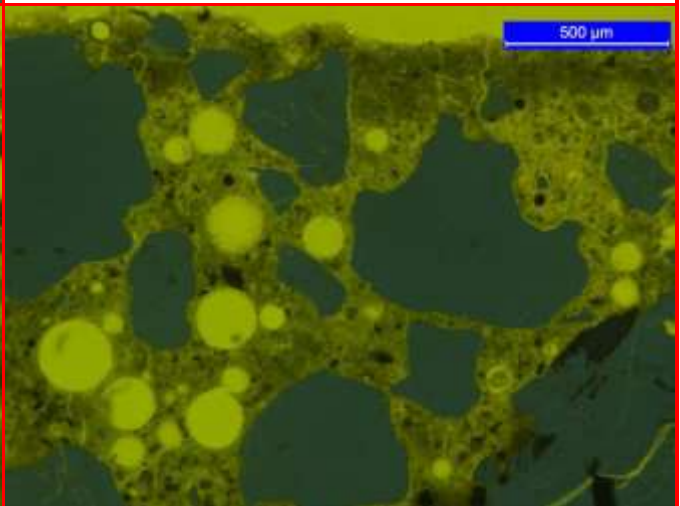
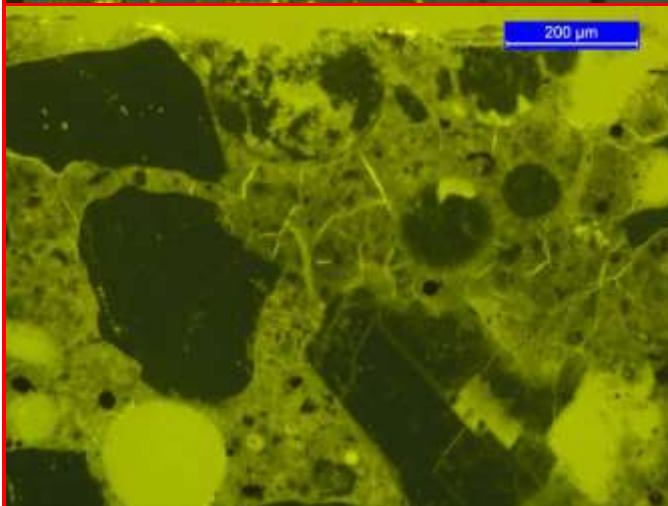
Concrete No.: Femern C; CEM I, 25% FA, w/c 0.40

Age: 2 years



Micro-observations (west/east)

Surface: Slightly scaled.
 Carbonation: Upper 0.2-0.4mm. Calcite crystals in voids in carbonated zone.
 Leached, black zone beneath carbonation: Distinct, 0.2-0.6mm thick.
 Popcorn carbonation: 0.8m thick.
 Leached paste behind popcorn: 2mm thick.
 Ettringite: Needles in air voids throughout but most intense outer 25mm.
 Porosity: Increased porosity in outer 1.2mm.
 Cracks: Small brittle paste cracks in outer 4mm. One fine crack to max. 10mm's depth. Few surface parallel cracks at depth of 1.2-3.2mm.
 Air: Relatively poor air void structure.
 Gypsum: Not observed.

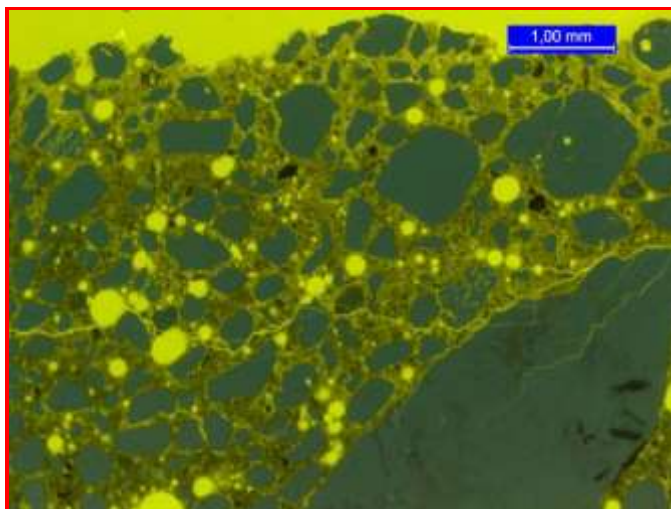




NO SEM-EDX

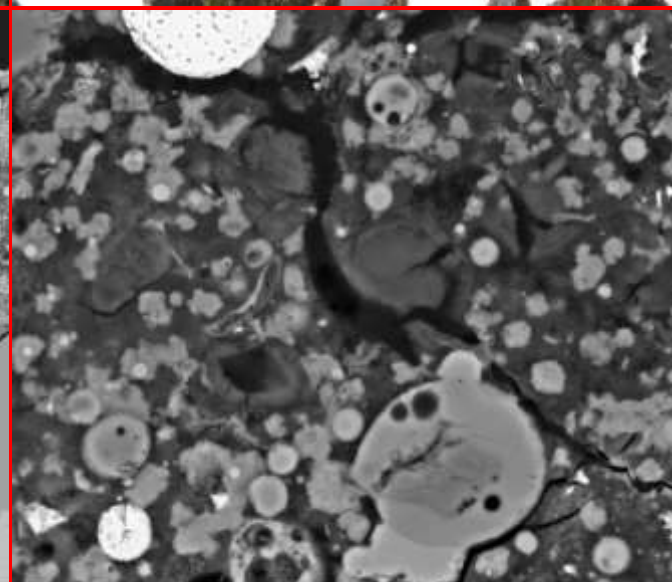
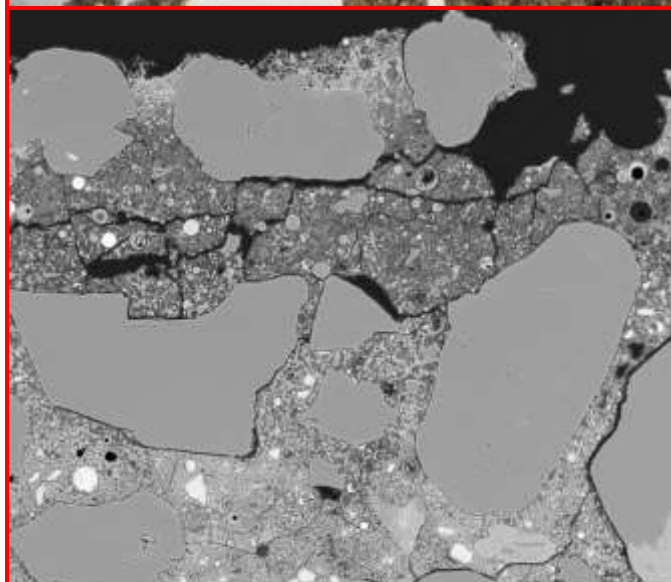
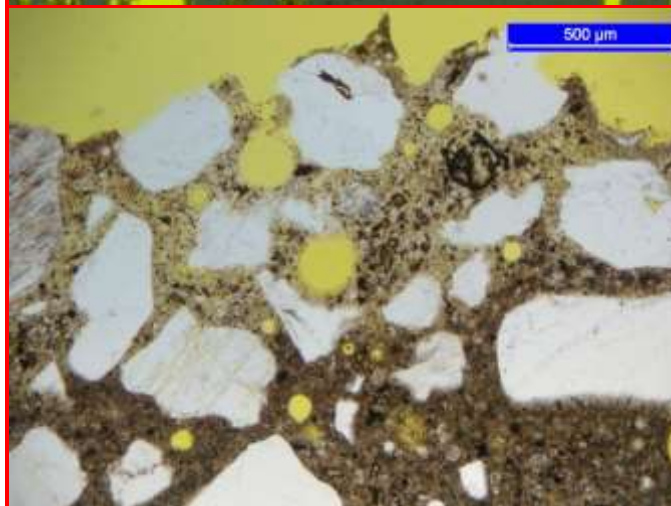
Concrete No.: Femern D; SCC CEM I, 25% FA, w/c 0.40

Age: 2 years



Micro-observations (west)

Surface: Scaled with exposed aggregate.
 Carbonation: Outer min. 0.12mm. Calcite crystals in voids in carbonated zone.
 Leached, black zone beneath carbonation: Distinct, 0.1-0.4 mm thick.
 Popcorn carbonation: 0.5-2.0 mm thick.
 Leached paste behind popcorn: 1.0-2.5mm.
 Ettringite: Needles in air voids throughout but most intense outer 25mm.
 Porosity: Increased porosity in outer 1.8mm.
 Cracks: Small brittle paste cracks in outer 2mm. Some fine cracks in the outer 6-8mm. Some adhesion cracks.
 Air: Ok air void structure.
 Gypsum: Possible observed in an air void in surface region.



10/3/2012 HFW HV mag WD spot
 8:40:18 AM 1.49 mm 20.00 kV 200 x 8.8 mm 5.0

500 µm

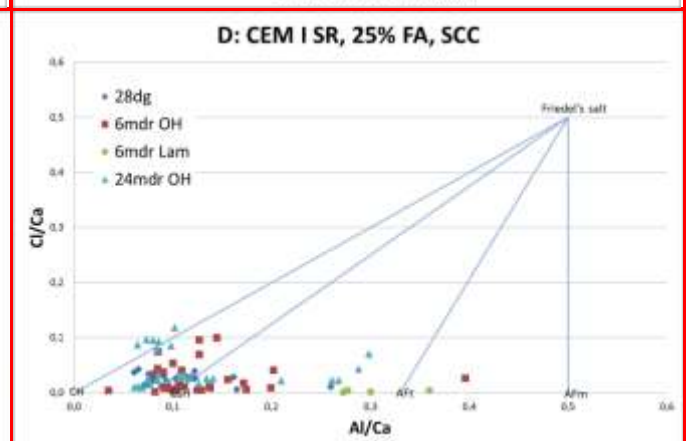
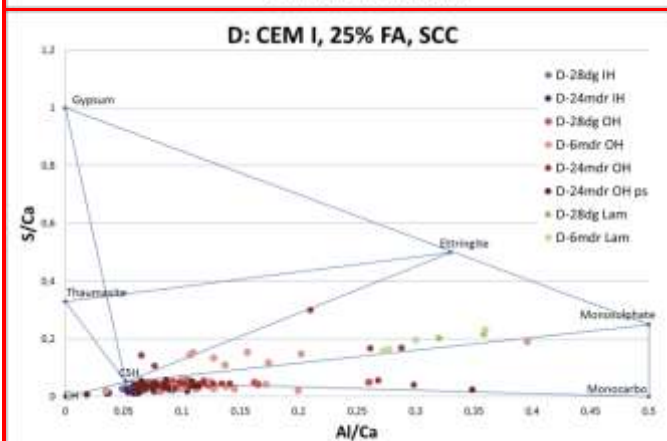
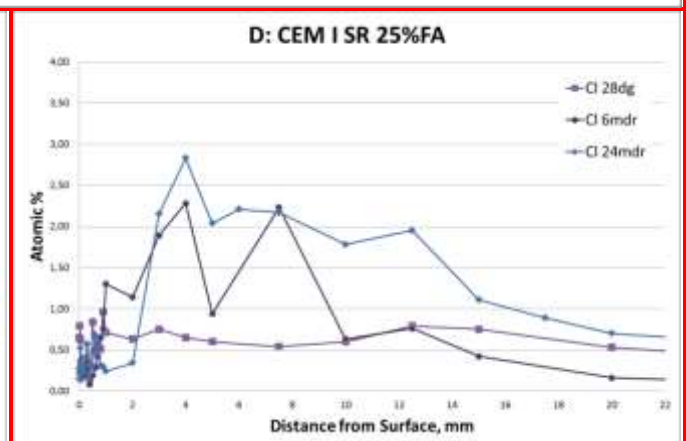
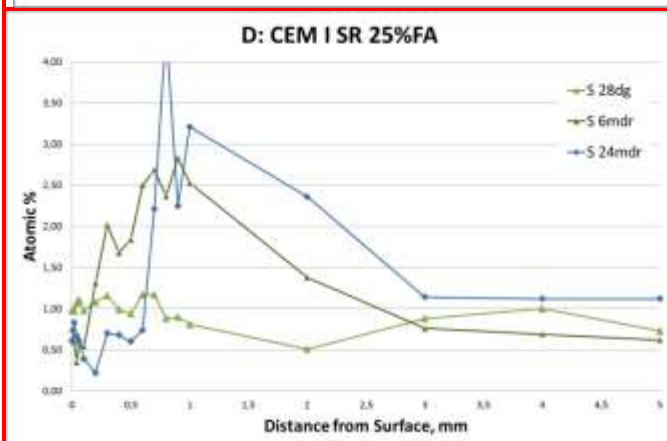
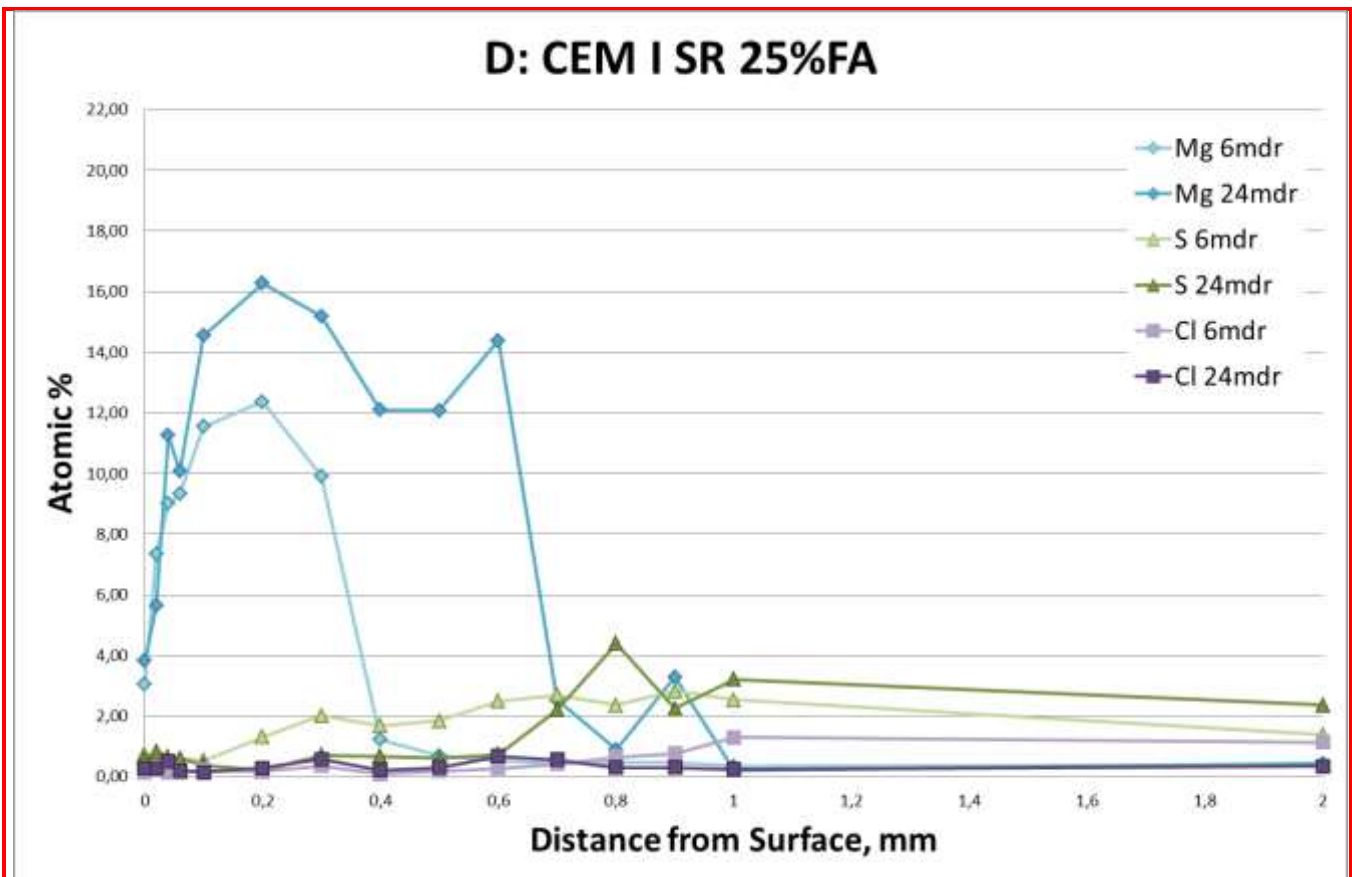
10/3/2012 HFW HV mag WD spot
 11:27:02 AM 131 µm 20.00 kV 2 273 x 8.7 mm 5.0

40 µm



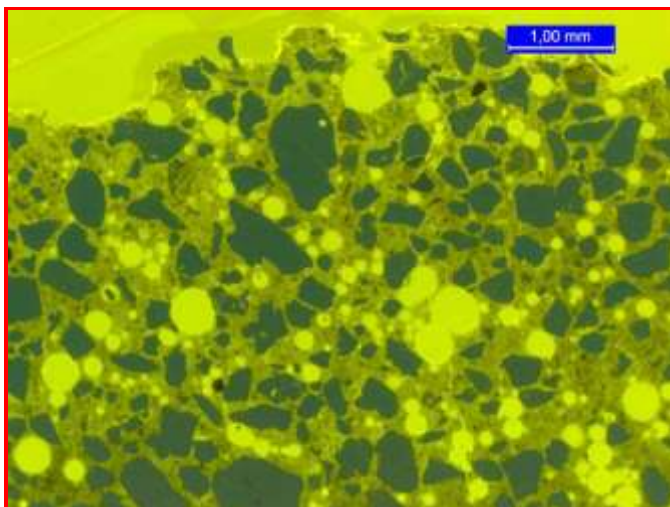
Concrete No.: Femern D; SCC CEM I, 25% FA, w/c 0.40

Age: 2 years



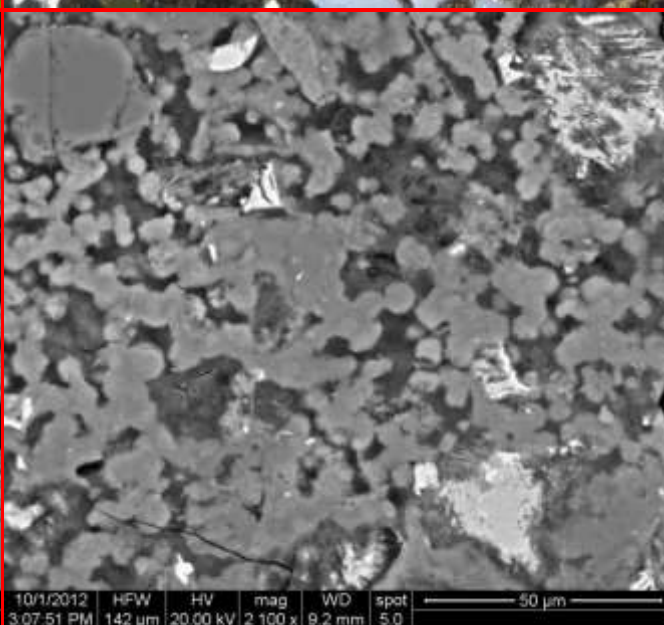
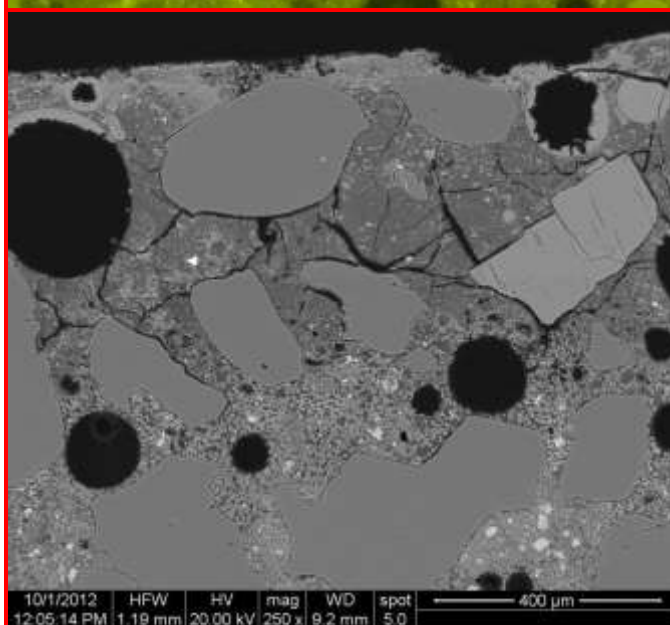
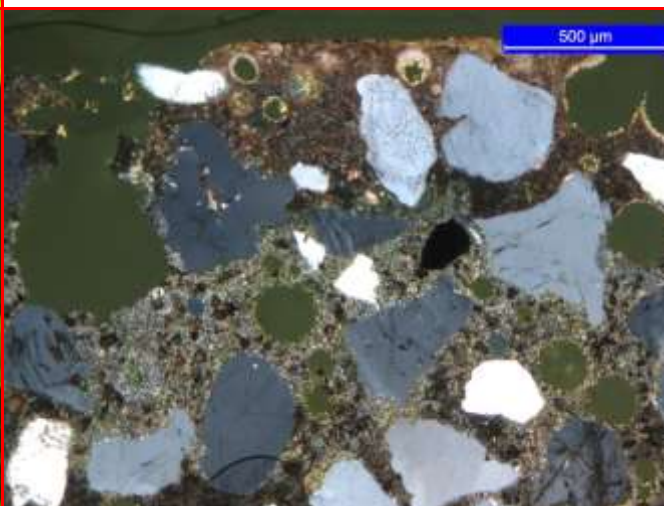
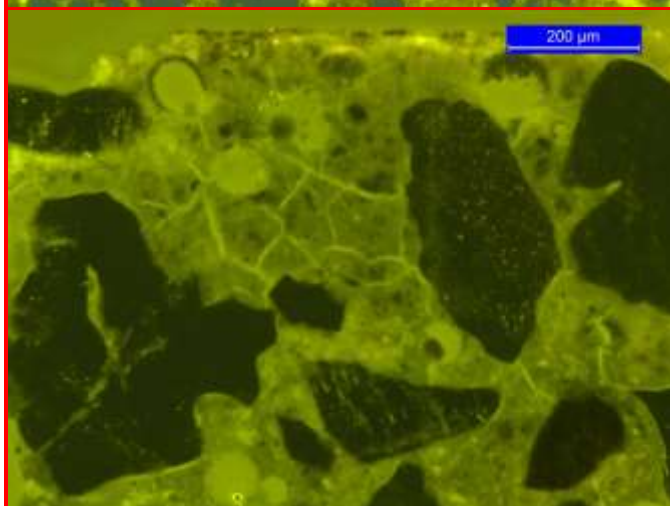
Concrete No.: Femern E; CEM I, 4% MS, w/c 0.40

Age: 2 years



Micro-observations (west)

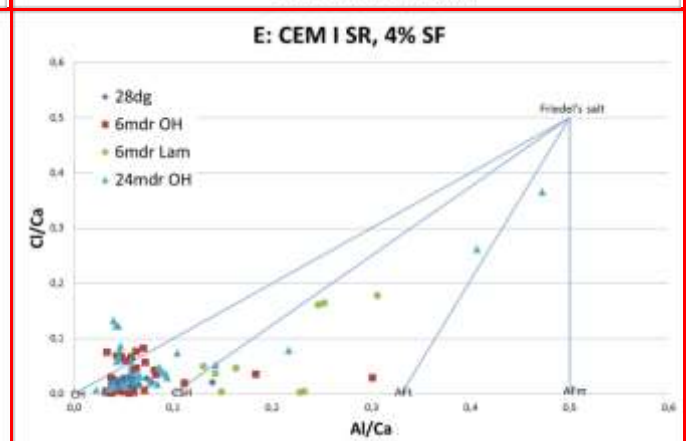
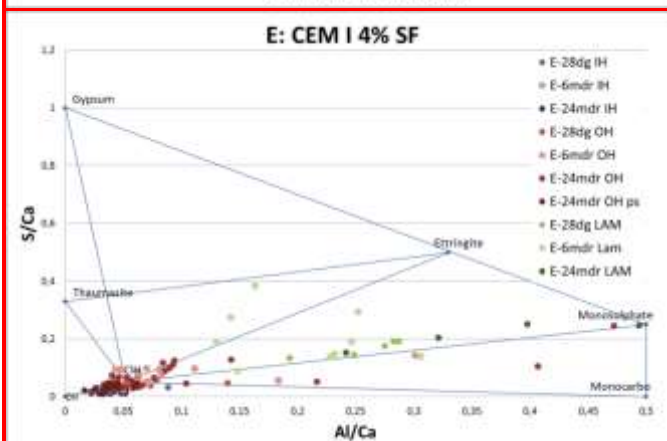
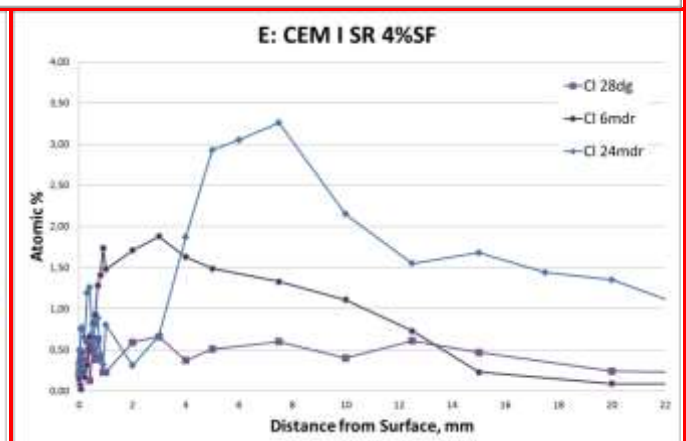
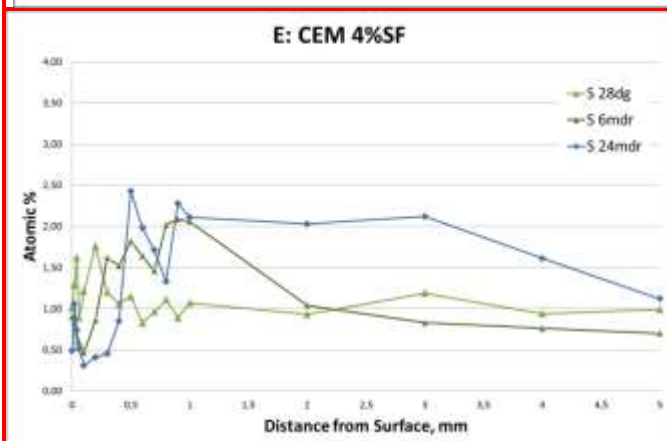
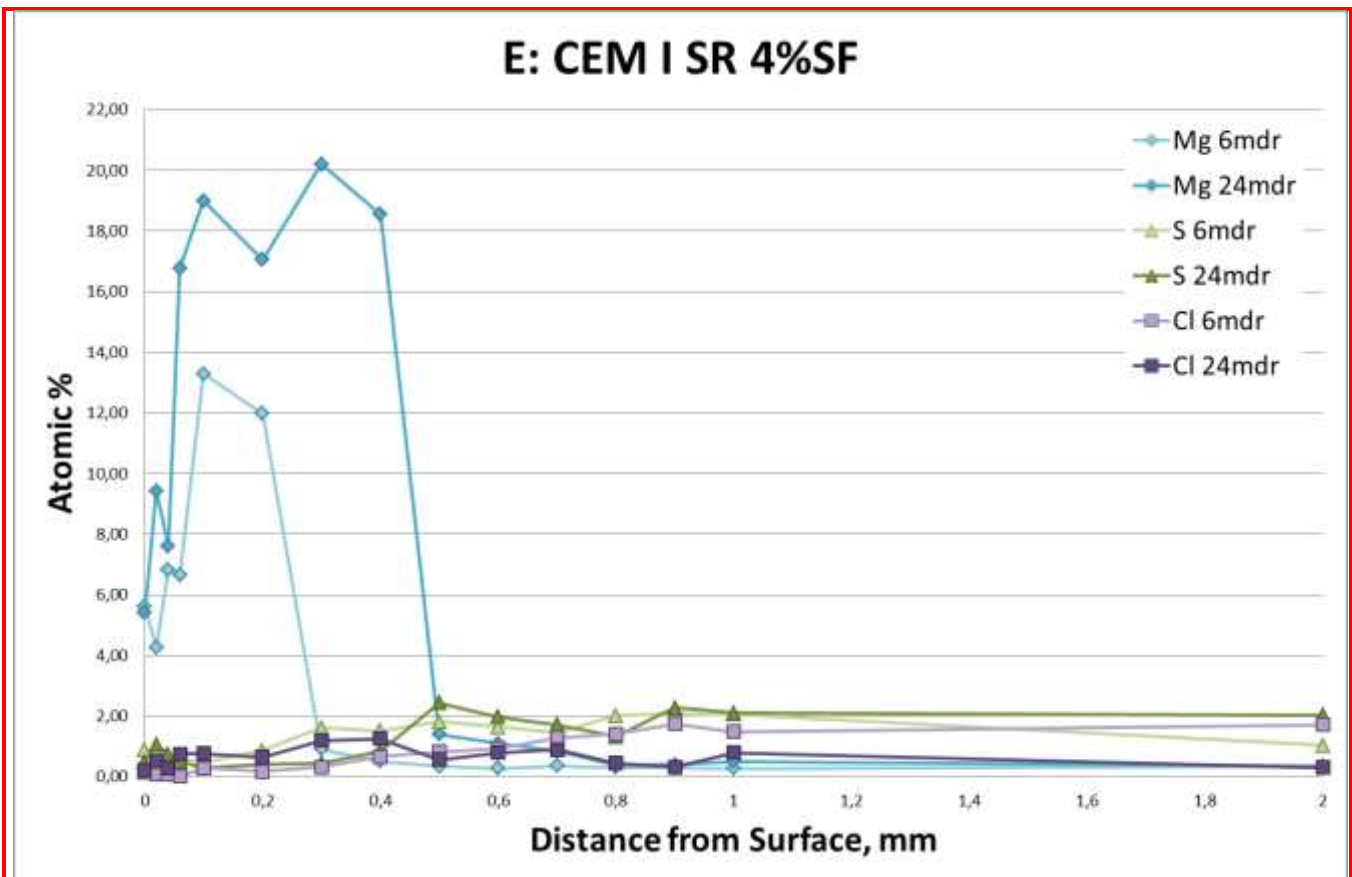
Surface: Intact to scaled with exposed aggregate.
 Carbonation: Outer 0.2mm. Calcite crystals in voids in carbonated zone.
 Leached, black zone beneath carbonation: Distinct, 0.2mm thick.
 Popcorn carbonation: 0.6-1.2m thick.
 Leached paste behind popcorn: 0.6-2mm.
 Ettringite: Needles in air voids throughout but most intense outer 2mm. Distinct orange birefringence of ettringite in popcorn zone (thaumasite).
 Porosity: Increased porosity in outer 2mm.
 Cracks: Small brittle paste cracks in outer 0.4-0.8mm. Fine crack to 4mm's depth.
 Air: Poor air void structure.
 Gypsum: Observed in voids with thaumasite.





Concrete No.: Femern E; CEM I, 4% MS, w/c 0.40

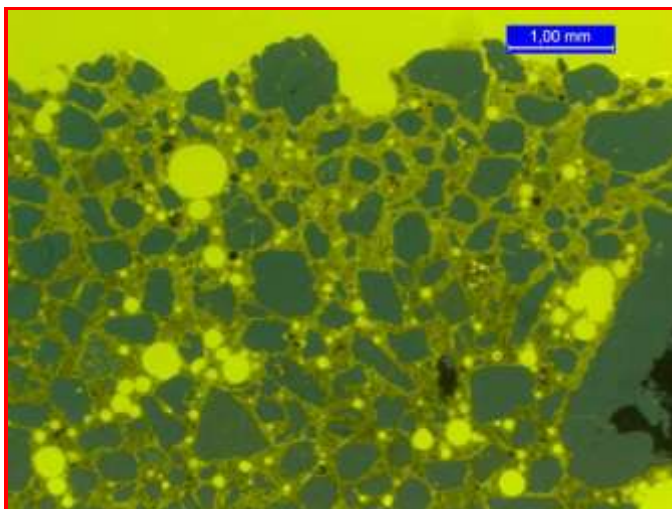
Age: 2 years



Concrete No.:

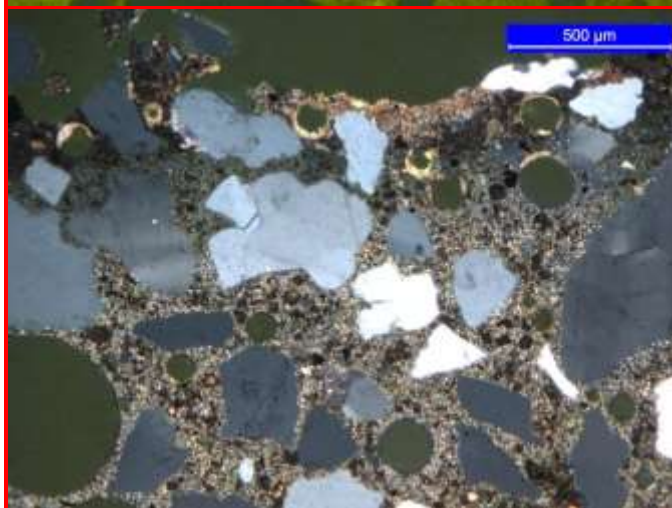
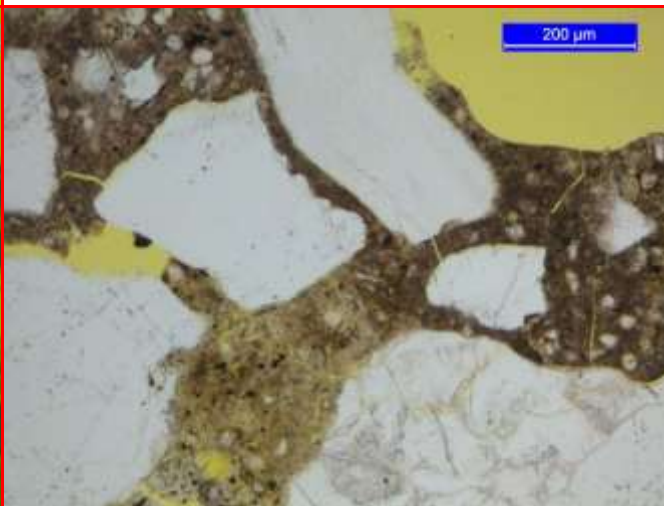
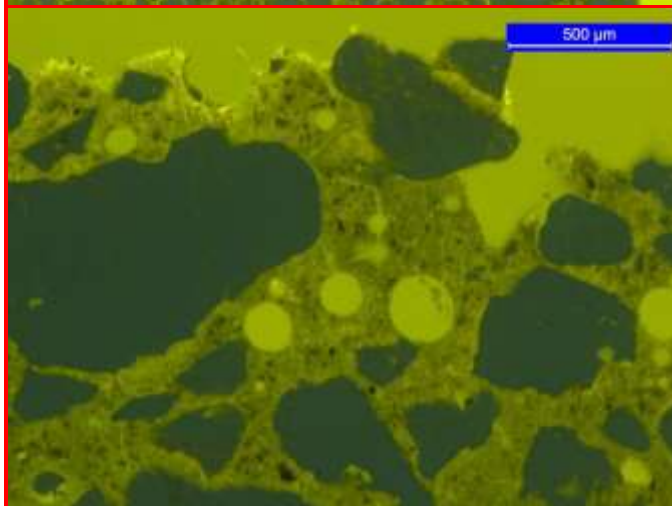
Femern F; CEM I, 12%FA, 4%MS, w/c 0.40

Age: 2 years



Micro-observations (west)

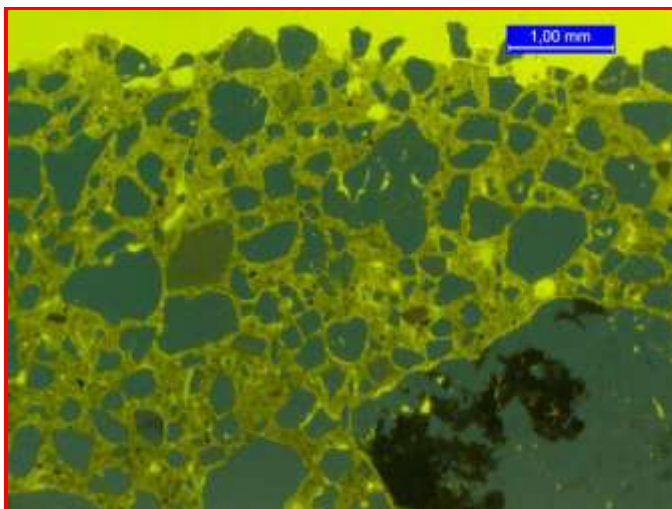
Surface: Scaled with exposed aggregate.
Carbonation: Outer min 0.2mm. Calcite crystals in voids in carbonated zone.
Leached, black zone beneath carbonation: Distinct, 0.2-0.4 mm thick.
Popcorn carbonation: 1.2-2 mm thick.
Leached paste behind popcorn: not distinct
Ettringite: Needles in air voids throughout but most intense outer 4mm. Distinct orange birefringence of ettringite in popcorn zone.
Porosity: Increased porosity in outer 0.9-1.8 mm.
Cracks: Small brittle paste cracks in outer 1-4mm.
Air: Ok, some agglomerated air..
Gypsum: Observed in several air voids in popcorn carbonated zone.



Concrete No.:

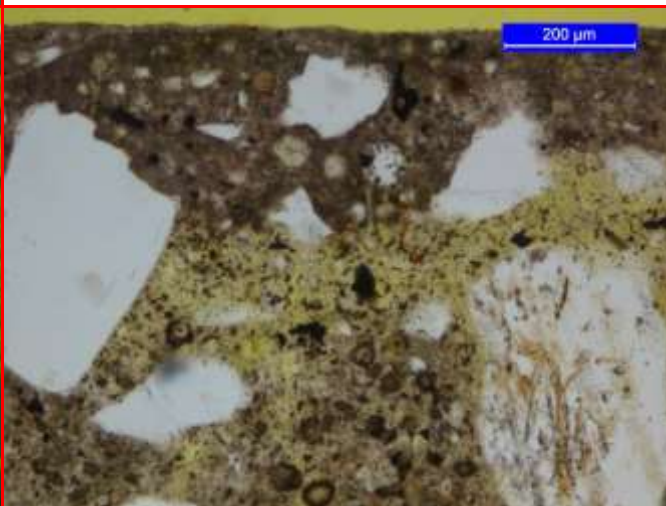
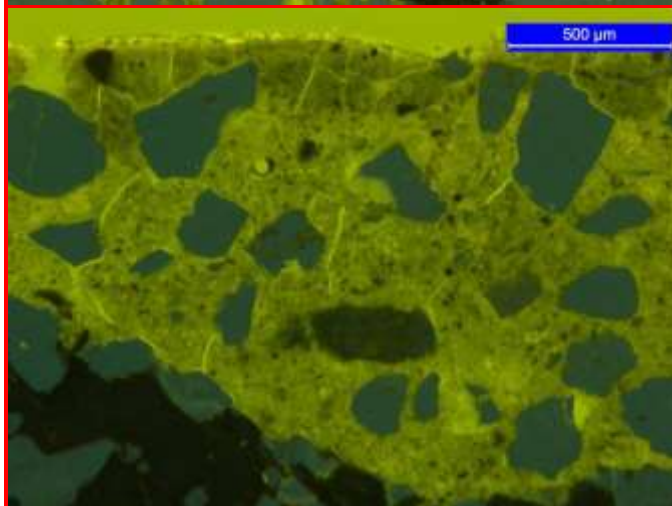
Femern G; CEM I, 12%FA, 4%MS, w/c 0.40

Age: 2 years



Micro-observations (west)

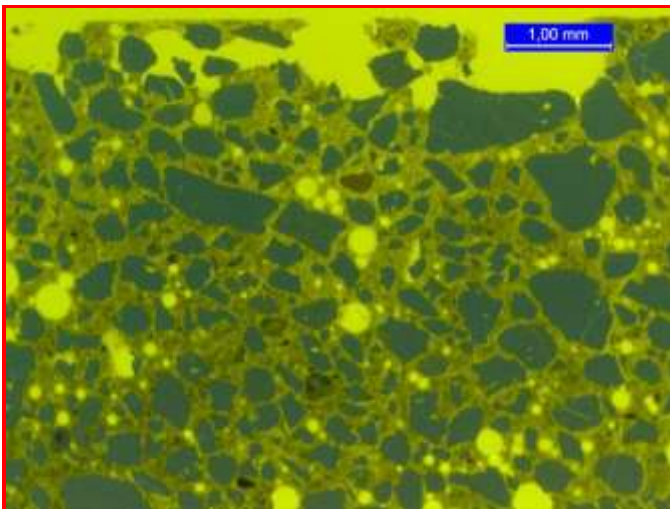
Surface: Intact to scaled with exposed aggregate.
Carbonation: Outer min 0.2mm. Calcite crystals in voids in carbonated zone.
Leached, black zone beneath carbonation: Distinct, 0.2mm thick.
Popcorn carbonation: 0.4-2m thick.
Leached paste behind popcorn: not distinct
Ettringite: Not much but intense in air voids in the popcorn carbonated zone. Distinct orange birefringence of ettringite.
Porosity: Increased porosity in outer 1.2-2mm.
Cracks: Small brittle paste cracks in outer 1-2mm.
Air: Few air voids
Gypsum: Observed in air voids in popcorn carbonated zone in East section.



Concrete No.:

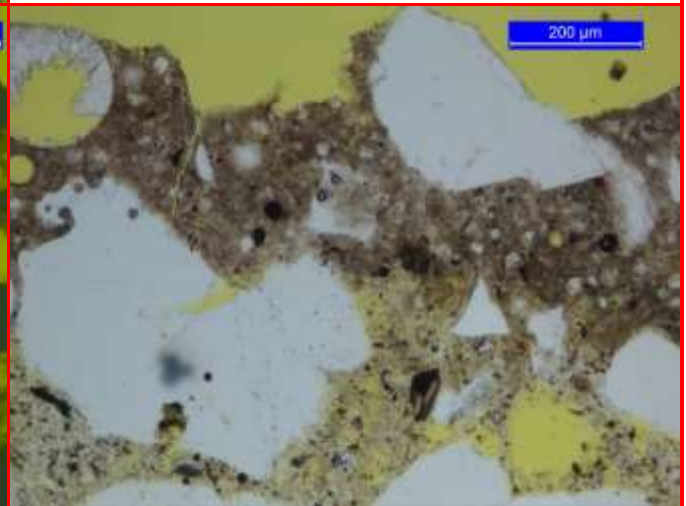
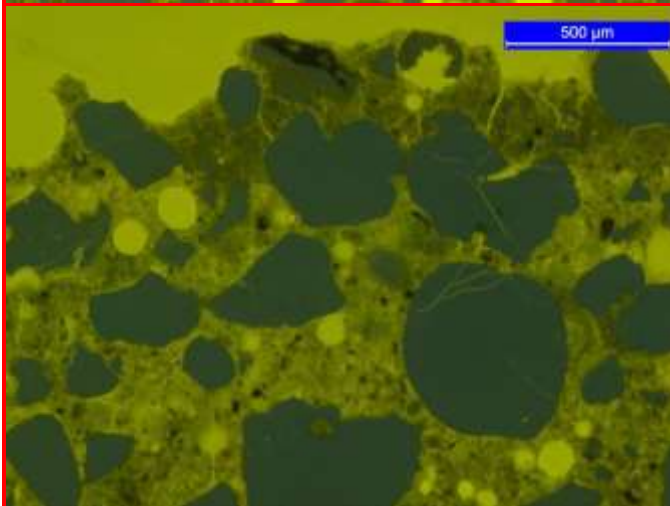
Femern H; CEM I, 12%FA, 4%MS, w/c 0.45

Age: 2 years



Micro-observations (west)

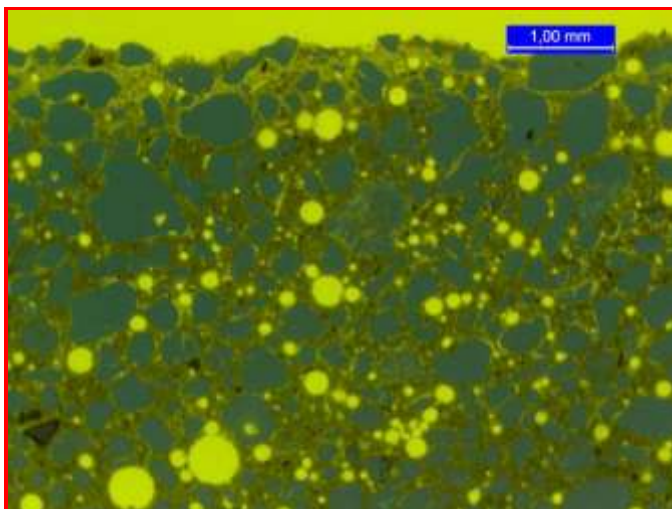
Surface: Intact to scaled with exposed aggregate.
Carbonation: Outer min 0.2-0.3mm. Calcite crystals in voids in carbonated zone.
Leached, black zone beneath carbonation: Distinct, 0.2-0.4mm thick.
Popcorn carbonation: 0.4-2.0 mm thick.
Leached paste behind popcorn: not distinct
Ettringite: Observed in voids throughout but must be distinct in the outer 2mm.
Porosity: Increased porosity in outer 2-4mm.
Cracks: Small brittle paste cracks in outer 1-2mm.
Air: Relatively poor structure.
Gypsum: Observed in air voids in popcorn carbonated zone in East section.



Concrete No.:

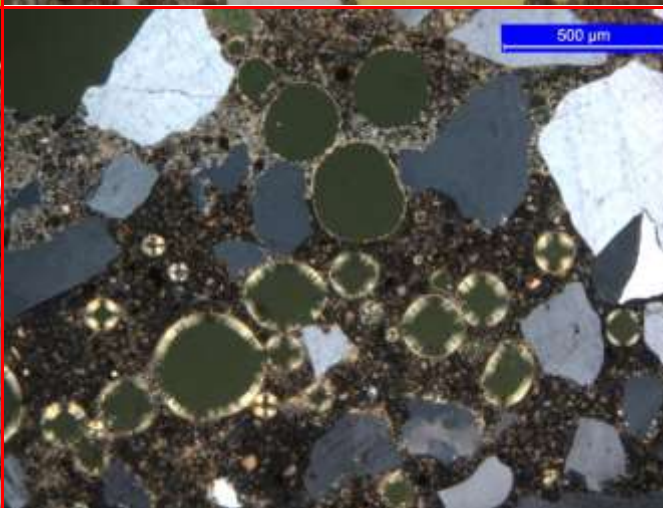
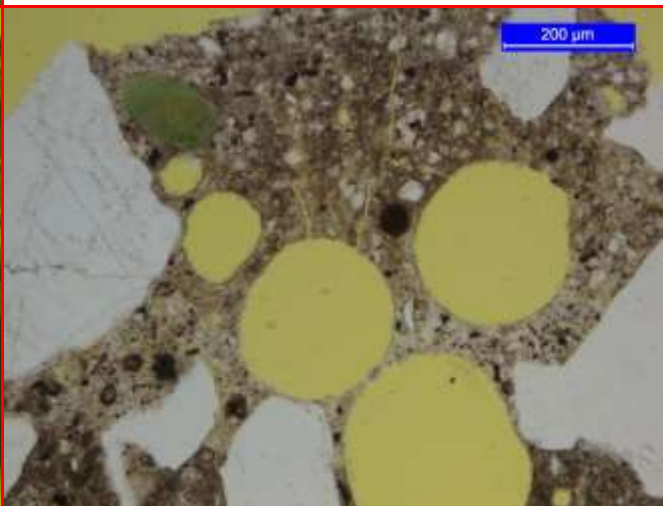
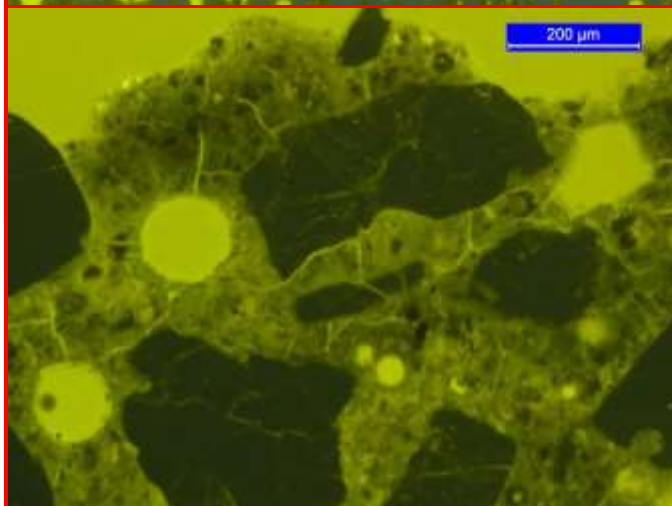
Femern I; CEM I, 12%FA, 4%MS, w/c 0.35

Age: 2 years

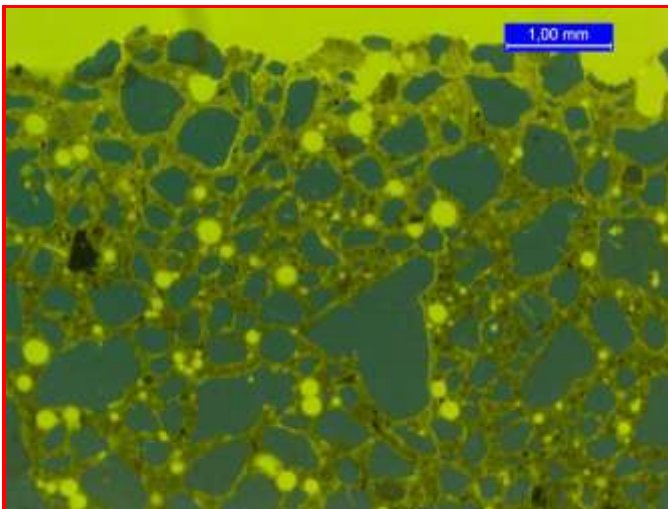


Micro-observations (west)

Surface: Scaled with exposed aggregate.
Carbonation: Outer min 0.2-0.3mm. Calcite crystals in voids in carbonated zone.
Leached, black zone beneath carbonation: Distinct, 0.2mm thick.
Popcorn carbonation: 0.4-0.8m thick.
Leached paste behind popcorn: 0.8mm
Ettringite: Observed in voids throughout but must distinct in the outer 2mm. High birefringence of "ettringite" observed (thaumasite!).
Porosity: Increased porosity in outer 0.6mm.
Cracks: Small brittle paste cracks in outer 1-2mm.
Air: Relatively poor structure.
Gypsum: Observed in air voids in popcorn carbonated zone.

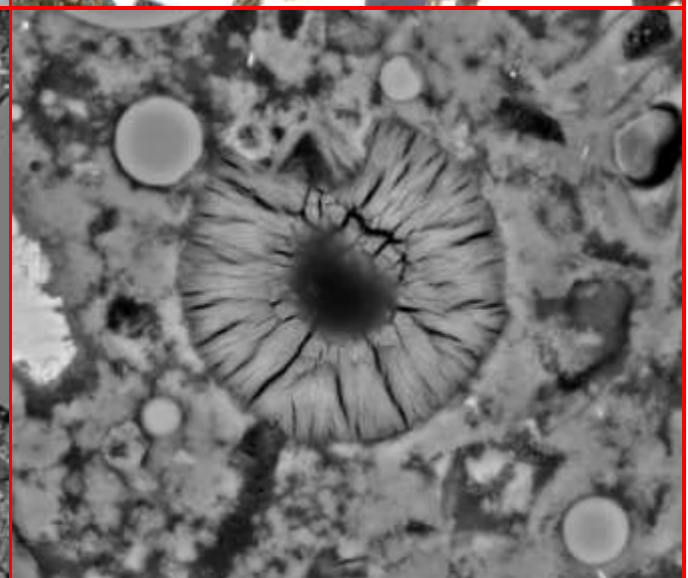
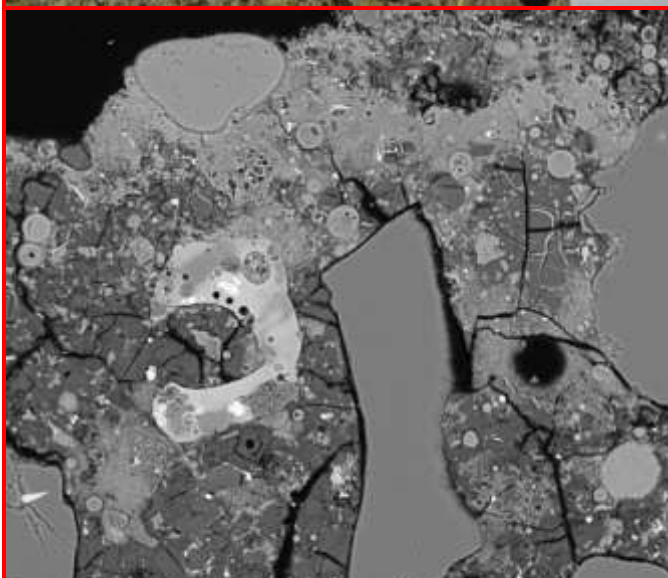
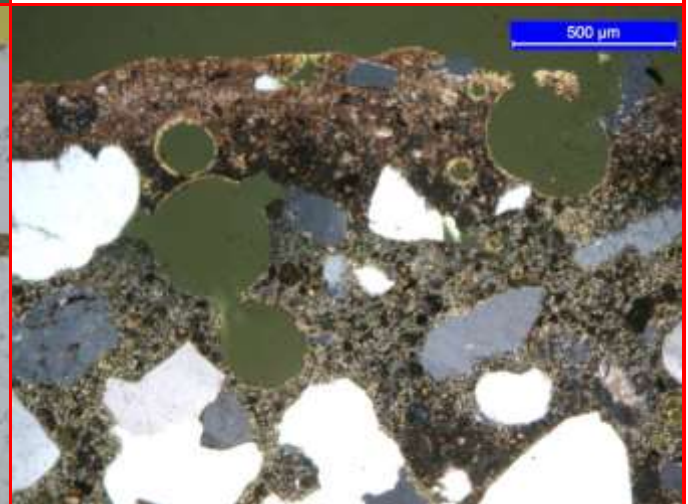
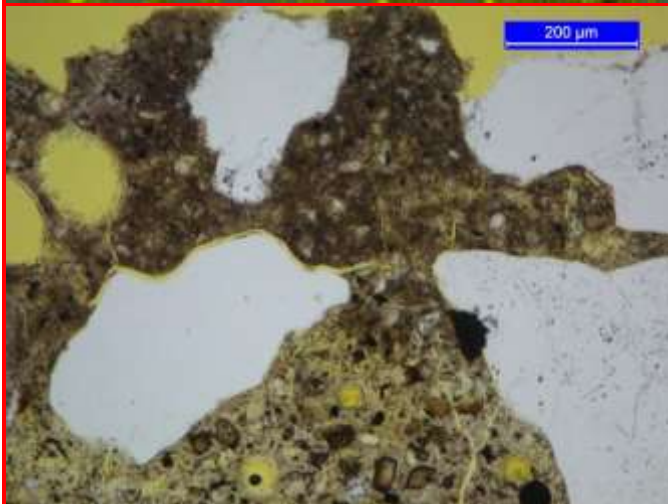


Concrete No.: Femern J; SCC, CEM I, 12%FA, 4%MS, w/c 0.40 Age: 2 years



Micro-observations (west)

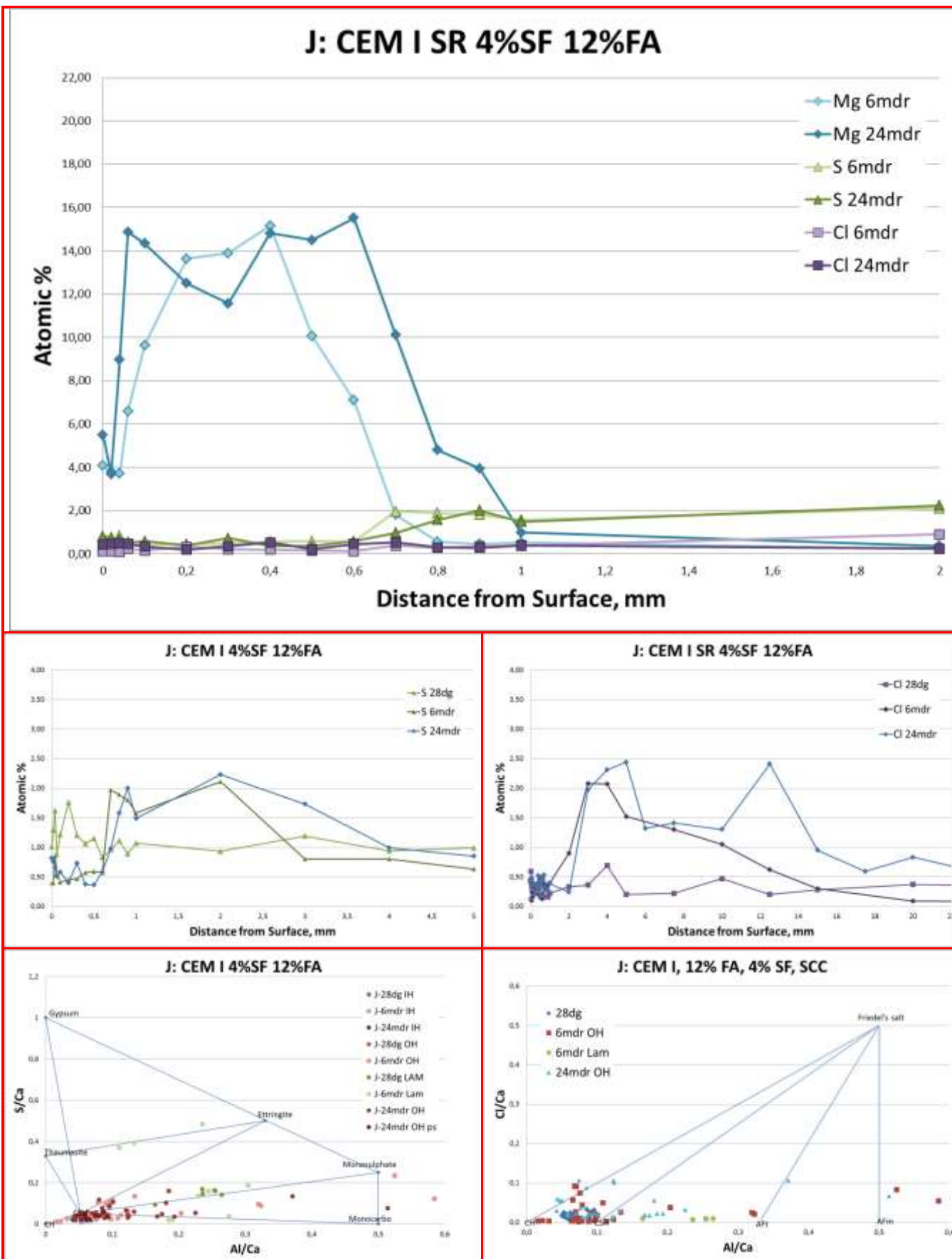
Surface: Scaled with exposed aggregate.
 Carbonation: Outer min 0.2mm. Calcite crystals in voids in carbonated zone.
 Leached, black zone beneath carbonation: Distinct, 0.2mm thick.
 Popcorn carbonation: 0.8m thick.
 Leached paste behind popcorn: not distinct
 Ettringite: Observed in voids throughout but most distinct in the outer 2-3mm.
 Porosity: Increased porosity in outer 1.2-2mm.
 Cracks: Small brittle paste cracks in outer 1-2mm.
 Air: Well distributed.
 Gypsum & thaumasite: Observed in air voids in popcorn carbonated zone.



10/4/2012 HFW HV mag WD spot
 3:21:09 PM 488 µm 20.00 kV 611 x 10.3 mm 5.0

10/4/2012 HFW HV mag WD spot
 4:10:04 PM 74.5 µm 20.00 kV 4 003 x 10.5 mm 5.0

Concrete No.: Femern J; SCC, CEM I, 12%FA, 4%MS, w/c 0.40 Age: 2 years

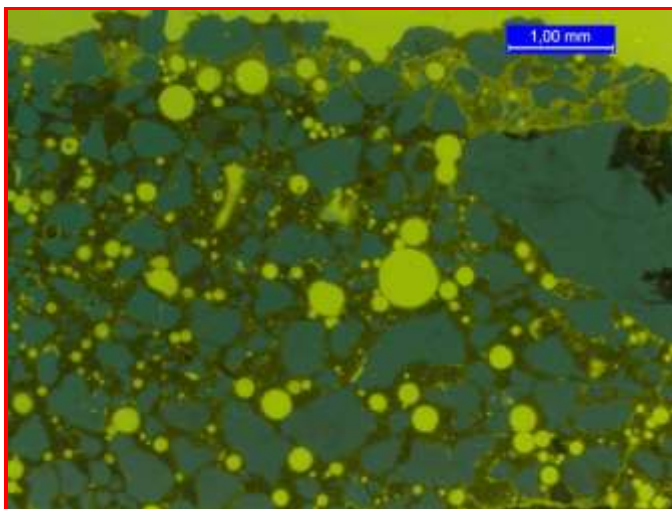




Concrete No.:

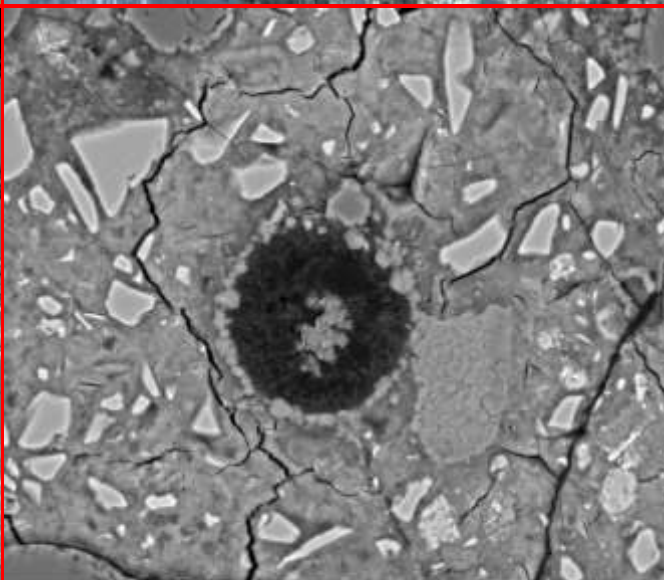
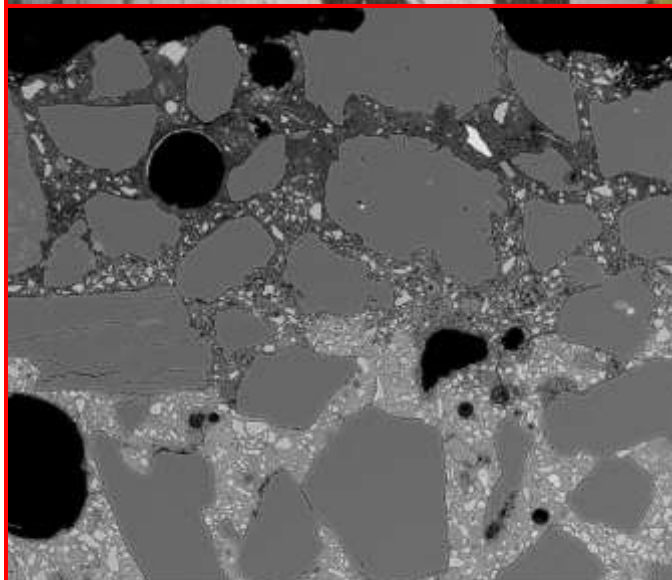
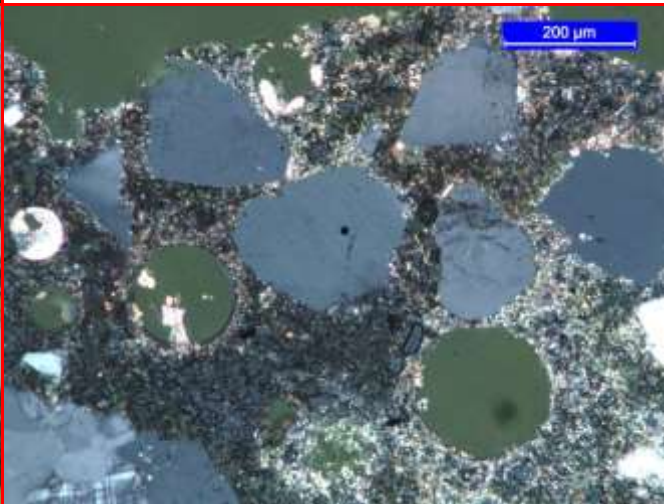
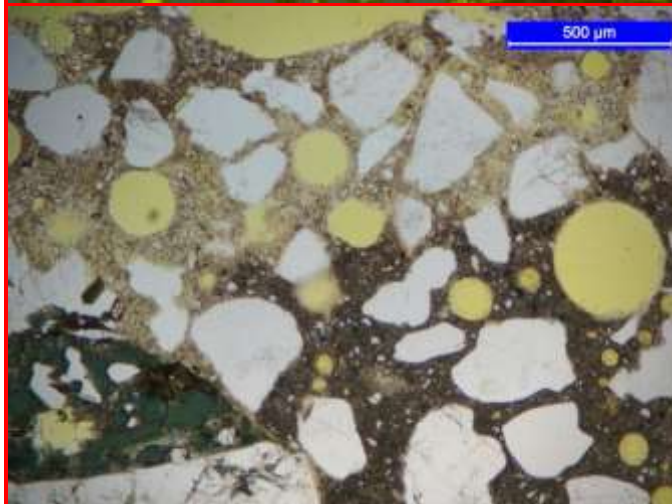
Femern K; CemIII/B, w/c 0.40

Age: 2 years



Micro-observations (west)

Surface: Scaled with exposed aggregate.
Carbonation: Outer min 0.2-0.3mm. Calcite crystals in voids in carbonated zone.
Leached, black zone beneath carbonation: Distinct, 0.2-0.4mm thick.
Popcorn carbonation: 0.4-0.6mm thick.
Leached paste behind popcorn: not distinct
Ettringite: Observed in voids throughout but must be distinct in the outer 4mm.
Porosity: Increased porosity in outer 0.8-1.2mm.
Cracks: Small brittle paste cracks in outer 0.2-1mm.
Air: Poor air void structure.
Gypsum: Observed by SEM in air voids in the popcorn zone.



10/8/2012 HFW HV mag WD spot
9:34:58 AM 1.49 mm 20.00 kV 200 x 8.4 mm 5.0

500 µm

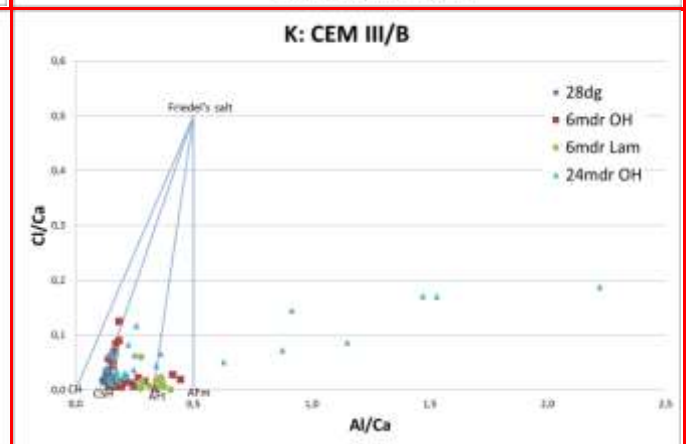
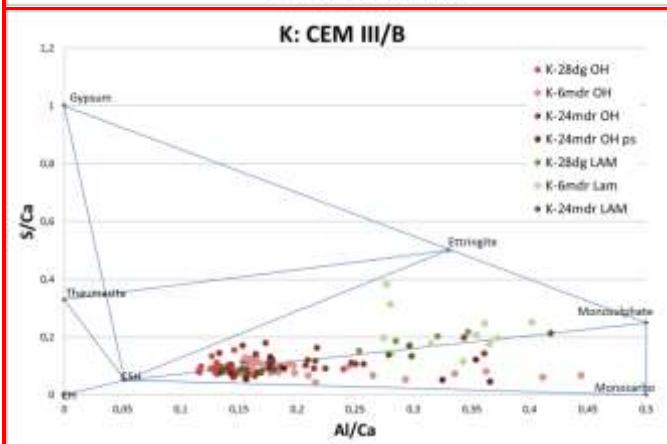
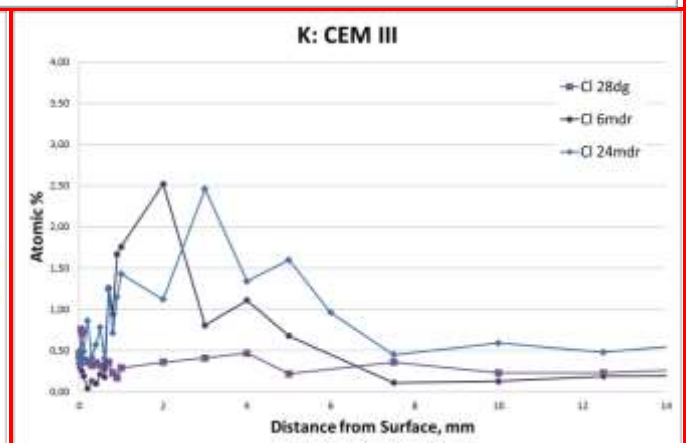
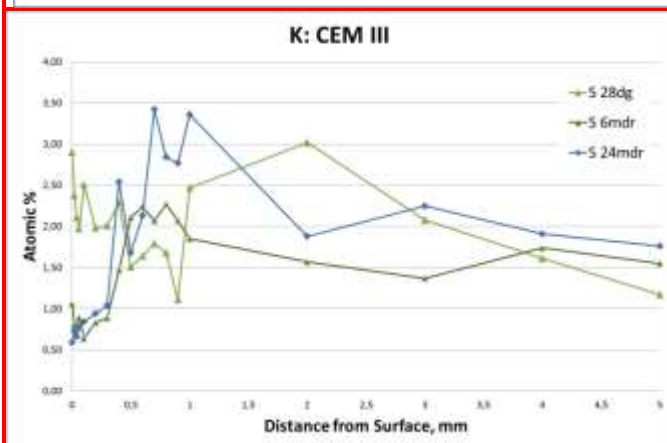
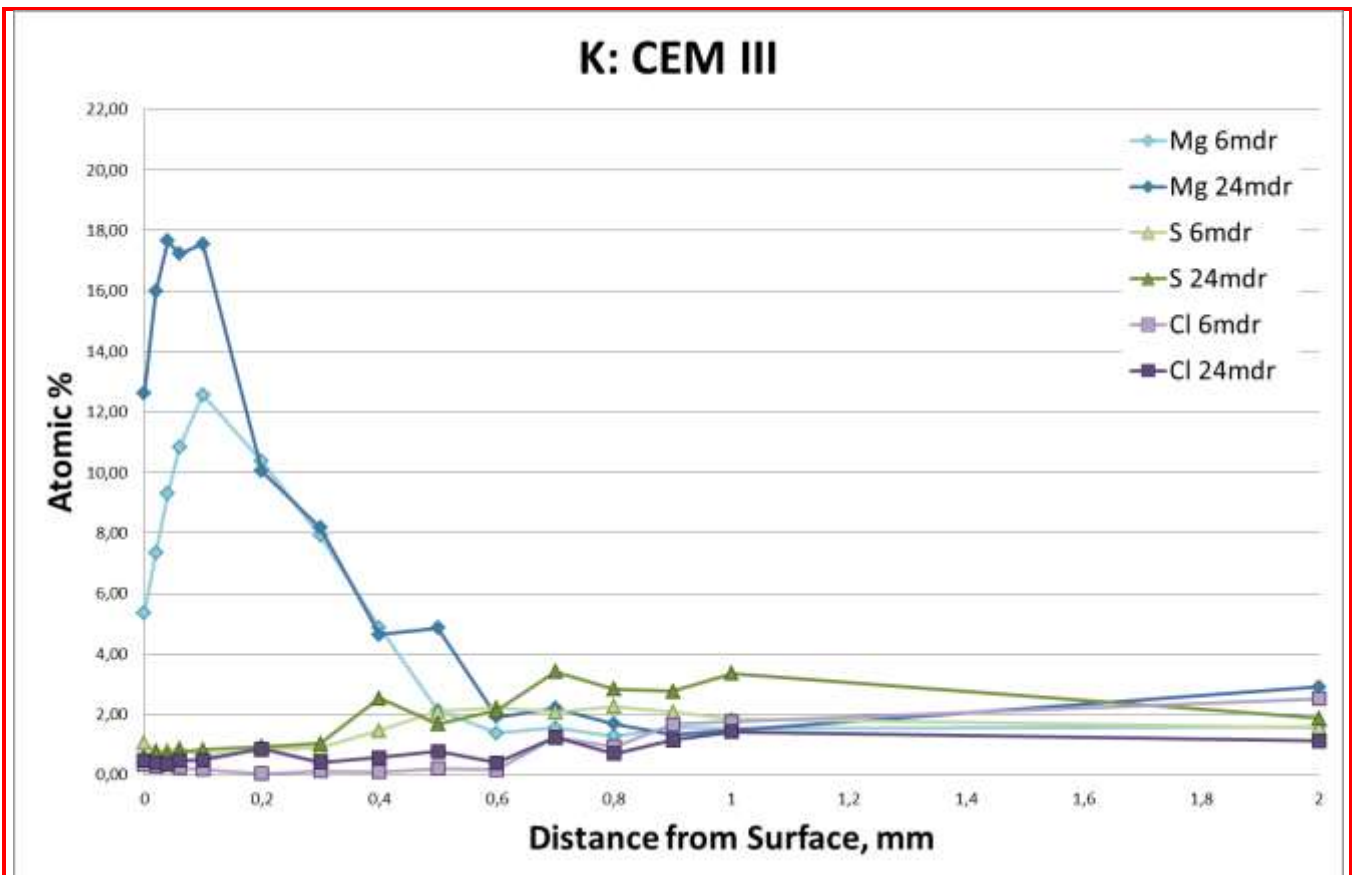
10/8/2012 HFW HV mag WD spot
10:58:30 AM 188 µm 20.00 kV 1 600 x 8.4 mm 5.0

50 µm



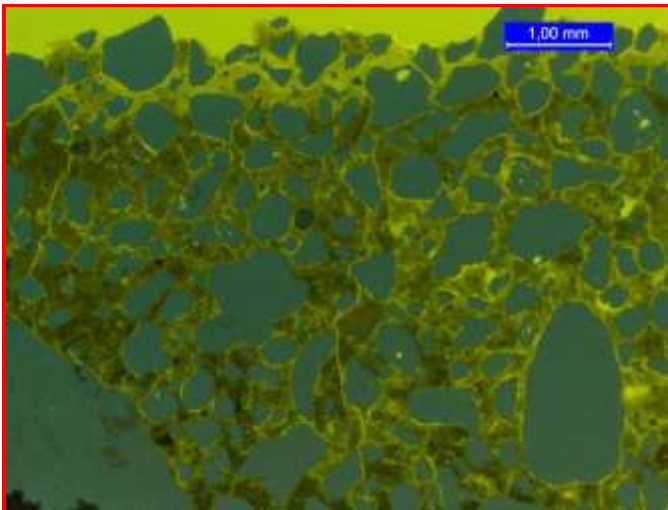
Concrete No.: Femern K; CemIII/B, w/c 0.40

Age: 2 years



Concrete No.: Femern L; CemIII/B, w/c 0.40

Age: 2 years



Micro-observations (west)

Surface: Scaled with exposed aggregate.

Carbonation: Scaled off.

Leached, black zone beneath carbonation: Scaled off.

Popcorn carbonation: 0.4-0.6mm thick.

Leached paste behind popcorn: not distinct

Ettringite: Observed in voids mostly in outer few mm's.

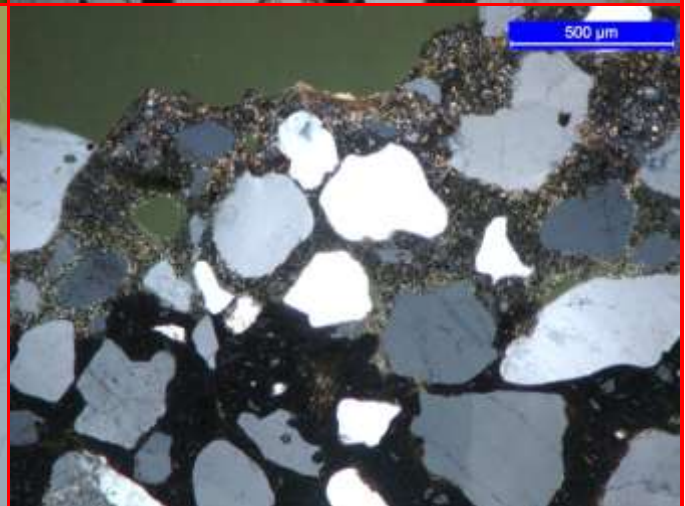
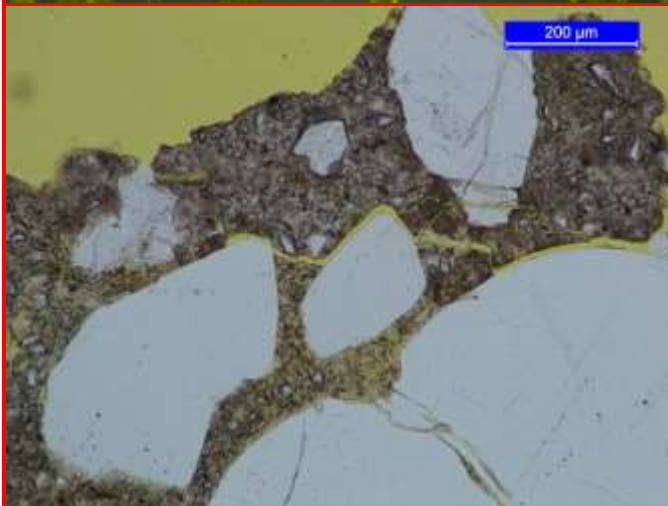
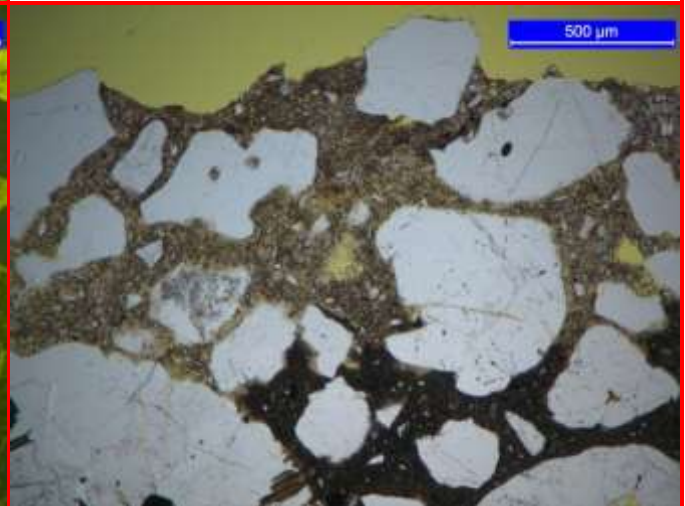
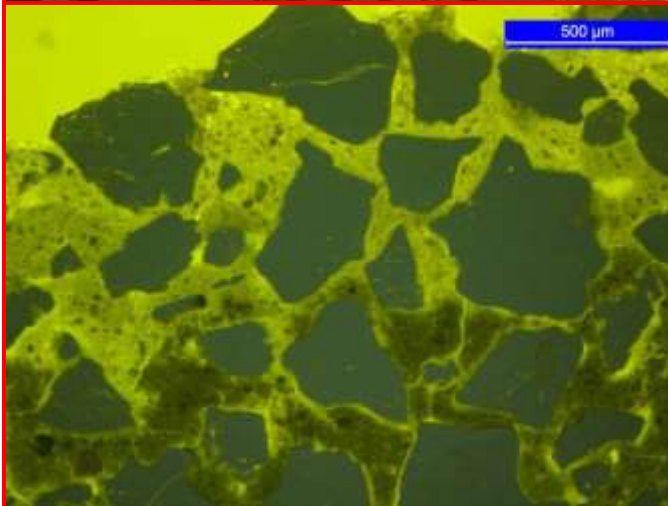
Porosity: Increased porosity in outer 1mm.

Cracks: Small brittle paste cracks in outer 0.2mm.

Some cracking, adhesion in the outer 6mm.

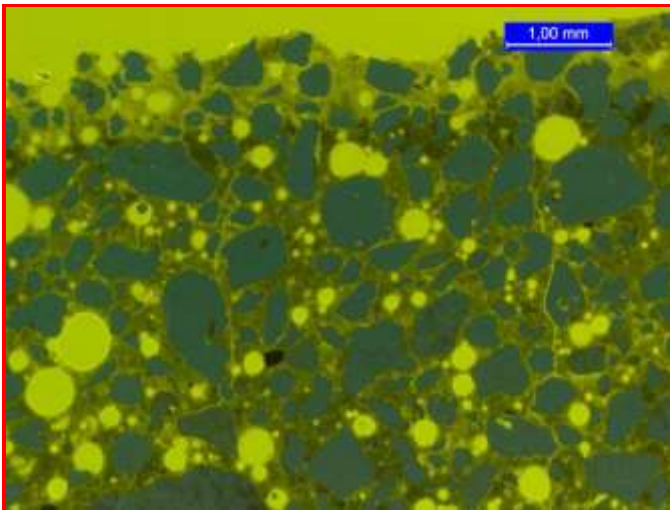
Air: Few voids.

Gypsum: Not observed.



Concrete No.: Femern M; SCC, CemIII/B, w/c 0.40

Age: 2 years



Micro-observations (west)

Surface: Scaled with exposed aggregate.

Carbonation: Min. 0.2mm

Leached, black zone beneath carbonation: 0.2-0.4mm

Popcorn carbonation: 0.4mm thick.

Leached paste behind popcorn: not distinct

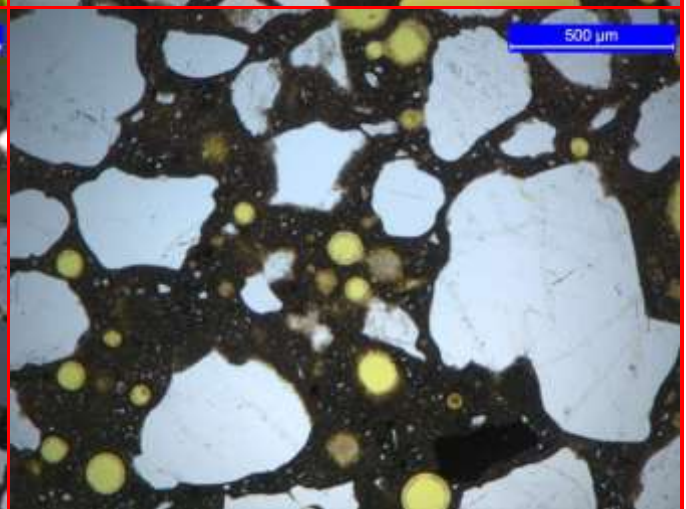
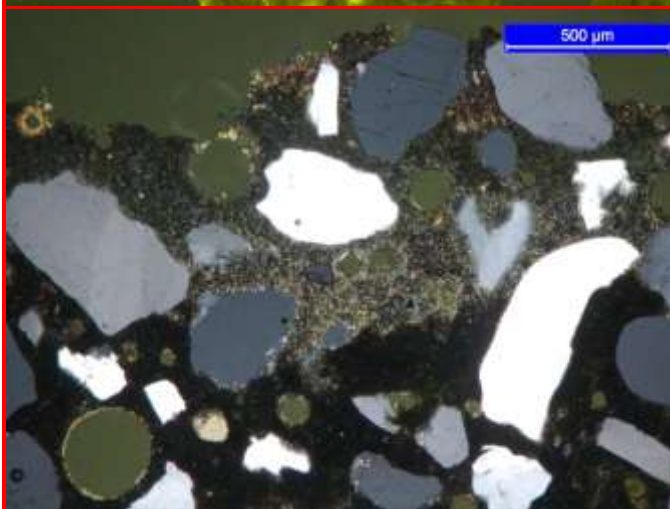
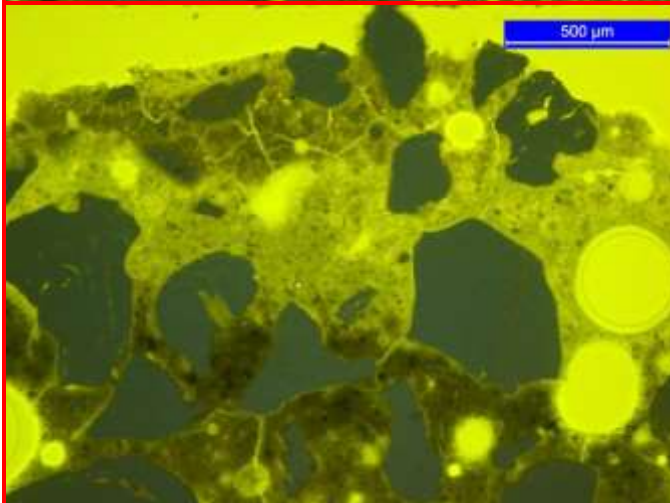
Ettringite: Observed in voids mostly in the outer 4mm. High birefringence.

Porosity: Increased porosity in outer 1mm.

Cracks: Small brittle paste cracks in outer 0.2-0.6mm. Some cracking, adhesion in the outer 6mm.

Air: Well distributed.

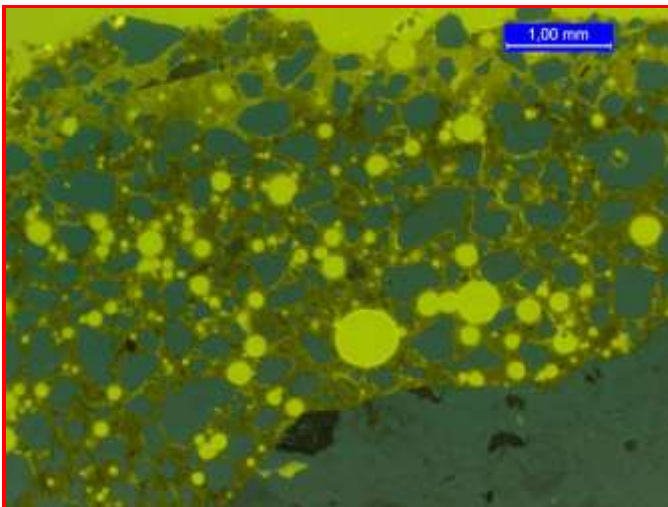
Gypsum: Not observed.



Concrete No.:

Femern N; CemI 52,5N, 70%slag, w/c 0.40

Age: 2 years



Micro-observations (west)

Surface: Scaled with exposed aggregate.

Carbonation: Min. 0.2mm

Leached, black zone beneath carbonation: 0.3mm

Popcorn carbonation: 0.3-0.4mm thick.

Leached paste behind popcorn: not distinct

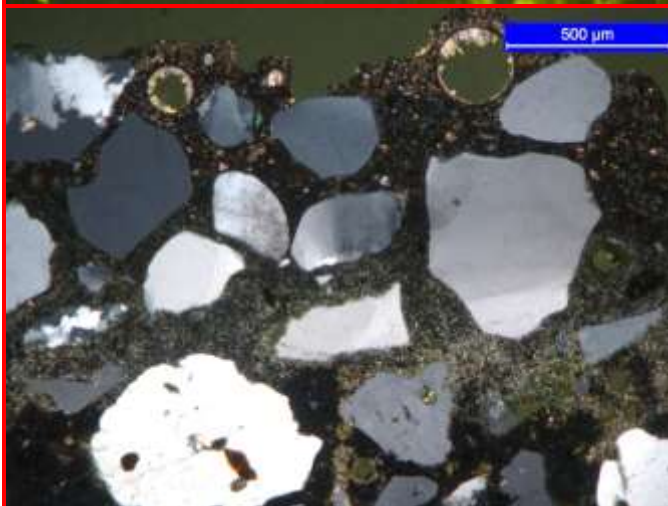
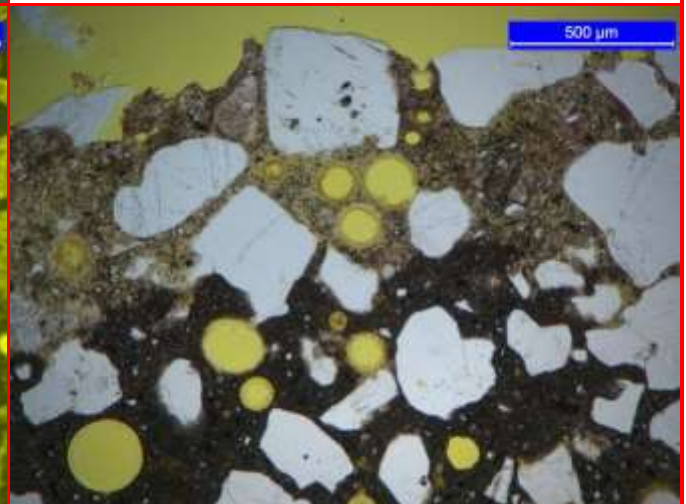
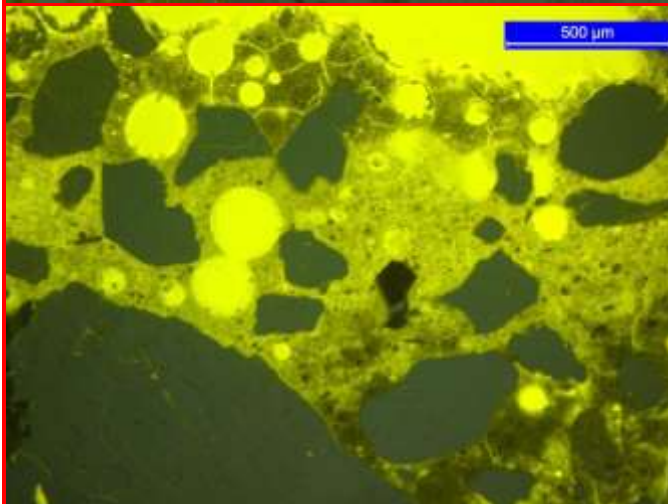
Ettringite: Observed in voids mostly in the outer 2mm. High birefringence.

Porosity: Increased porosity in outer 1-1.2mm.

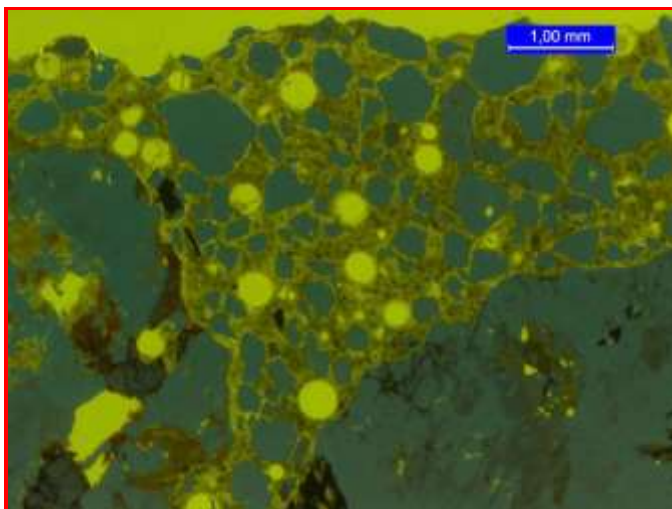
Cracks: Small brittle paste cracks in outer 0.2-0.6mm. Some cracking, adhesion in the outer 5mm.

Air: Well distributed.

Gypsum: Not observed.

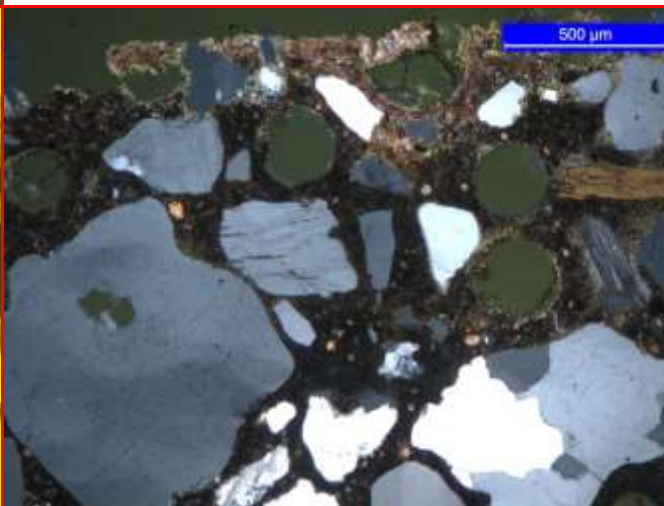
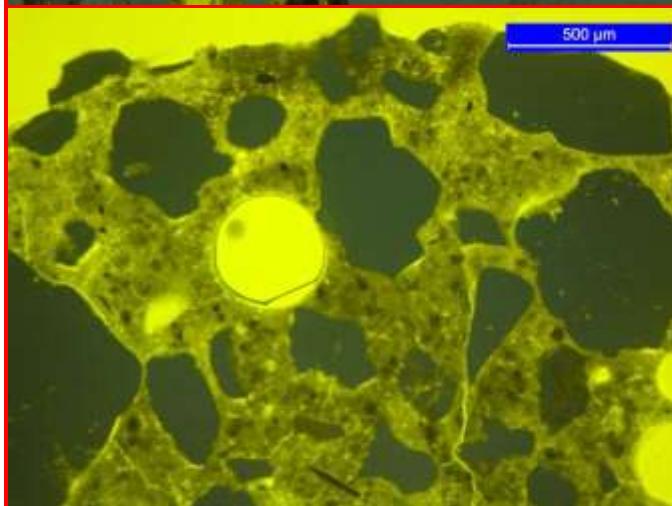


Concrete No.: Femern O; CEM III, 4%MS, w/c 0.40, polymers **Age:** 2 years



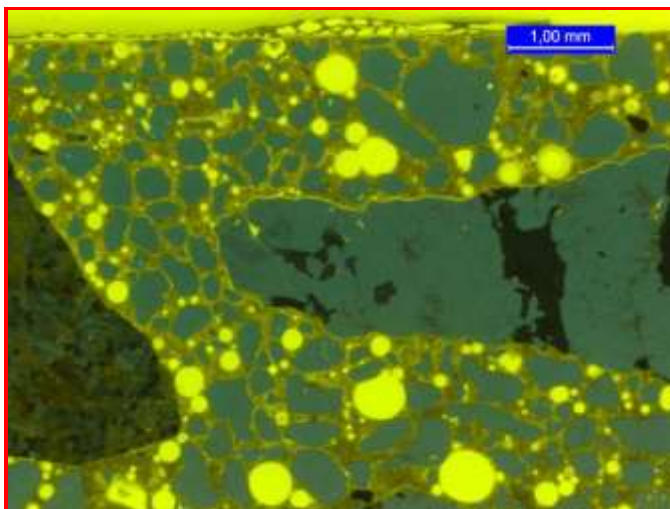
Micro-observations (west)

Surface: Scaled with exposed aggregate.
 Carbonation: 0.2-1.2mm
 Leached, black zone beneath carbonation: 0.2-1.2mm
 Popcorn carbonation: Not observed.
 Ettringite: Not observed
 Porosity: Increased porosity in outer 0.5mm.
 Cracks: Some cracking, adhesion in the outer 3mm.
 Air: Air voids are lined with a membrane.
 Gypsum: Not observed.



Concrete No.: Femern Basis; CemII

Age: 2 years



Micro-observations (core)

Surface: Intact surface occasionally with calcite crust.

Carbonation: To 0.4, max 1mm. Difficult to observe due to lime fine content. Large calcite crystals in voids of carbonated zone.

Leached zone beneath carbonation: To 1.2mm.

Ettringite: Almost all air voids in the concrete are lined with needle shaped ettringite.

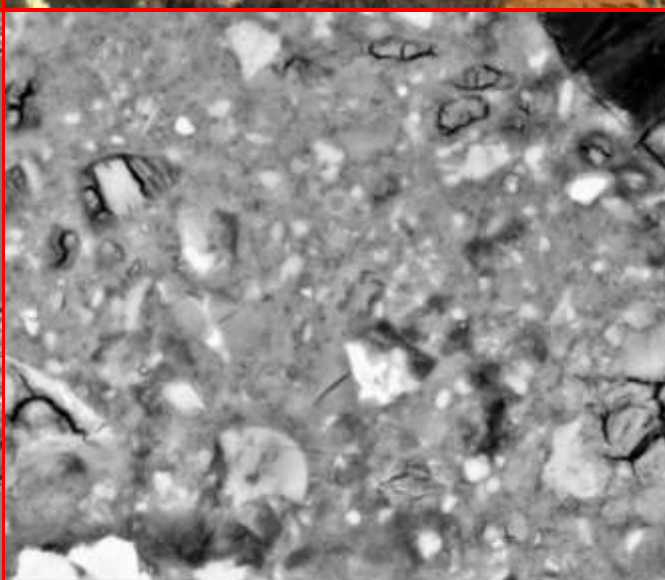
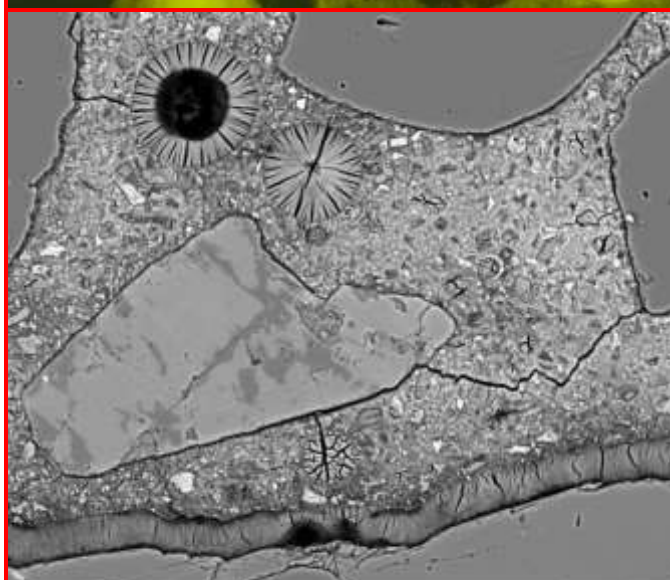
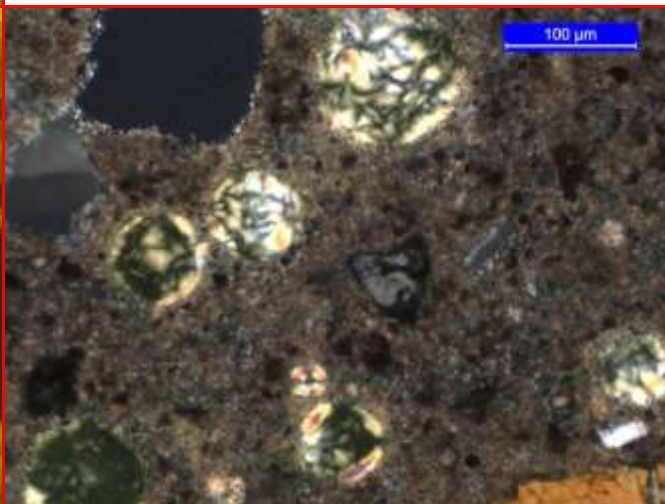
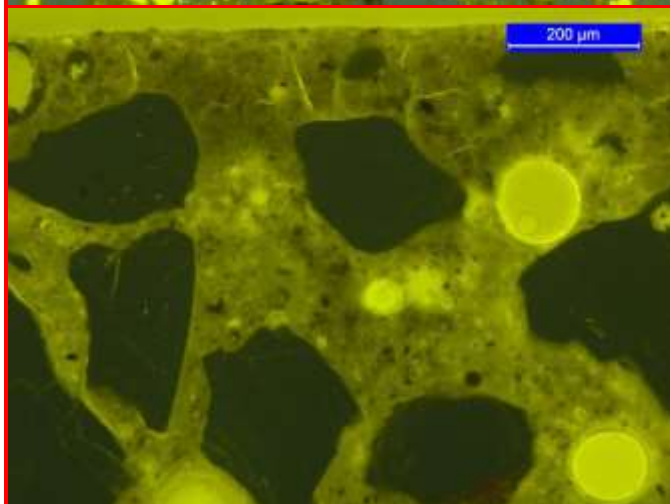
Porosity: Slightly increased porosity in upper 1mm.

Cracks: Small brittle cracking in porous/leached surface zone. Few micro-cracks in surface.

Generally no cracks inside the concrete.

Air: Well entrained.

Thaumasite: Present in voids and cracks in the upper 1mm. Possible together with gypsum and brucite.



10/10/2012 HFW HV mag WD spot
9:28:22 AM 383 µm 20.00 kV 776 x 9.5 mm 5.0

100 µm

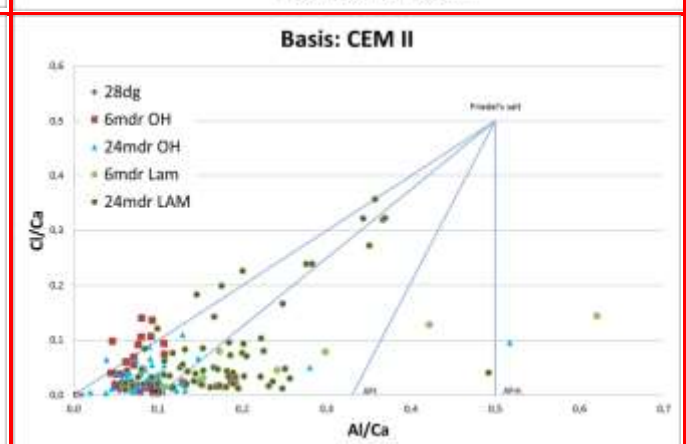
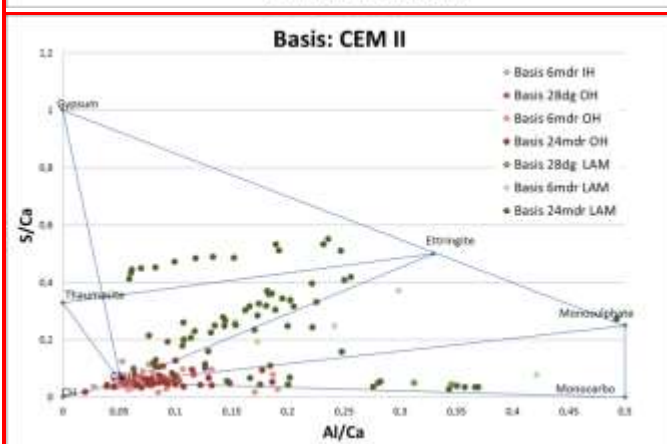
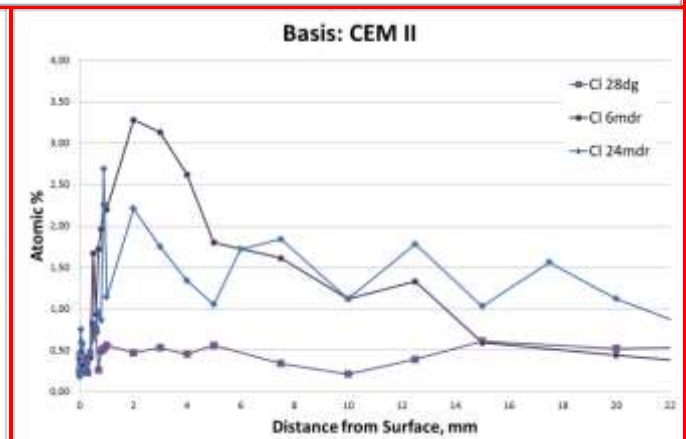
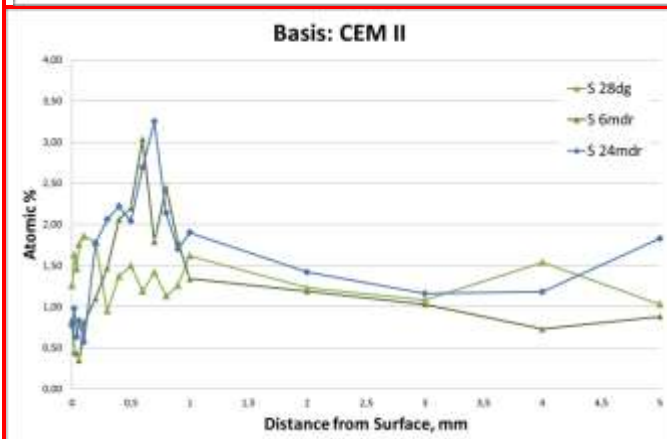
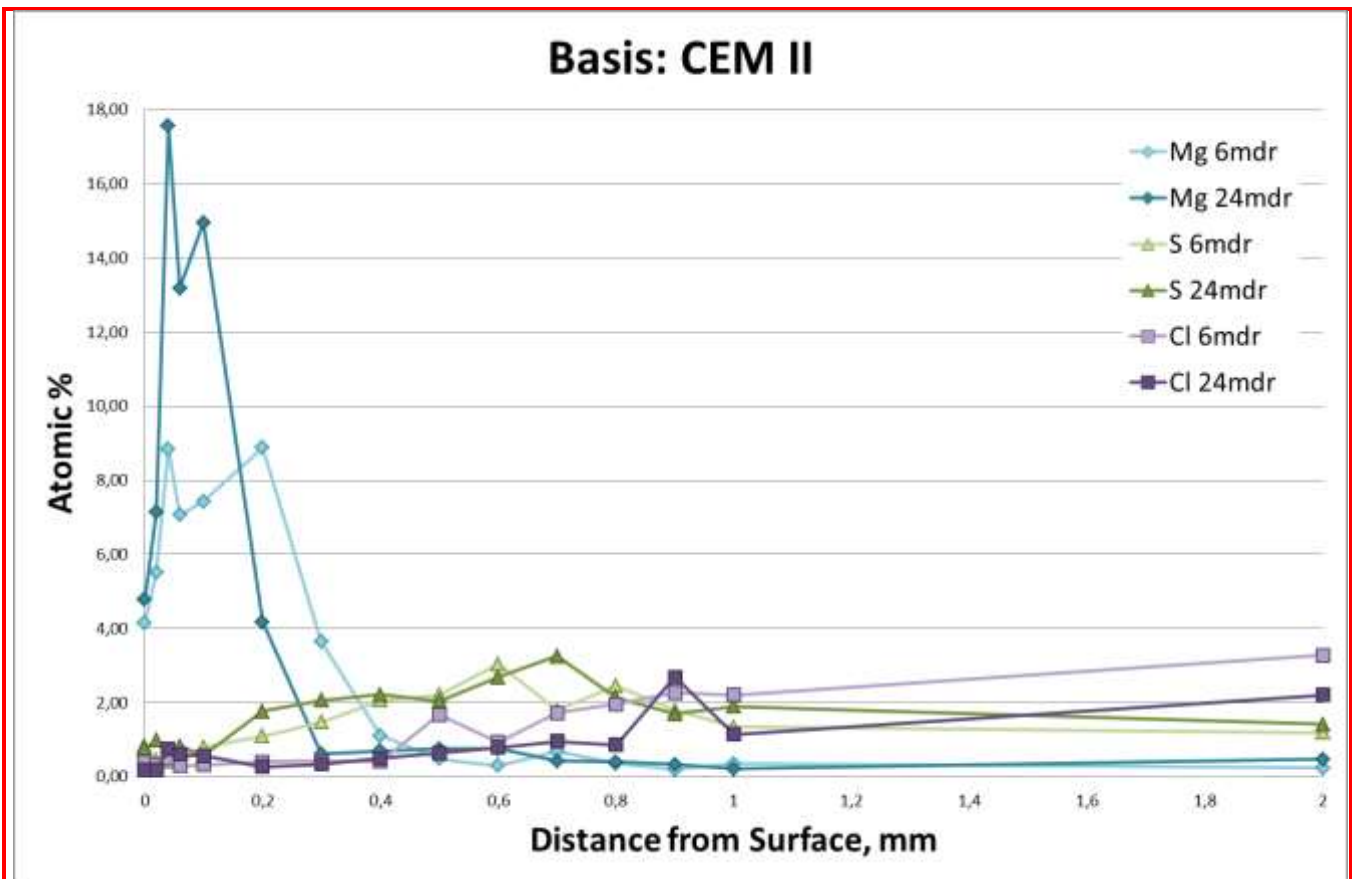
10/10/2012 HFW HV mag WD spot
9:52:44 AM 49.8 µm 20.00 kV 5 894 x 9.4 mm 5.0

10 µm



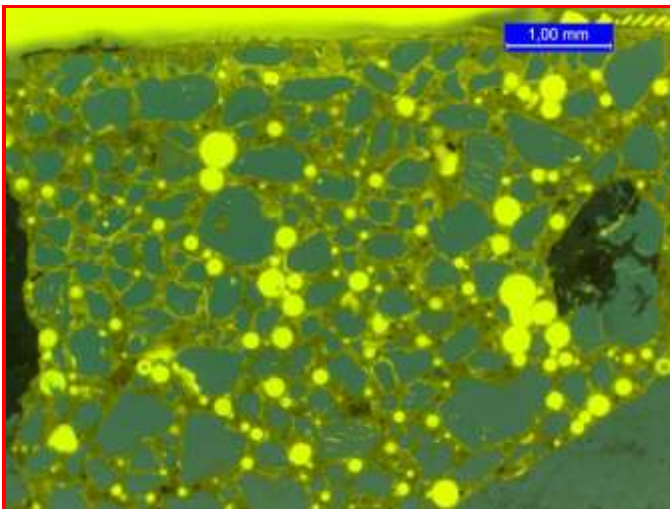
Concrete No.: Femern Basis; CemII

Age: 2 years



Concrete No.: Femern Rapid; CEM I

Age: 2 years



Micro-observations

Surface: Intact covered by calcite to weakly scaled with exposed aggregate.

Carbonation: 0.4 to 1.2, avg. 0.6. Large calcite crystals in voids of carbonated zone.

Leached zone beneath carbonation: 1 to 1.2mm.

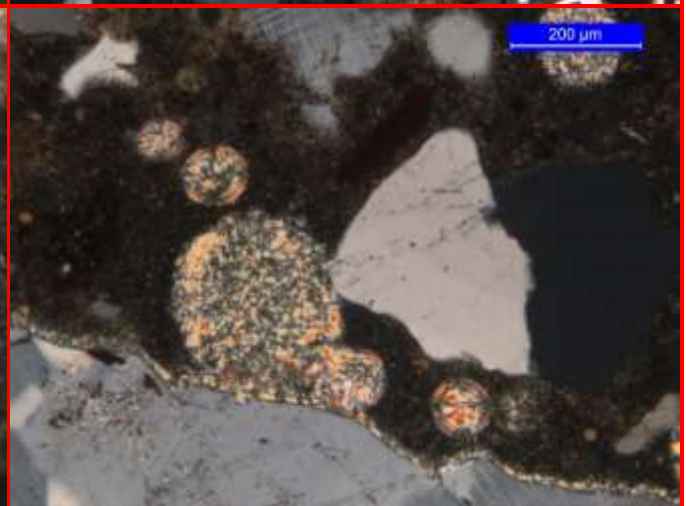
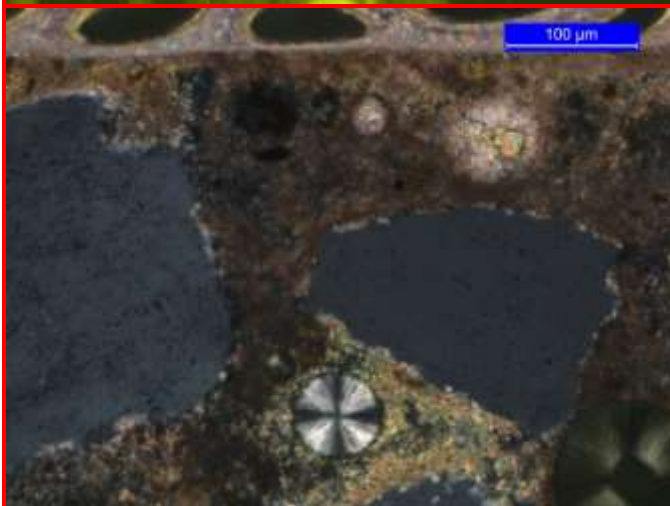
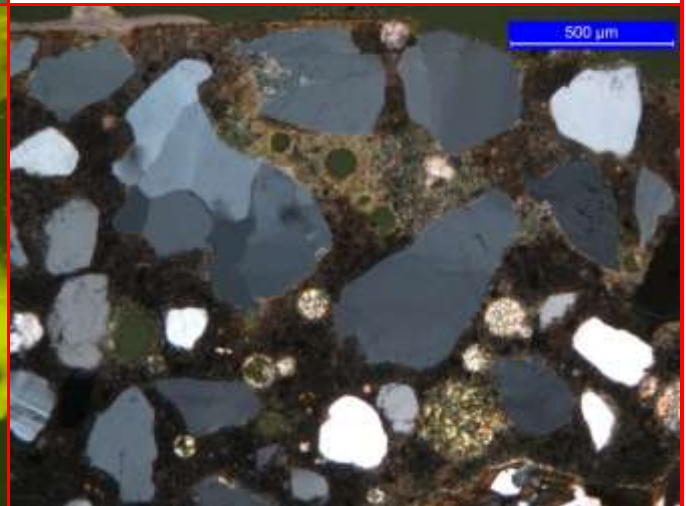
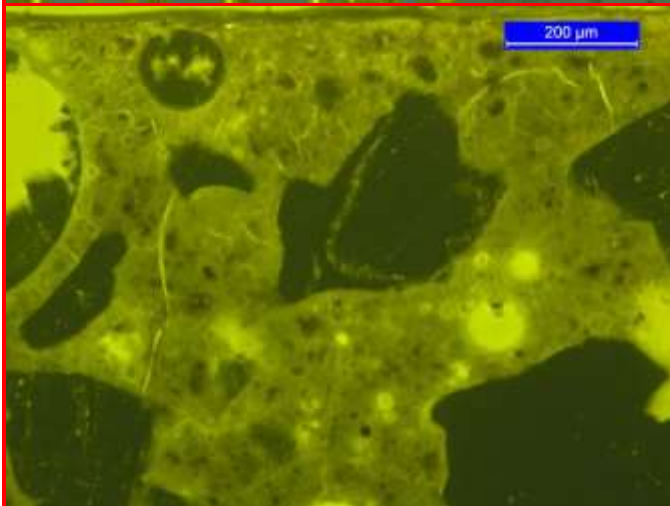
Ettringite: Almost all air voids in the concrete are lined with needle shaped ettringite.

Porosity: Slightly increased porosity in upper 0.4mm.

Cracks: Small brittle cracking in porous/leached surface zone (outer 0.4mm). Few micro-cracks in surface. Generally no cracks inside the concrete.

Air: Well entrained.

Thaumasite: Present in voids and cracks in the upper 1mm. Possible together with gypsum and brucite.

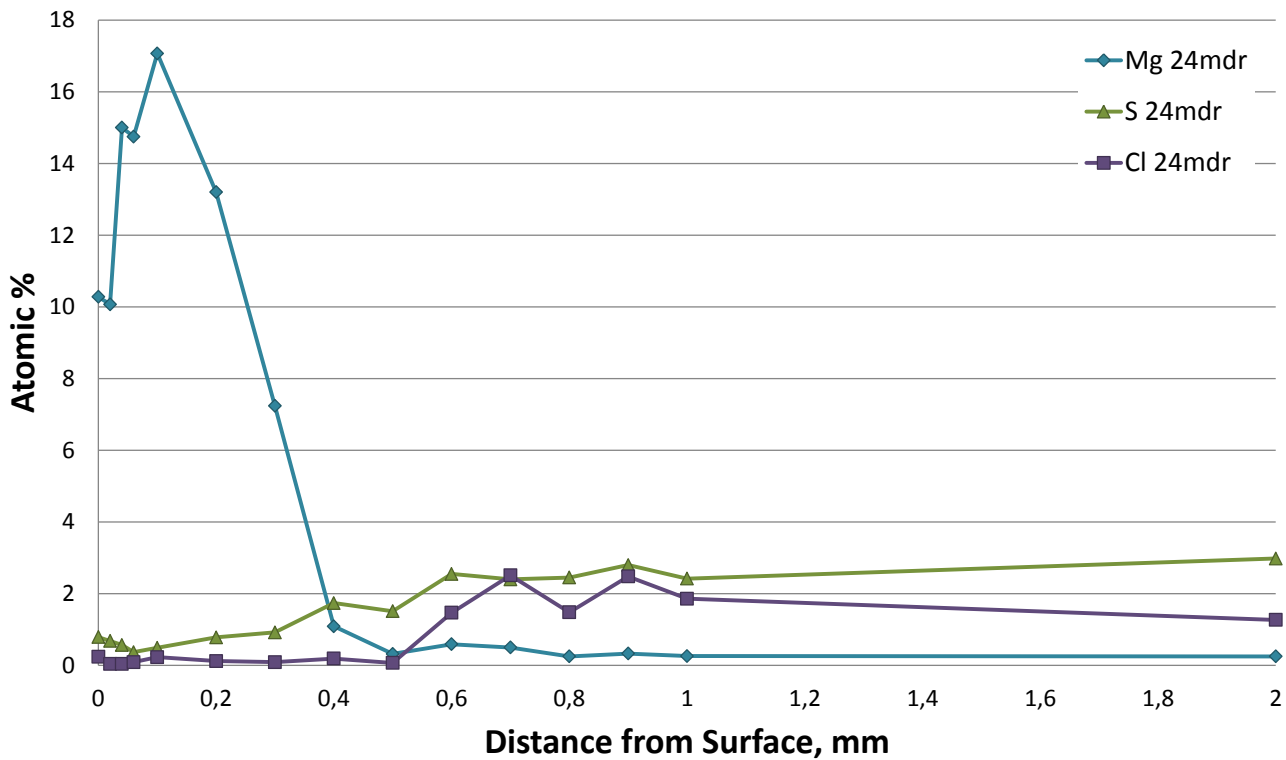




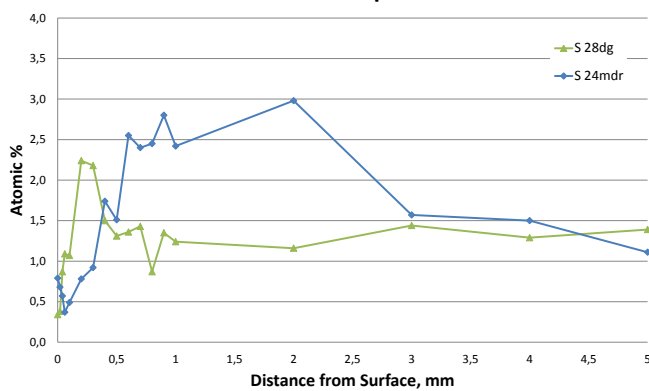
Concrete No.: Femern Rapid; CEM I

Age: 2 years

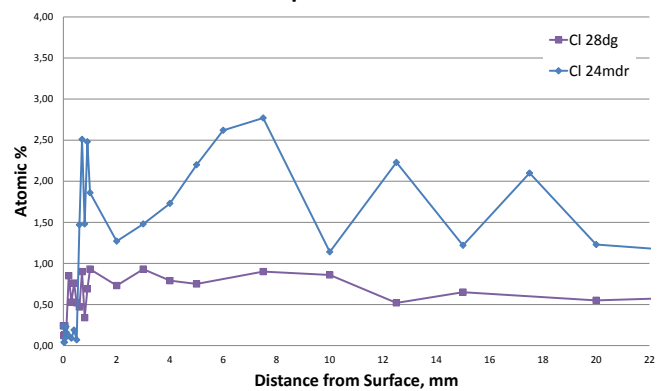
Rapid: CEM I



Concrete Rapid

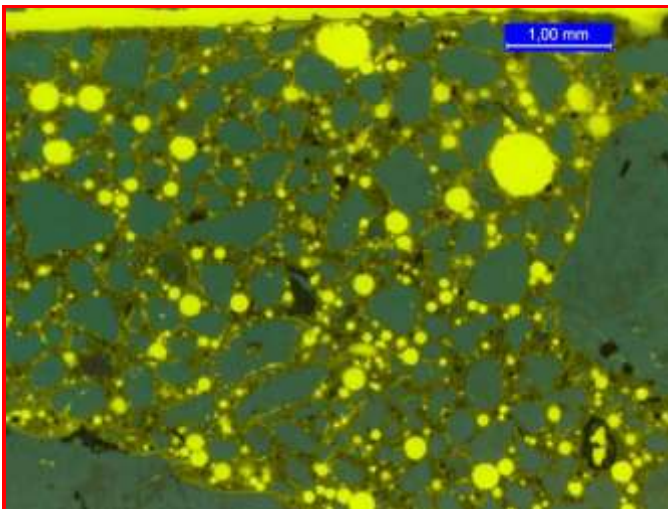


Rapid: CEM I



Concrete No.: Femern Rapid; CEM I+FA

Age: 2 years



Micro-observations

Surface: Primarily scaled with exposed aggregate. Occasionally intact with calcite crust.

Carbonation: 0.4 to 1.2mm. Large calcite crystals in voids of carbonated zone. Leached paste is occasionally present above carbonated paste.

Leached zone beneath carbonation: 2-4mm.

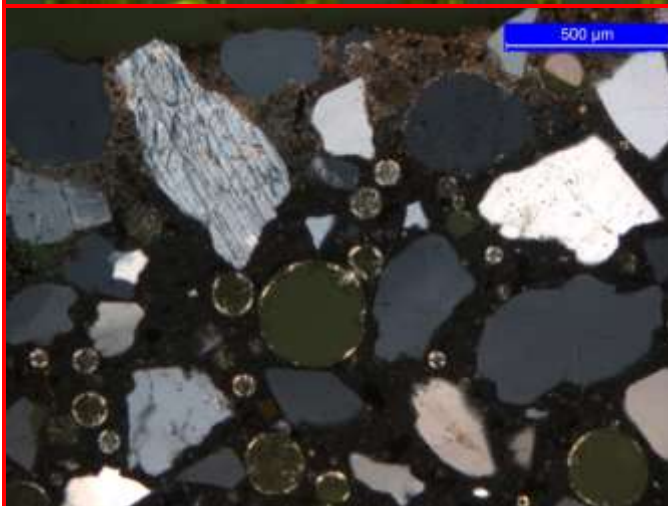
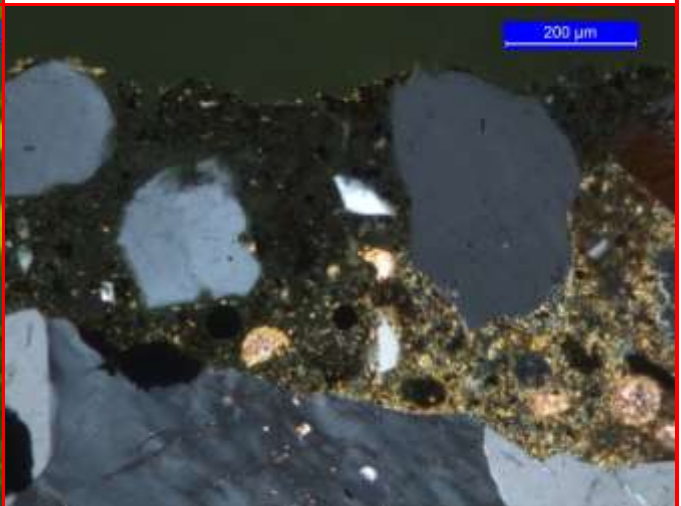
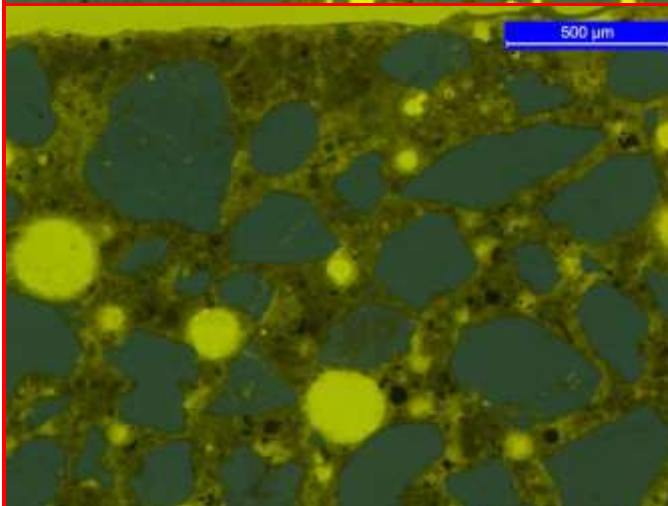
Ettringite: Almost all air voids in the concrete are lined with needle shaped ettringite, most pronounced in upper 12mm.

Porosity: Slightly increased porosity in upper 0.6-1.2mm.

Cracks: Small brittle cracking in porous/leached surface zone (upper 0.2mm). Few micro-cracks in surface to 2mm. Generally no cracks inside the concrete.

Air: Well entrained.

Thaumasite: Present in voids and cracks in the upper 1-2mm. Possible together with gypsum and brucite.

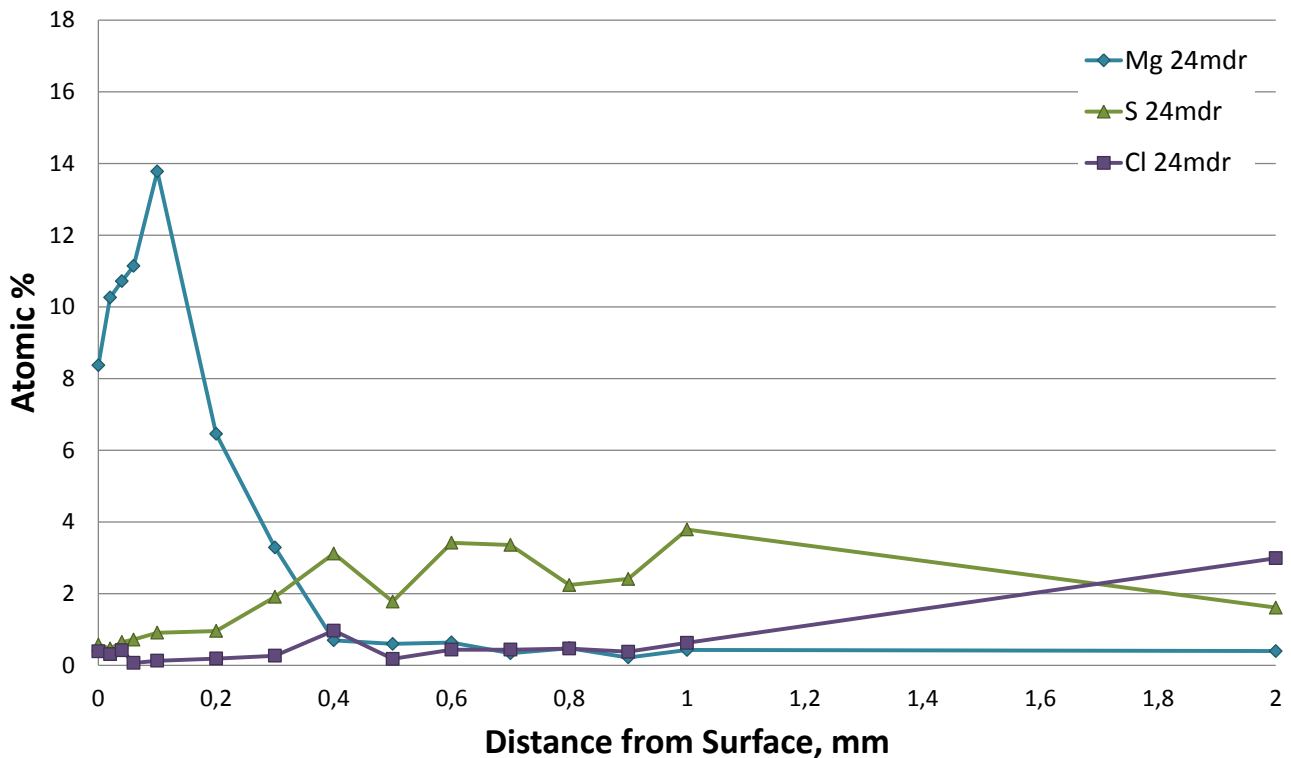




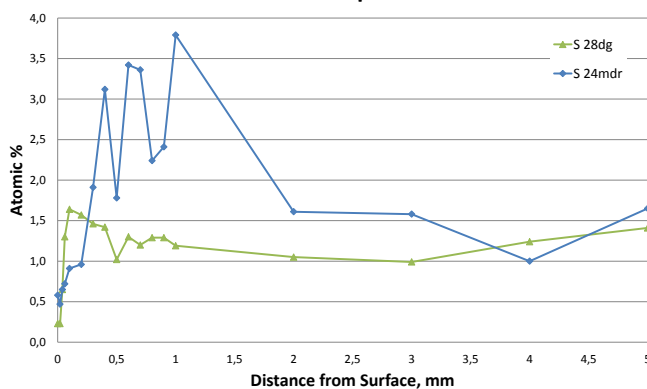
Concrete No.: Femern Rapid; CEM I+FA

Age: 2 years

Rapid: CEM I, FA



Concrete Rapid-FA



Rapid: CEM I, FA

