

Article

Supplementary materials

Hybrid cements. Mechanical Strengths, Microstructure and Radiological Behavior

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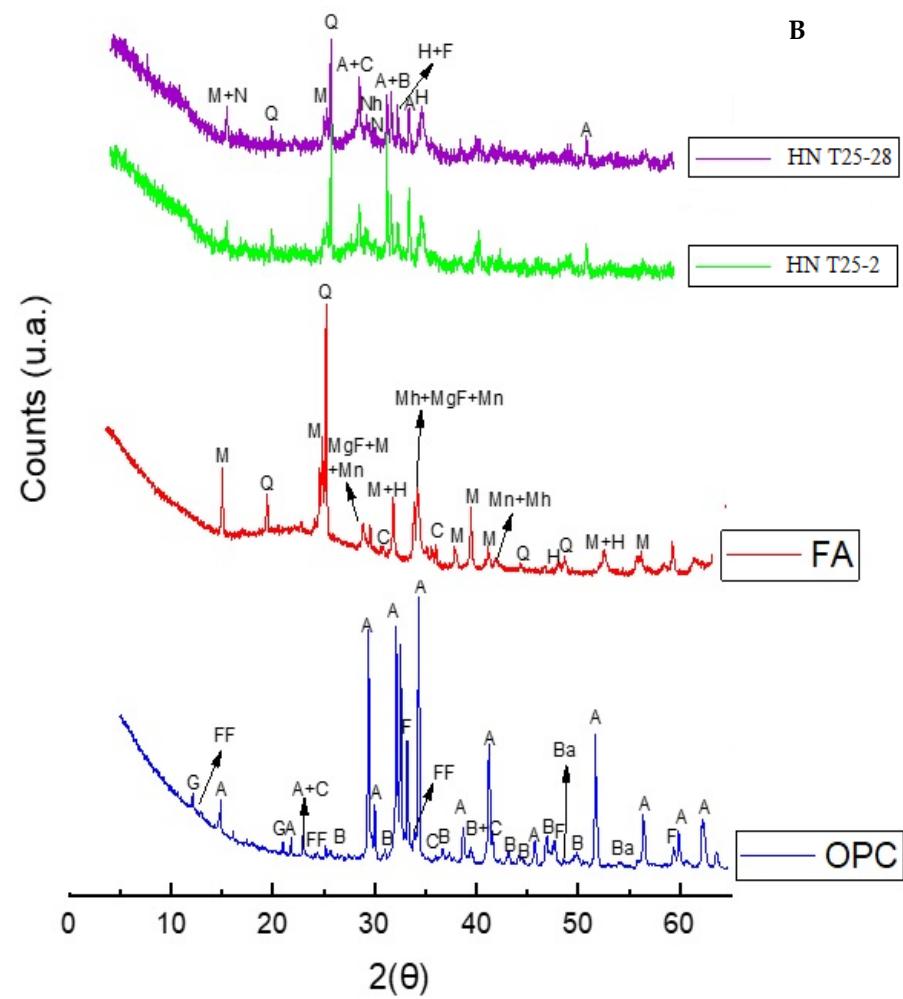
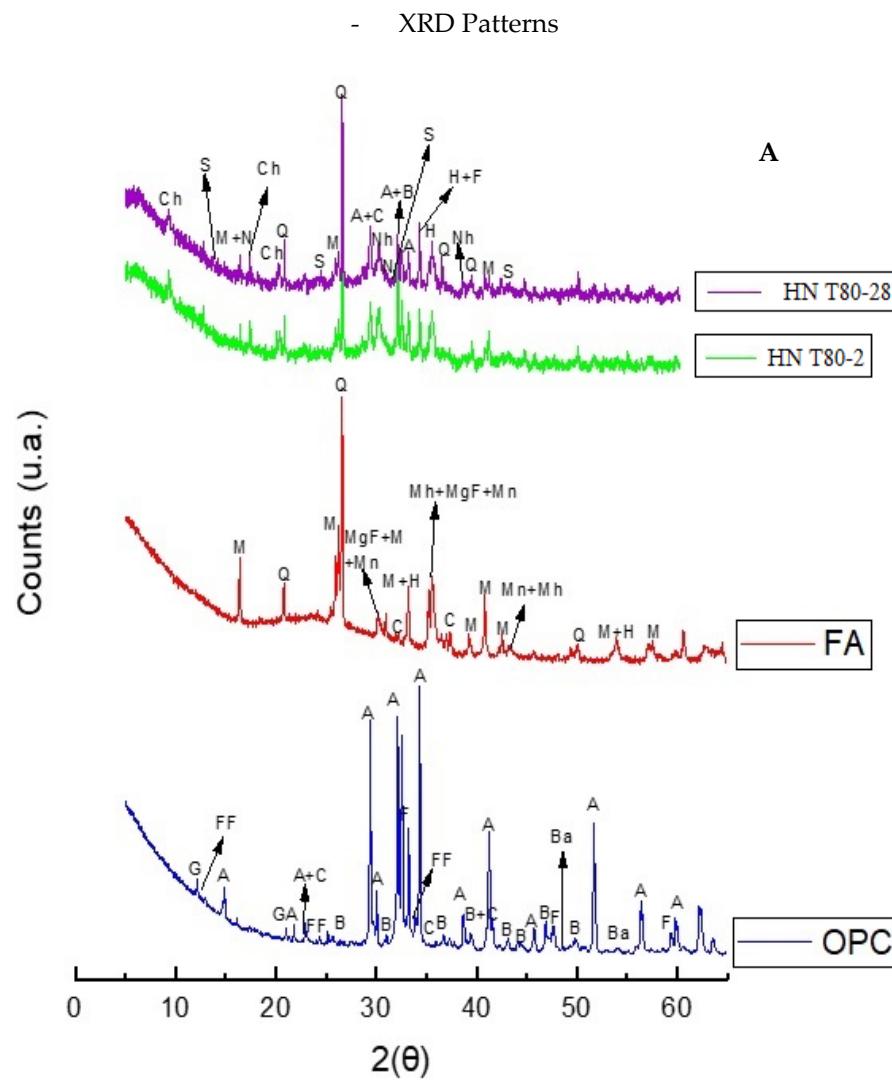
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Specifications for the HPGe detectors used

Table S1. Specifications for the high purity germanium detectors used in this study

Parameter	Detector 07	Detector 50	Detector 90
Model	GXI0022	GR3321	BE50360
Type	Extended range coaxial	Reverse electrode coaxial	Broad energy
Resolution at 1.33 MeV (keV)	2.04	2.04	1.84
Relative efficiency at 1.33 MeV (%)	115.7	35.5	48.0
Crystal diameter (mm)	84	58	80
Crystal length (mm)	72	60	30
Outer shielding (cm)¹	15	15	15
Inner shielding-1st layer (Cu) (mm)	3.0	-	2.5
Inner shielding-2nd layer (Zn) (mm)	-	-	1.5
Inner space shielding (dm³)	25	25	25
Shielding composition	Fe	Fe	Pb

Hybrid cement paste (30% OPC + 70% FA) mineralogical and microstructural characterisation: XRD patterns, ATD/TG thermograms, ²⁹Si and ²⁷Al MAS-NMR spectra and BSEM micrographs.



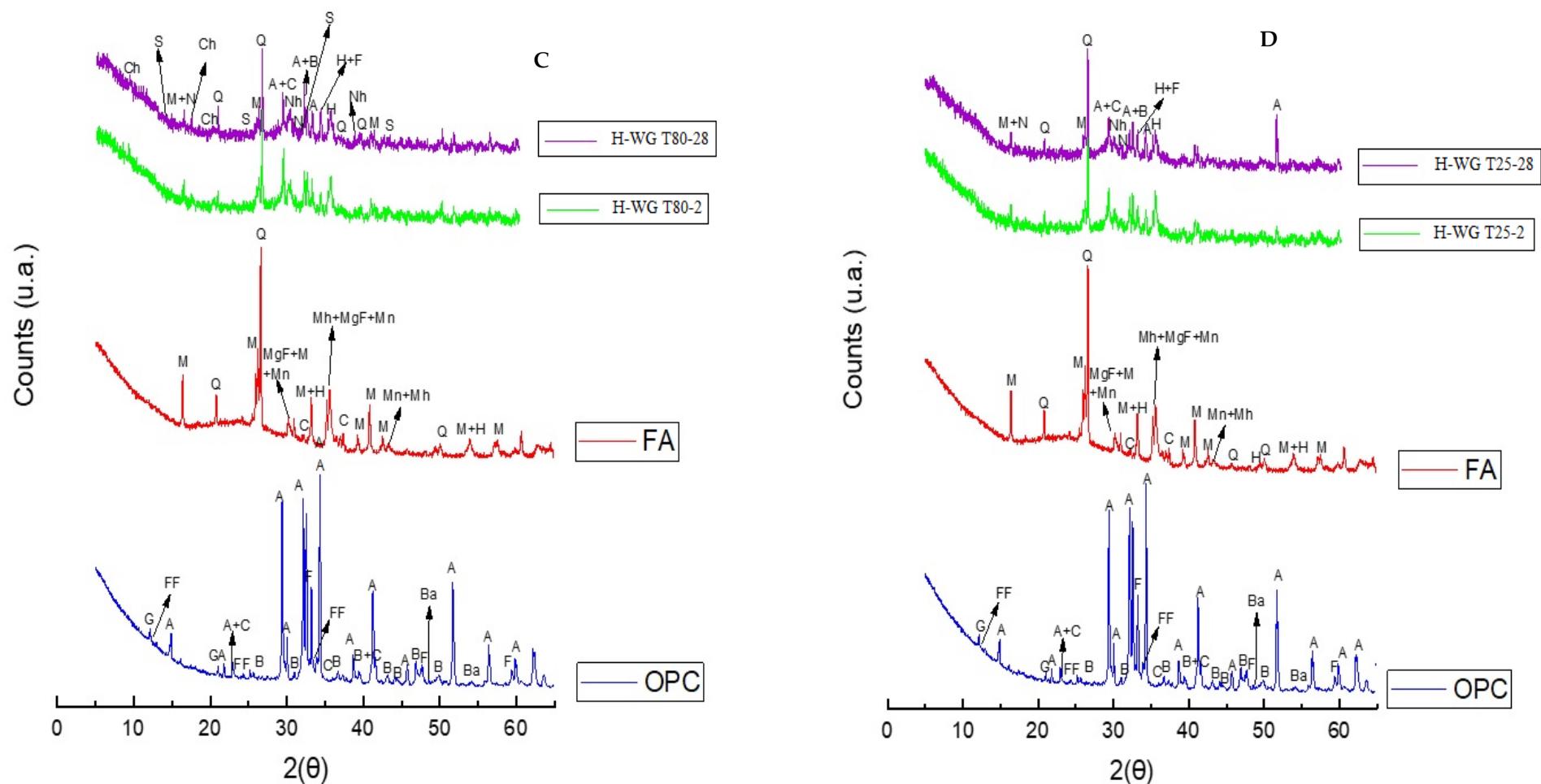
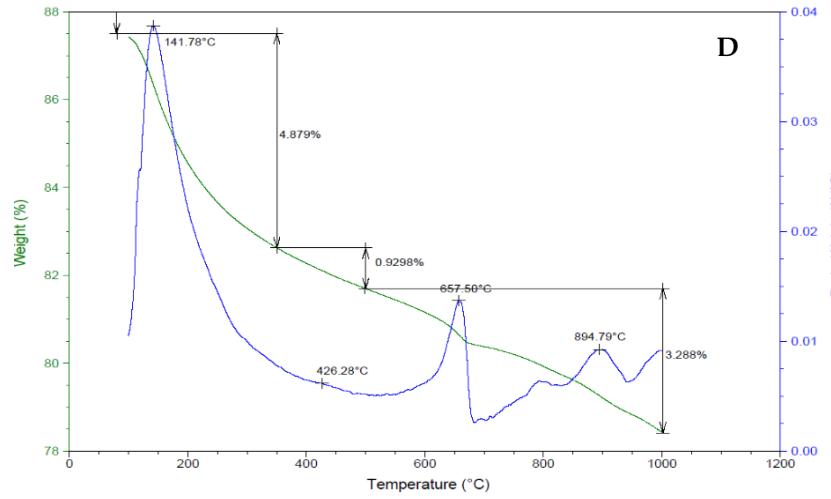
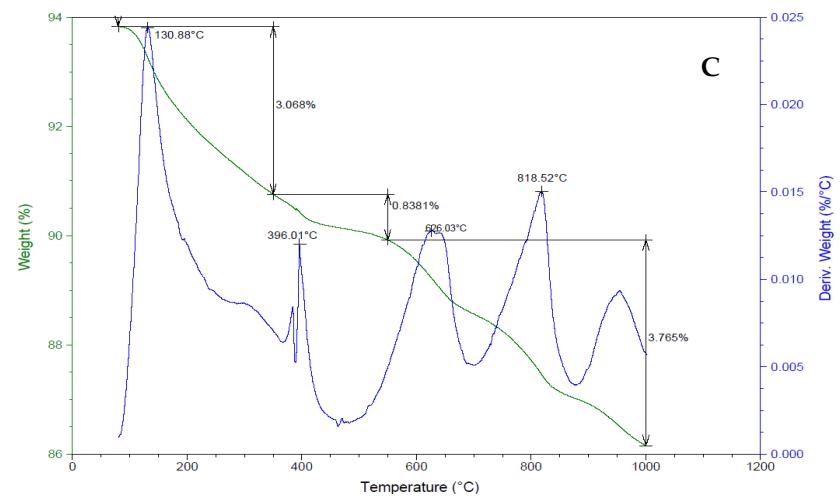
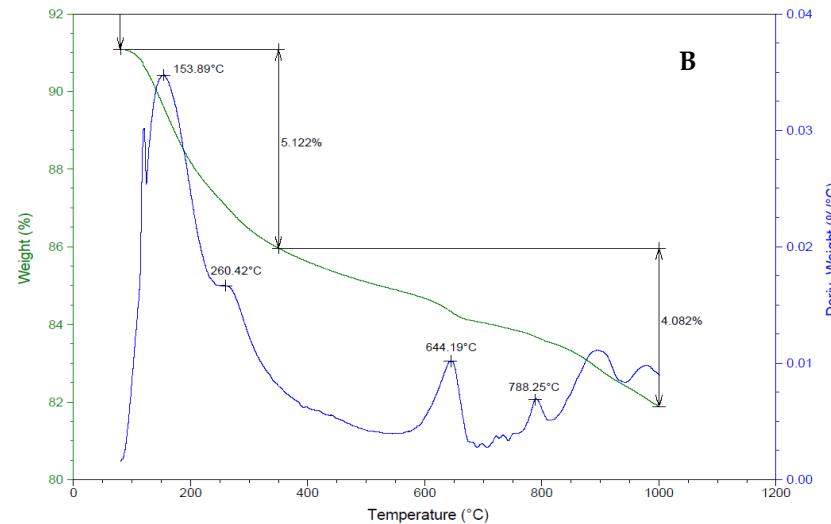
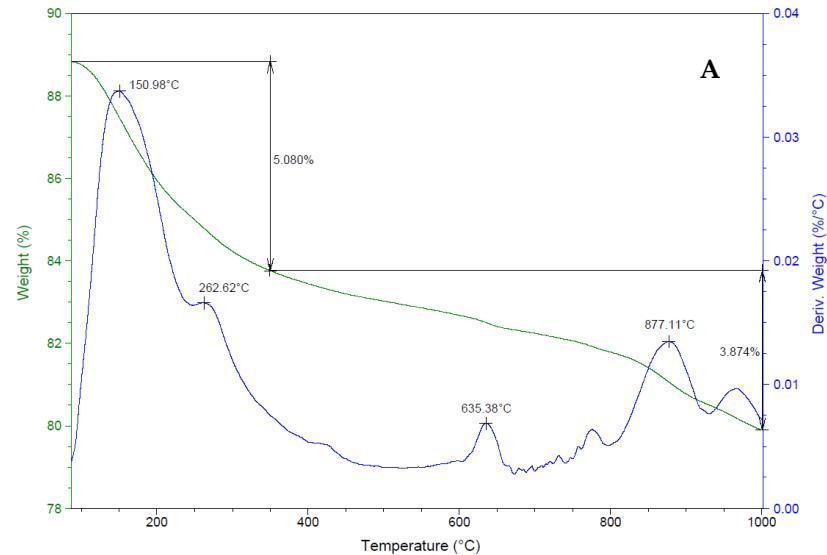


Figure S1. XRD patterns of anhydrous, 2 days and 28 days hybrid cement: (A) HN T80; (B) HN T25; (C) H-WG T80; (D) H-WG T25 (A: alite; B: belite; F: tricalcium aluminate; FF: ferrite; Ba: basanite; G: gypsum; Q: quartz; M: mullite; H: hematite; N: natron; Nh: nahcolite; C: CaCO_3 ; Ch: chabazite-Na; S: hydroxysodalite).

- ATD/TG Thermograms



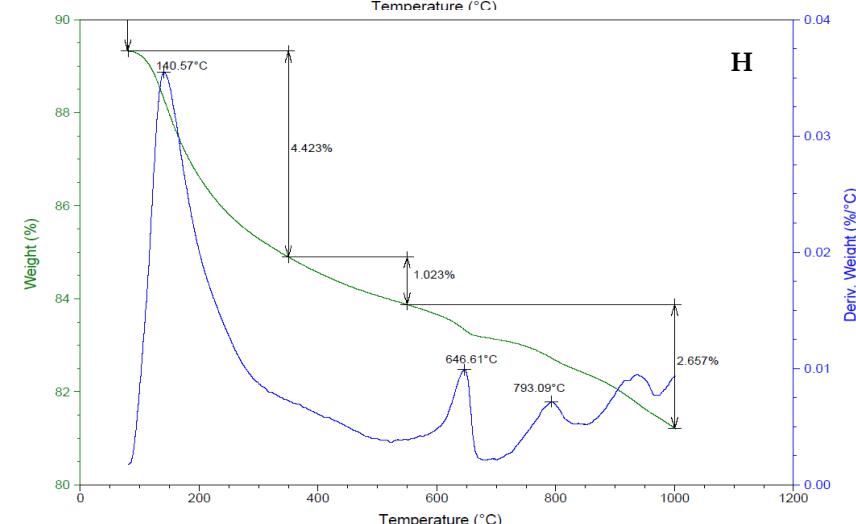
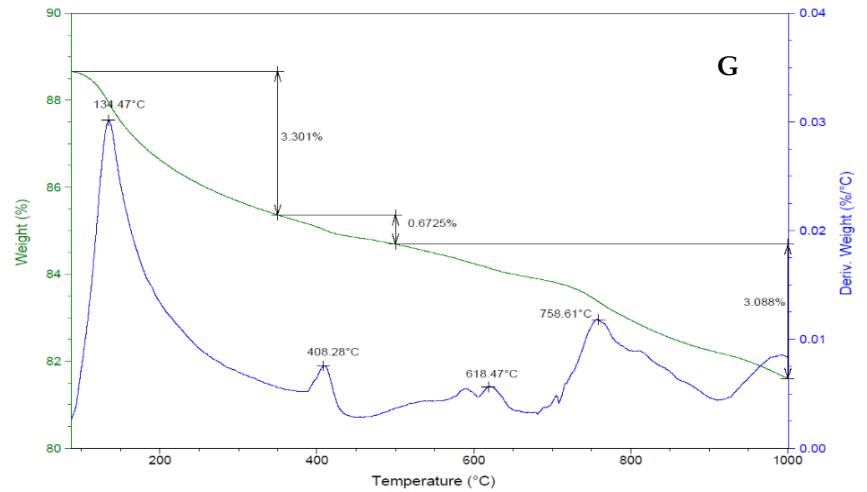
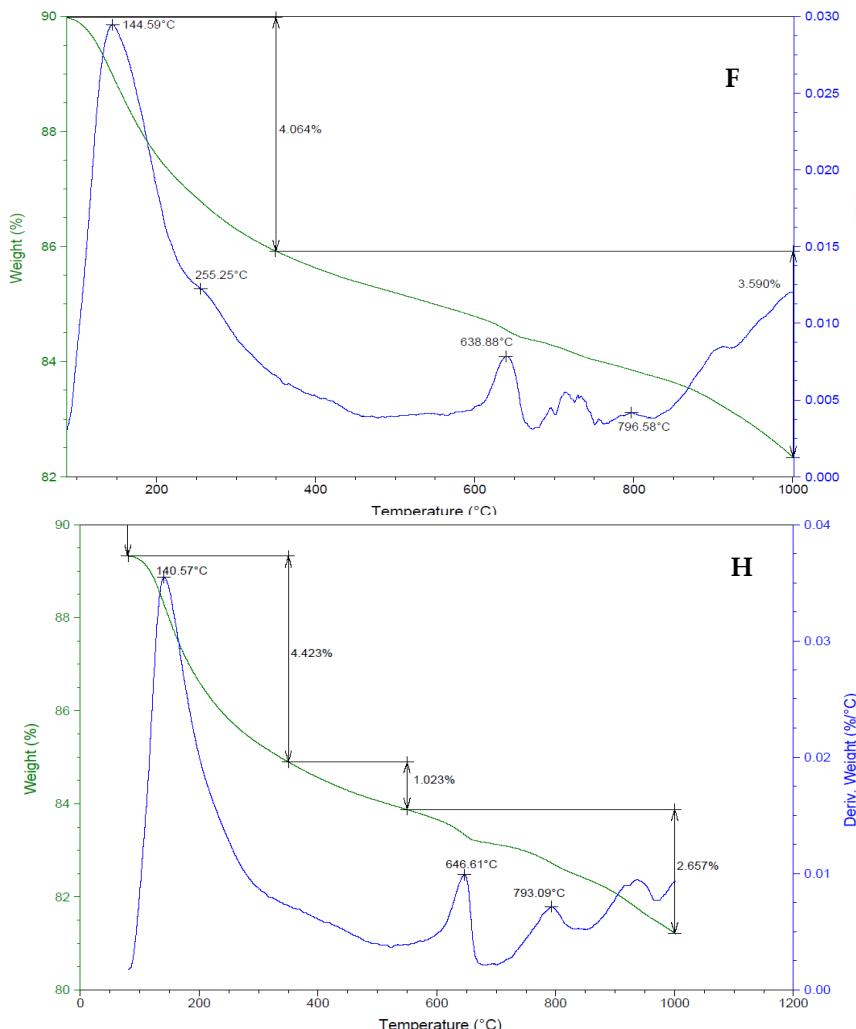
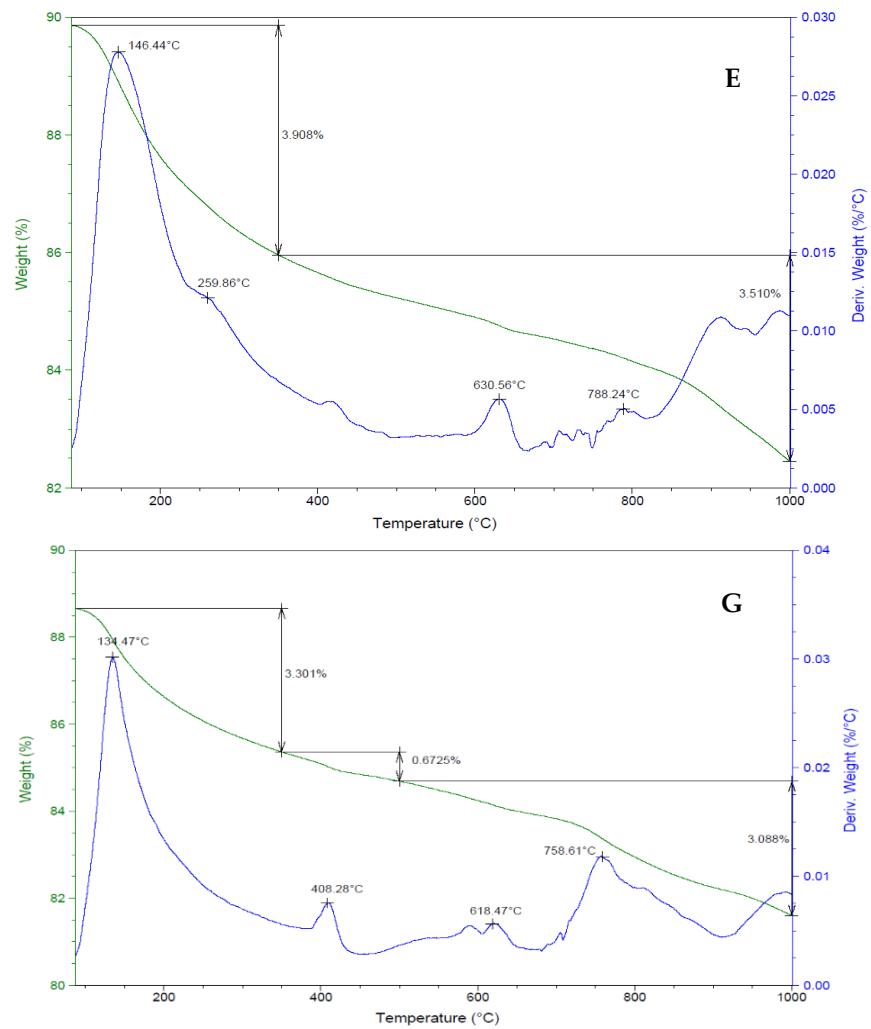
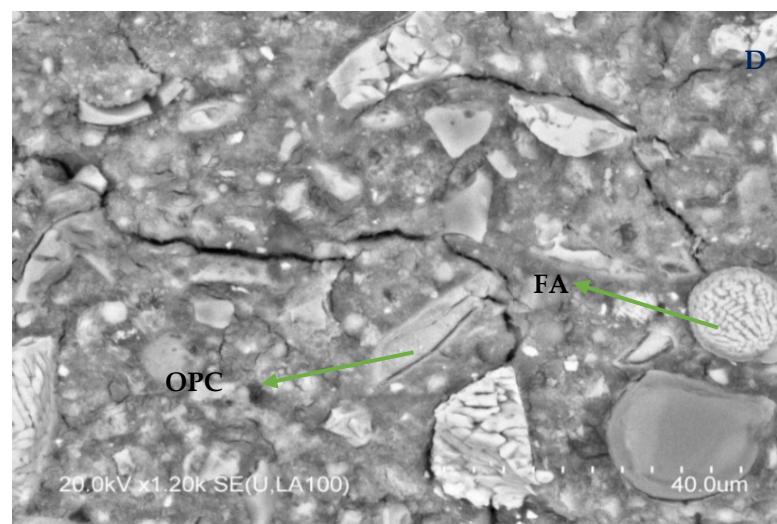
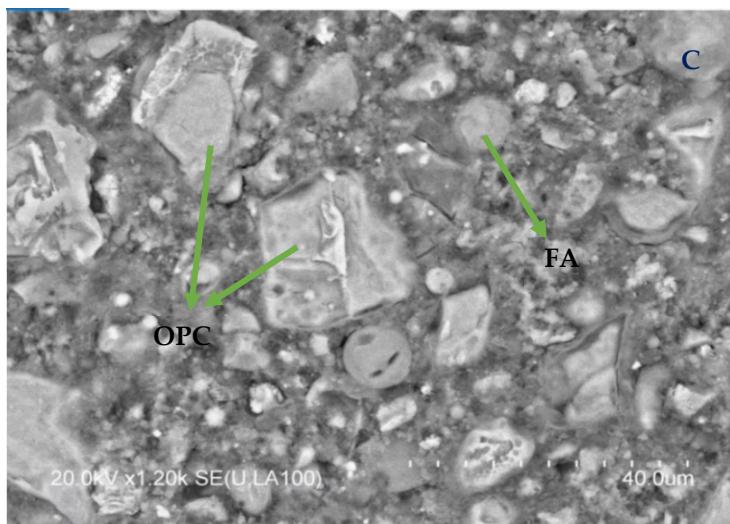
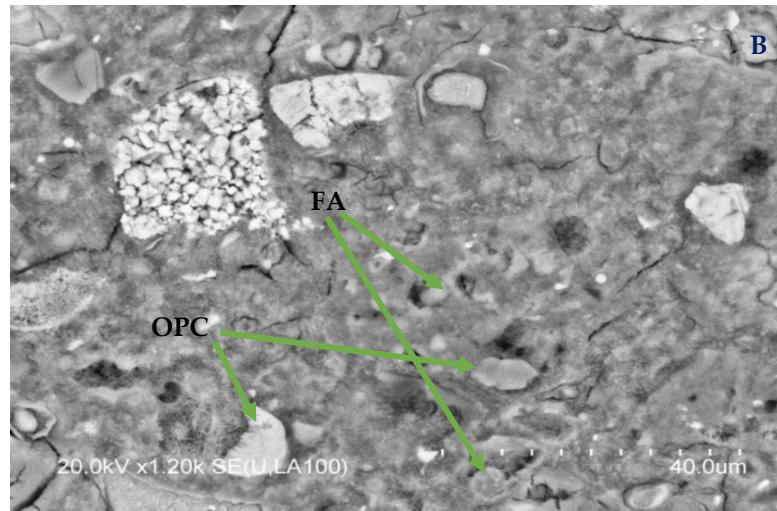
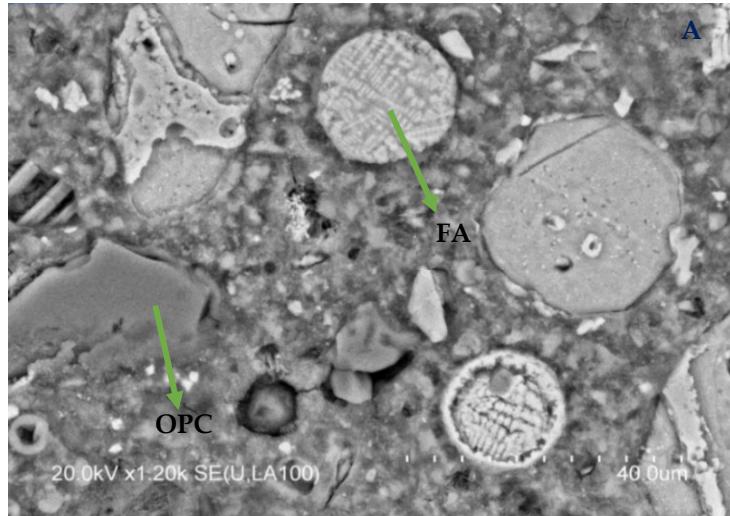


Figure S2. TG (green) and ATD (blue) curves for 2 days and 28 days pastes: (A) HN T80-2; (B) HN T80-28; (C) HN T25-2; (D) HN T25-28; (E) H-WG T80-2; (F) H-WG T80-28; (G) H-WG T25-2; (H) H-WG T25-28

- BSEM micrographs.



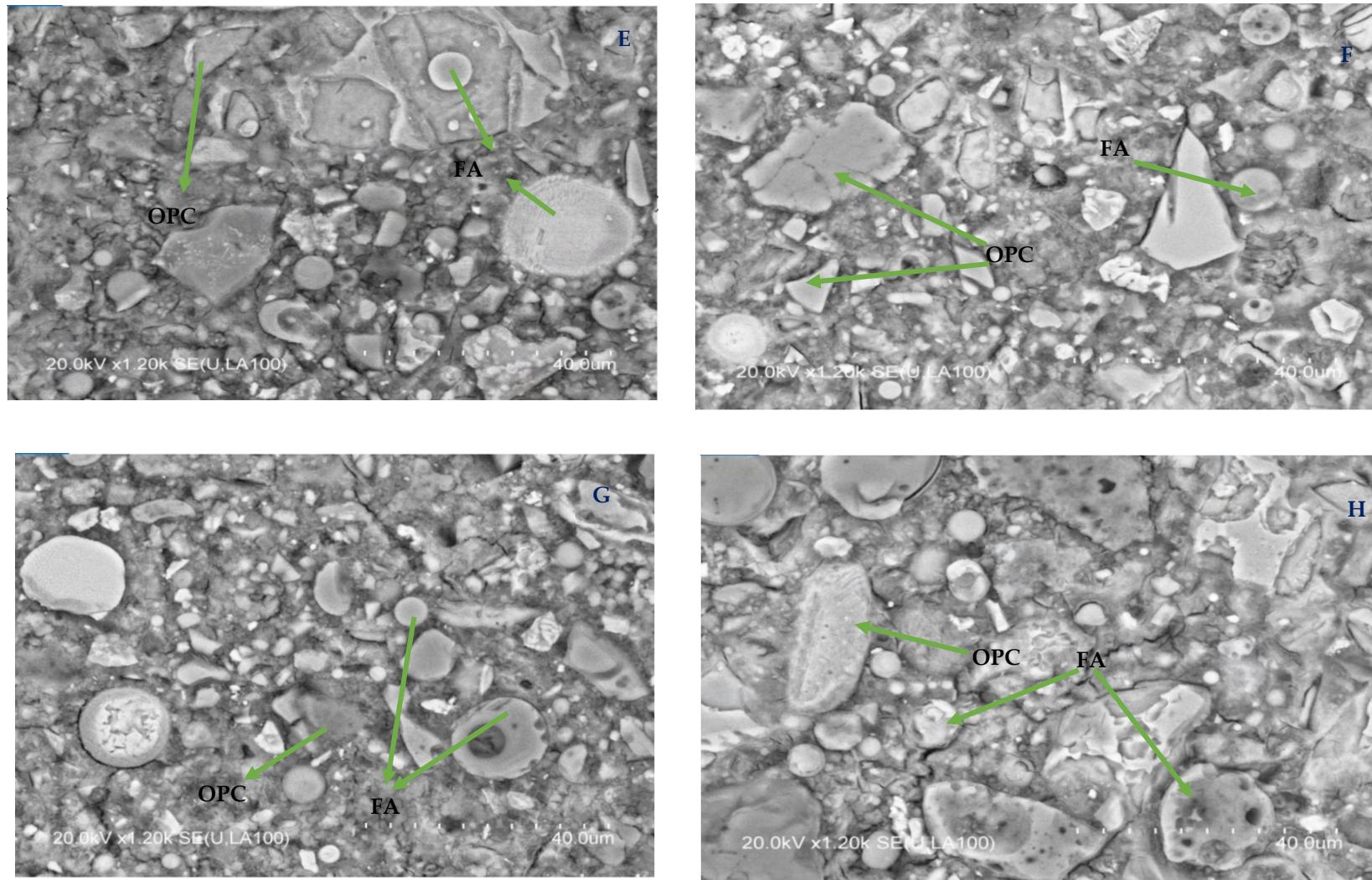
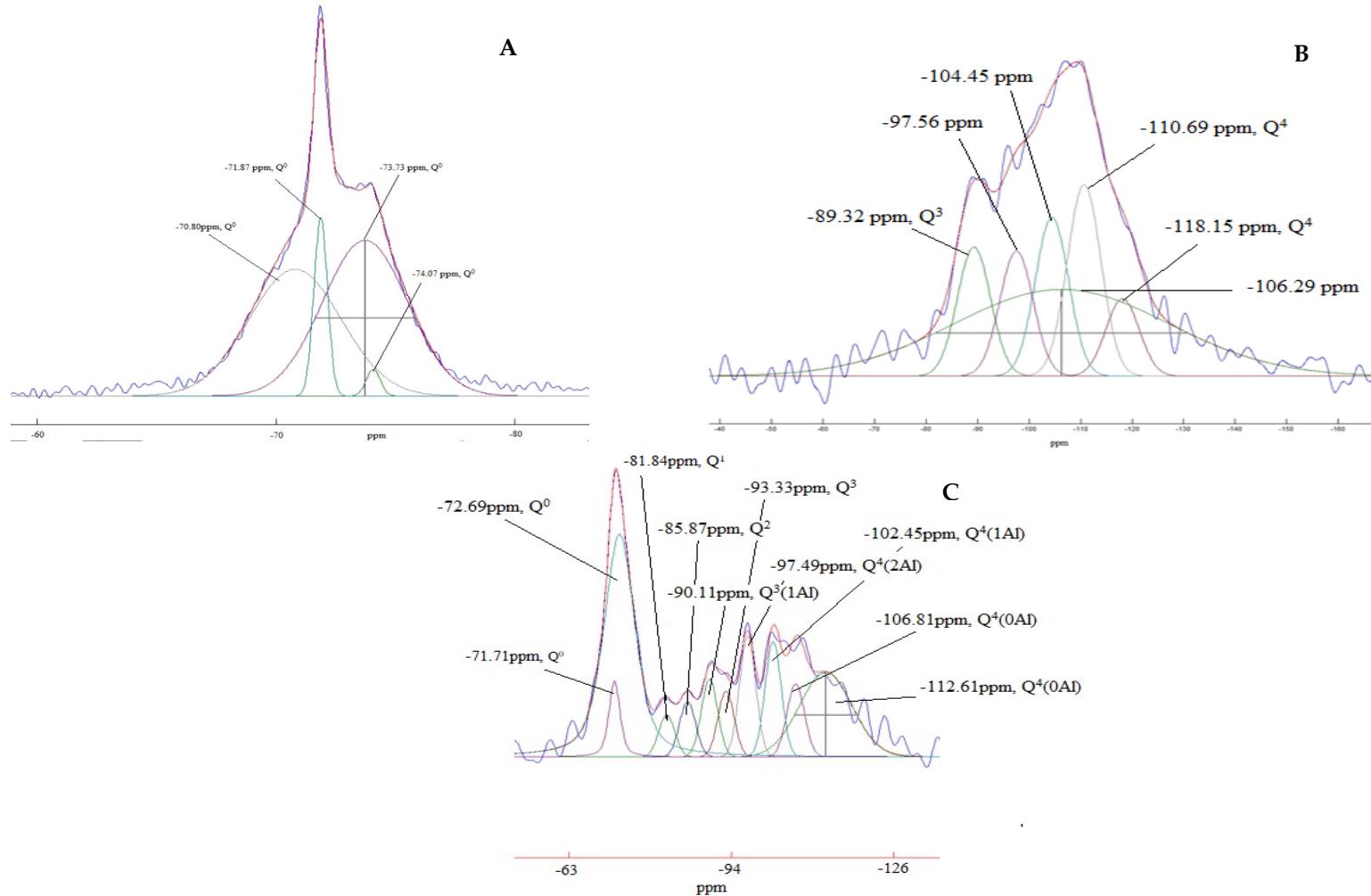
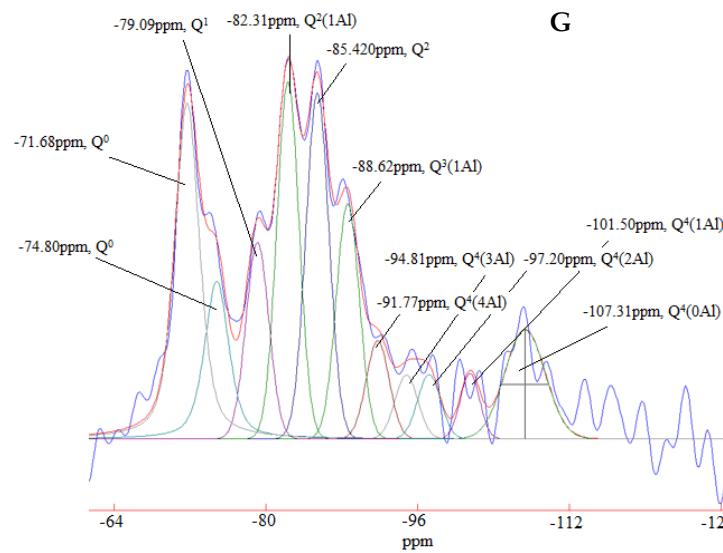
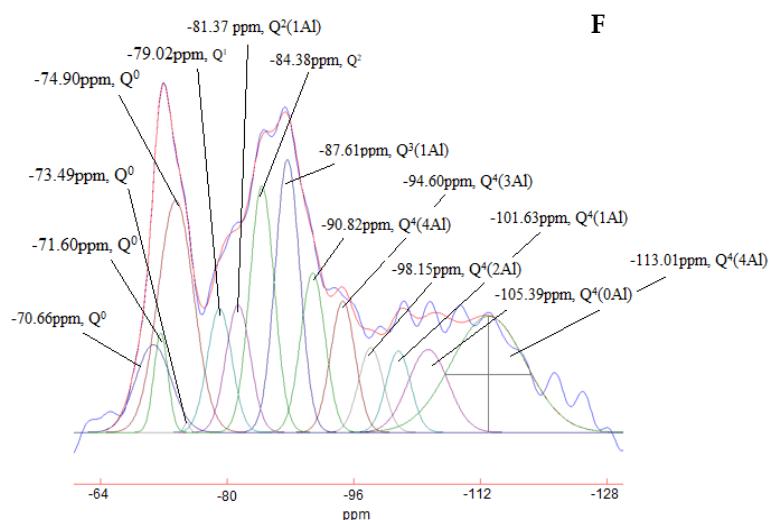
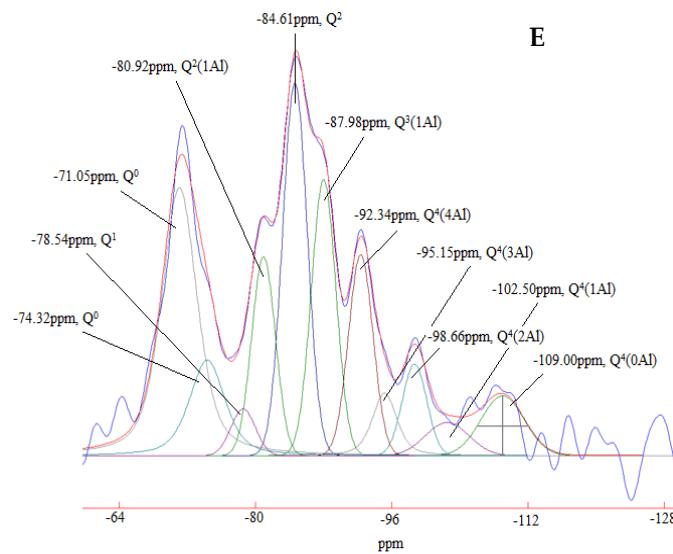
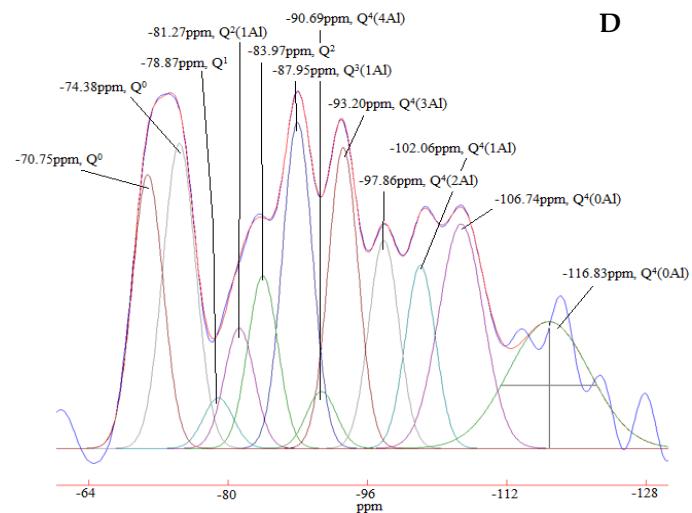


Figure S3. BSEM micrographs for 2 days and 28 days hybrid cement pastes: (A,B) HN T80; (C,D) HN T25; (E,F) H-WG T80; (G,H) H-WG T25.

- ^{29}Si MAS-NMR spectra.





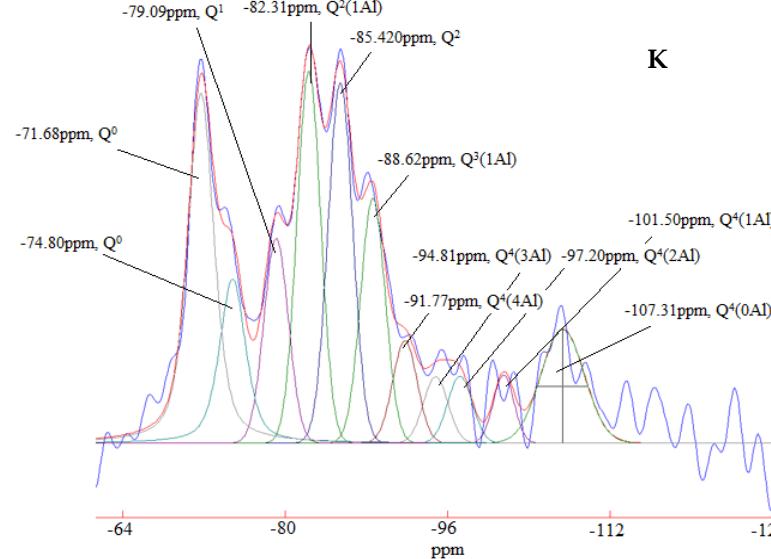
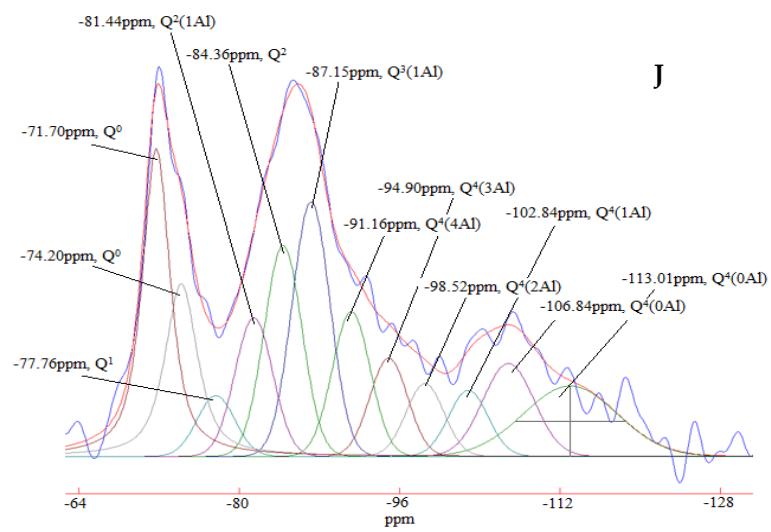
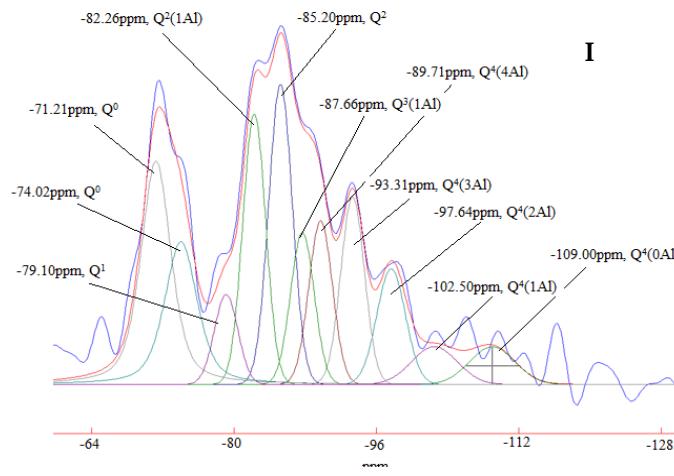
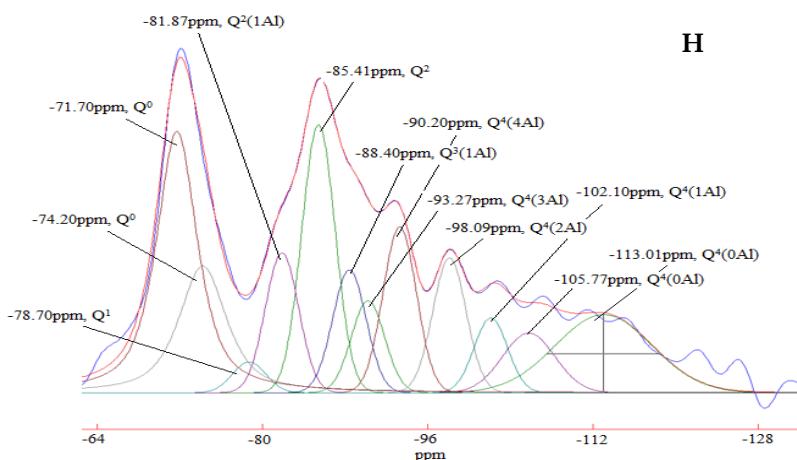
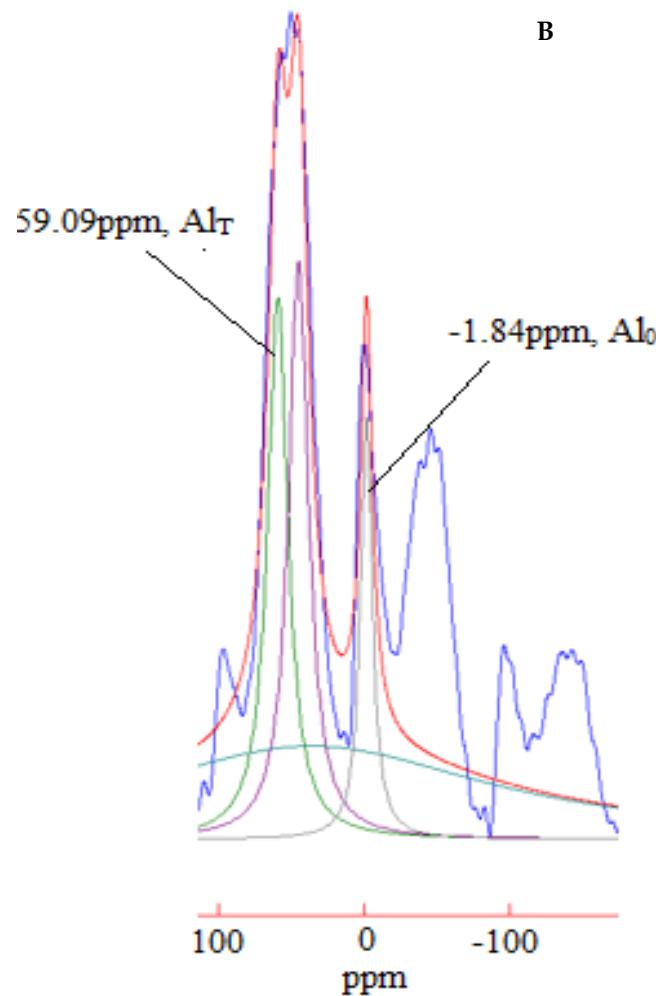
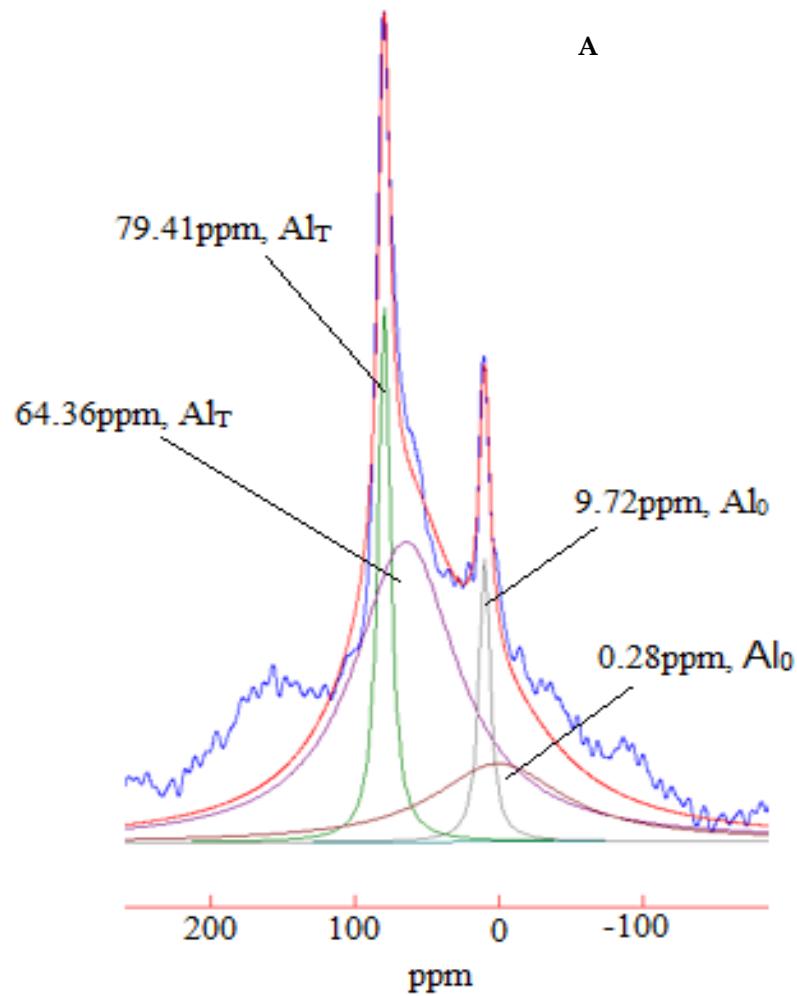


Figure S4. ^{29}Si MAS-NMR spectra for: (A) anhydrous OPC; (B) anhydrous FA; (C) anhydrous 30%OPC+70%FA; (D): HN T80-2; (E) HN T80-28; (F) HN T25-2; (G) HN T25-28; (H) H-WGN T80-2; (I) H-WG T80-28; (J) H-WG T25-2; (K) H-WG T25-2.

- ^{27}Al MAS-NMR spectra

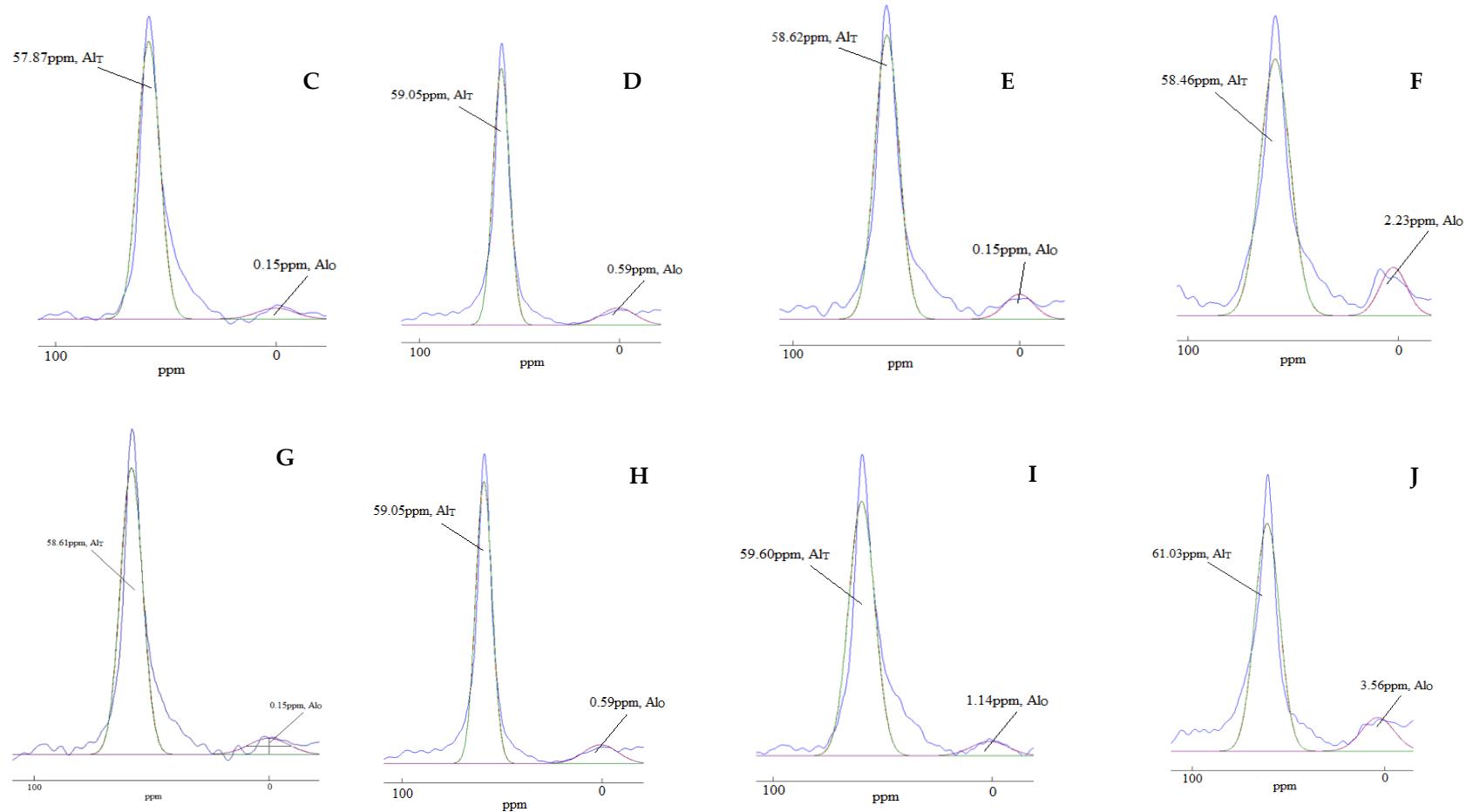


Figure S5. ^{27}Al MAS-NMR spectra for: (A) anhydrous OPC; (B) anhydrous FA; (C) HN T80-2; (D) HN T80-28; (E) HN T25-2; (F) HN T25-28; (G) H-WG T80-2; (H) H-WG T80-28; (I) H-WG T25-2; (J) H-WG T25-28