The European Research Project *GEOASH*
Geopolymer Cement Based on European Fly Ashes

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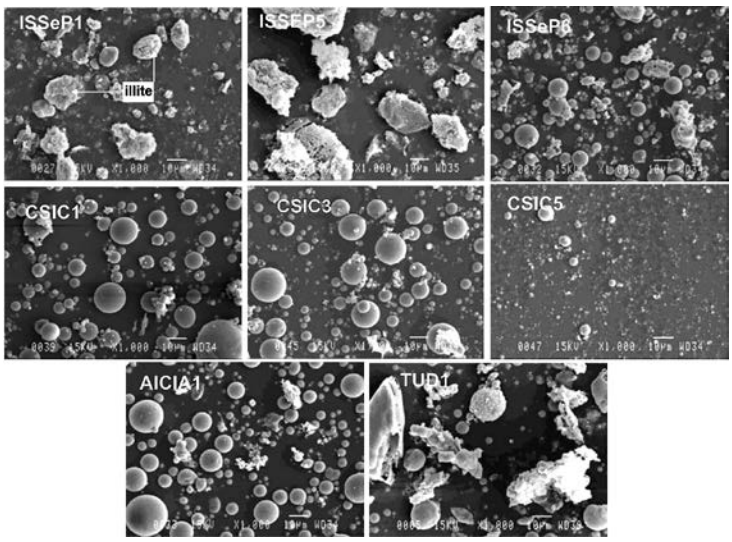
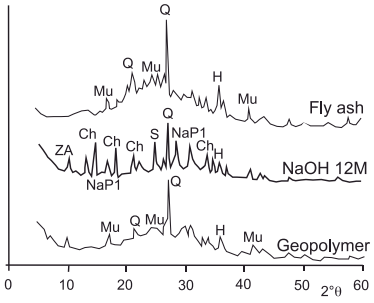
Fuel combustible	Combustion technology	Code
Coal tailings 51 %, wood pellets 49 %	fluidized-bed (850°C)	ISSeP-1
Wood pellets France	fluidized-bed (734–870°C)	ISSeP-2
Sewage sludge Belgium	fluidized-bed (734–870°C)	ISSeP-3
Wood pellets 84 %, sewage sludge 16 %	fluidized-bed (734–870°C)	ISSeP-4
Coal tailings Belgium 25 %, coal Poland 75 %	fluidized-bed (850°C)	ISSeP-5
Coal 65 % + 25 %, sew sludge 5 %, olive 5 %	PCC 1 (1250°C)	ISSeP-6
Co-comb. coal 86 %, wood 11 %, palmpit 3 %	PCC 1 (1250°C)	TUD-1
Co-comb average coal, olive pulp 10 %	PCC 1 (1250°C)	TUD-2
Coal alkaline from Silex	PCC 2 (1500°C)	TUD-3
Coal neutral from Silex	PCC 2 (1500°C)	TUD-4
Coal acid from silex	PCC 2 (1500°C)	TUD-5
Coal, Narcea	PCC 2 (1500°C)	CSIC-1
Coal, Teruel	PCC 2 (1500°C)	CSIC-2
Co-comb. coal and petr. coke, Compostilla III	PCC 2 (1600°C)	CSIC-3
Co-comb. coal and petr. coke, Compostilla IV	PCC 2 (1600°C)	CSIC-4
Co-gasific coal and petr. coke, Elcogas	IGCC (1800°C)	CSIC-5
Coal, Los Barrios	PCC 2 (1500°C)	AICIA-1

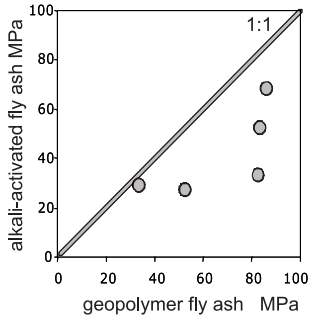


Fly ash structure depends on combustion technology

Comparison alkali-activated / geopolymer



X-ray: NaOH crystalline zeolites
Geopolymer : amorphous matrix



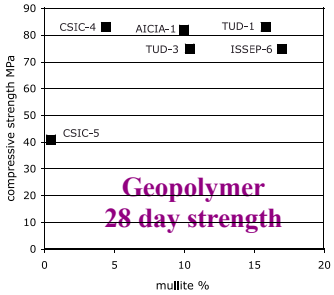
28 day compressive strength: geopolymer method provides higher strength

Conventional method: alkali-activation, dissolution and zeolite formation

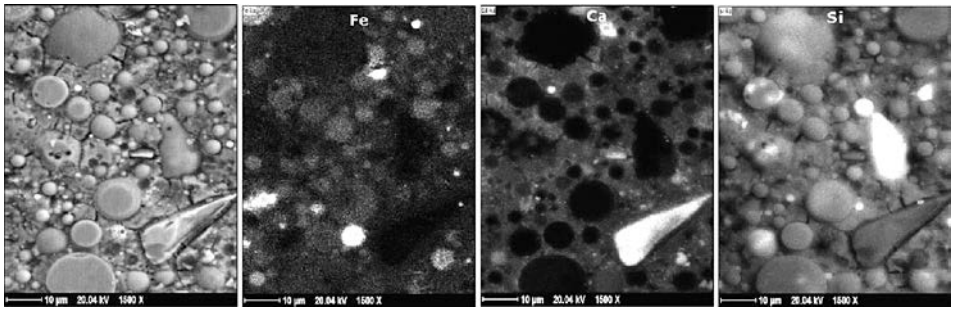
The best compressive strength values for the conventional alkali-activated zeolitic method were obtained by applying the following conditions: 0.3-0.4 L/kg, NaOH 12M, mixture 5-10 min, ultrasonic vibration, 24h room temperature, curing at 80°C for 48h. ***These are very caustic and corrosive conditions.*** KOH is not optimal.

Geopolymeric method: room temperature hardening, polycondensation.

The geopolymeric method is based on the system fly ash / slag / Ksil / H2O reacting at room temperature. The ashes, 60-85% by weight of the mix, were mixed with the geopolymeric slurry containing K-silicate solution (molar SiO2:K2O >1.40), blast furnace slag and water, ***These are not corrosive conditions but rather user-friendly handling methods.***



According to the standard alkali-activated method, any fly ash with a mullite content higher than 5% is not suitable and may not be used. This not the case with the (Ca,K)-based geopolymeric method. The 28 day compressive strength obtained in relation with the mullite content are higher than 50 MPa, the majority reaching strengths higher than 70 MPa.



Distribution of Fe, Ca, Si in CSIC 1 geopolymer-based cement (microprobe mapping)

Details in the book *Geopolymer Chemistry & Applications*