

Table S1: XRD analysis illustrating the characteristics of raw BC, BABC (1–18 M), and the optimal AABC activation sample (7 M).

Substance	Activation	Peak	Intensity	Ref
BC	Raw	29.48°	134, SiO ₂	[50]
		33.14°	58, Na ₂ O	
BABC	1M	35.72°	112, SiO ₂	[39,45]
		48.62°	40, MgO	
	4M	54.12°	62, Al ₂ O ₃	
		61.86°	66, SiO ₂	
	7M	24.38°	38, Na ₂ O	
		33.42°	32, Na ₂ O	
	10M	49.58°	18, SiO ₂	
		54.2°	24, Al ₂ O ₃	
	13M	62.24°	36, Al ₂ O ₃	
		24.5°	42, Na ₂ O	
	16M	25.48°	48, Na ₂ O	
		28.06°	48, Al ₂ O ₃	
		33.24°	62, Na ₂ O	
		35.64°	66, SiO ₂	
		43.18°	44, SiO ₂	
		49.48°	24, SiO ₂	
		24.3°	82, Na ₂ O	
		26.46°	44, Na ₂ O	
		29.78°	106, SiO ₂	
		31.56°	42, SiO ₂	
		33.14°	50, Na ₂ O	
		34.84°	70, Al ₂ O ₃	
		35.68°	62, SiO ₂	
		42.68°	40, Al ₂ O ₃	
		49.52°	24, Al ₂ O ₃	
		53.98°	32, Al ₂ O ₃	
		51.88°	28, MgO	
		61.72°	34, SiO ₂	
		64.02°	26, SiO ₂	
		24.5°	119, Na ₂ O	
		31.94°	54, SiO ₂	
		33.4°	38, Na ₂ O	
		34.84°	66, Al ₂ O ₃	
		35.84°	56, SiO ₂	
		43°	48, SiO ₂	
		52.1°	38, MgO	
		54.14°	26, Al ₂ O ₃	
		58.46°	32, Al ₂ O ₃	
		64.32°	28, SiO ₂	
		24.42°	166, Na ₂ O	
		24.54°	70, Na ₂ O	
		28.28°	36, Al ₂ O ₃	
		34.72°	94, Al ₂ O ₃	
		42.82°	60, Al ₂ O ₃	
		58.34°	32, Al ₂ O ₃	
		31.7°	62, SiO ₂	
		35.66°	54, SiO ₂	
		36.8°	32, SiO ₂	
		62.26°	24, Al ₂ O ₃	
		64.1°	52, SiO ₂	
		52.18°	30, MgO	
		54.14°	26, MgO	
		24.44°	170, Na ₂ O (⊗)	
		25.52	38, Na ₂ O (⊗)	
		26.56°	80, Na ₂ O (⊗)	
		28.3°	36, Al ₂ O ₃ (√)	
		29.48°	58, SiO ₂ (△)	
		31.64°	56, SiO ₂ (△)	

		33.24° 34.7 35.62° 37.7° 41.04 42.8 49.48 51.98° 52 54.2° 58.36 62.3 63.98 69.42	62, Na ₂ O (⊗) 92, Al ₂ O ₃ (▽) 58, SiO ₂ (△) 32, Al ₂ O ₃ (▽) 24, Al ₂ O ₃ (▽) 60, Al ₂ O ₃ (▽) 26, Al ₂ O ₃ (▽) 28, MgO (□) 24, MgO (□) 28, MgO (□) 38, Al ₂ O ₃ (▽) 28, Al ₂ O ₃ (▽) 34, Al ₂ O ₃ (▽) 28, SiO ₂ (△)	
	18M	24.48° 26.82° 31.84° 33.28° 34.72° 35.76° 42.94° 54.16° 58.32° 62.02° 64.1° 69.4°	158, Na ₂ O 76, Na ₂ O 50, SiO ₂ 58, Na ₂ O 78, Al ₂ O ₃ 64, SiO ₂ 58, Al ₂ O ₃ 22, MgO 34, Al ₂ O ₃ 26, Al ₂ O ₃ 24, SiO ₂ 28, Al ₂ O ₃	
AABC	7M	23° 27.1°	122, SiO ₂ 100, Al ₂ O ₃	[46]