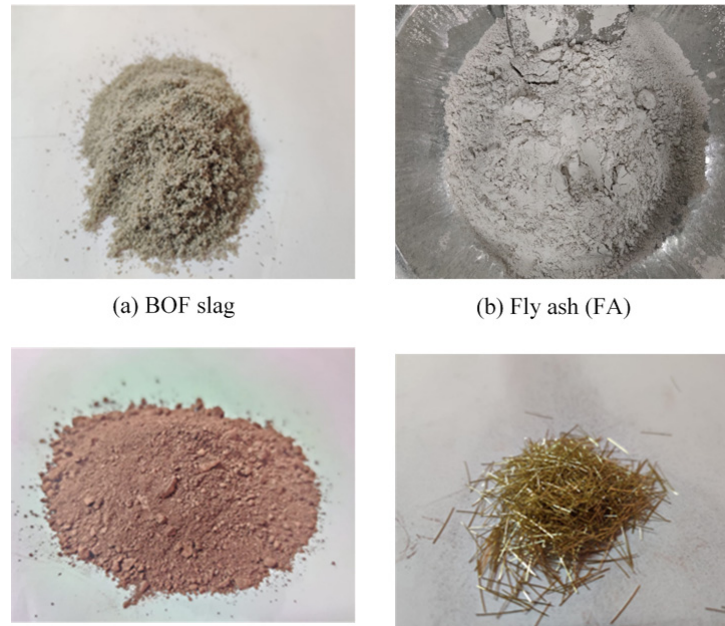


## Supplementary Materials



**Fig. S1.** Raw materials for the proposed EGC

**Table S1.** Characteristics of IOT and M-Sand

Description	Iron Ore Tailings (IOT)	Standard limits	Manufactured sand (M-Sand)	Standard limits
Specific Gravity	3.47(SSD)	Limit not specified	2.64(SSD)	2.1 to 3.2
	3.39(OD)		2.59(OD)	
Water absorption (%)	1.9	Not more than 5%	0.05	Not more than 5%
Surface Moisture	Nil	Nil	Nil	NA
Bulk Density (kg/m <sup>3</sup> )	1660	Limit not specified	1630	Limit not specified
Bulk Density- loose condition (kg/l)	1.89	Limit not specified	1.63	Limit not specified
Bulk Density – compacted condition (kg/l)	1.99	Limit not specified	1.83	Limit not specified

*SSD- saturated surface dry state; OD- Oven dry state*

**Table S2.** Combinations of steel fibre percentage and IOT replacement

Variable (SF)	Steel Fibre %	EGC variant (varying IOT)	Variable (IOT)	IOT replacement %	EGC variant (varying SF)
SF 1	0.8	FA: BOF-SF0.8-IOT (0-100)	IOT 1	0	FA: BOF- MS-SF (0.8-2)
SF 2	1	FA: BOF-SF1-IOT (0-100)	IOT 2	10	FA: BOF- IOT10-SF (0.8-2)
SF 3	1.5	FA: BOF-SF1.5-IOT (0-100)	IOT 3	20	FA: BOF- IOT20-SF (0.8-2)
SF 4	1.8	FA: BOF-SF1.8-IOT (0-100)	IOT 4	35	FA: BOF- IOT35-SF (0.8-2)
SF 5	2	FA: BOF-SF2-IOT (0-100)	IOT 5	45	FA: BOF- IOT45-SF (0.8-2)

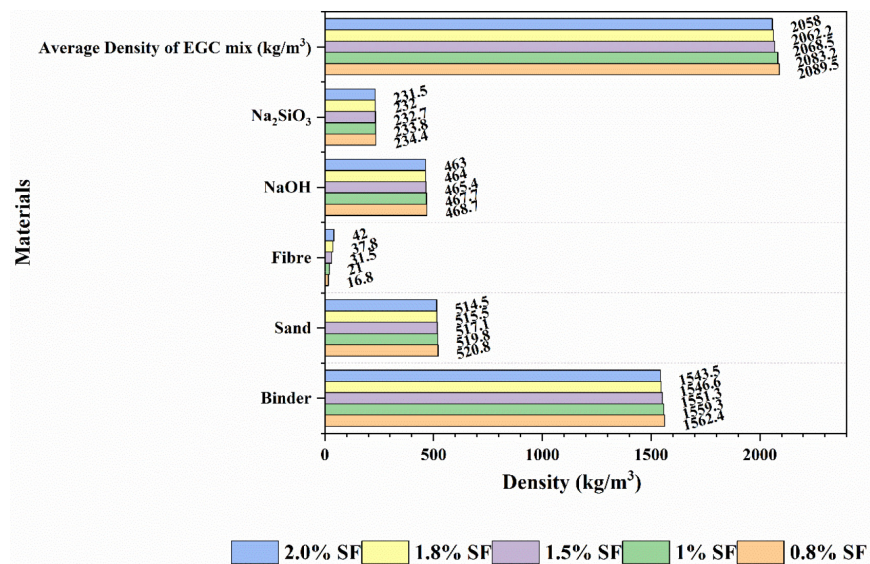
*SF- Steel fibre (vol. %); IOT – Iron Ore Tailings; MS- M-sand (wt. %)*

**Table S3.** Binder combinations

Variable (FA: BOF)	Mix ID	FA %	BOF slag %
FA: BOF 1	EGC-FA-100	100	0
FA: BOF 2	EGC-FA: BOF-90:10	90	10
FA: BOF 3	EGC-FA: BOF-80:20	80	20
FA: BOF 4	EGC-FA: BOF-70:30	70	30
FA: BOF 5	EGC-FA: BOF-60:40	60	40
FA: BOF 6	EGC-FA: BOF-50:50	50	50

**Table S4.** Design mix specifications of EGC

Description	Value
Assumed density (Binder + Fine aggregate) (kg/m <sup>3</sup> )	2100
Proposed steel fibre volume %	0.8%,1%,1.5%,1.8% and 2%
Reduced density (upon deducting SF volume) (kg/m <sup>3</sup> )	2083;2079;2068;2062;2058
Average density (kg/m <sup>3</sup> )	2070
Fine aggregate (Sand) /Binder ratio	0.3



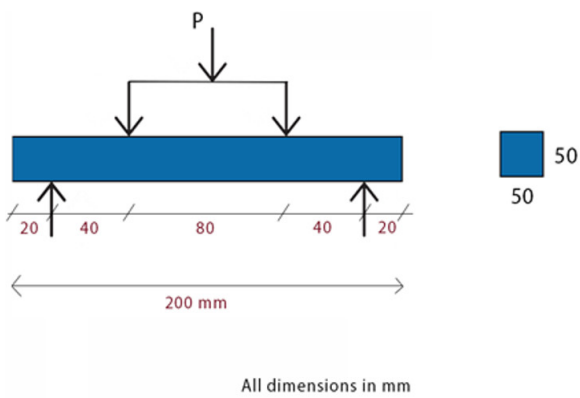
**Fig. S2.** Calculated values of density (kg/m<sup>3</sup>) for various EGC mixes



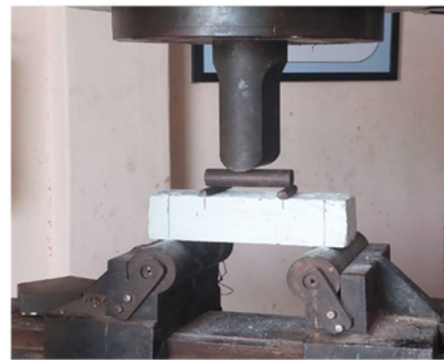
Fig. S3. Mortar mixer machine



Fig. S4. Ambient cured EGC specimens



(a) Three-point loading illustration



(b) Three-point loading setup

Fig. S5. Flexural strength test setup

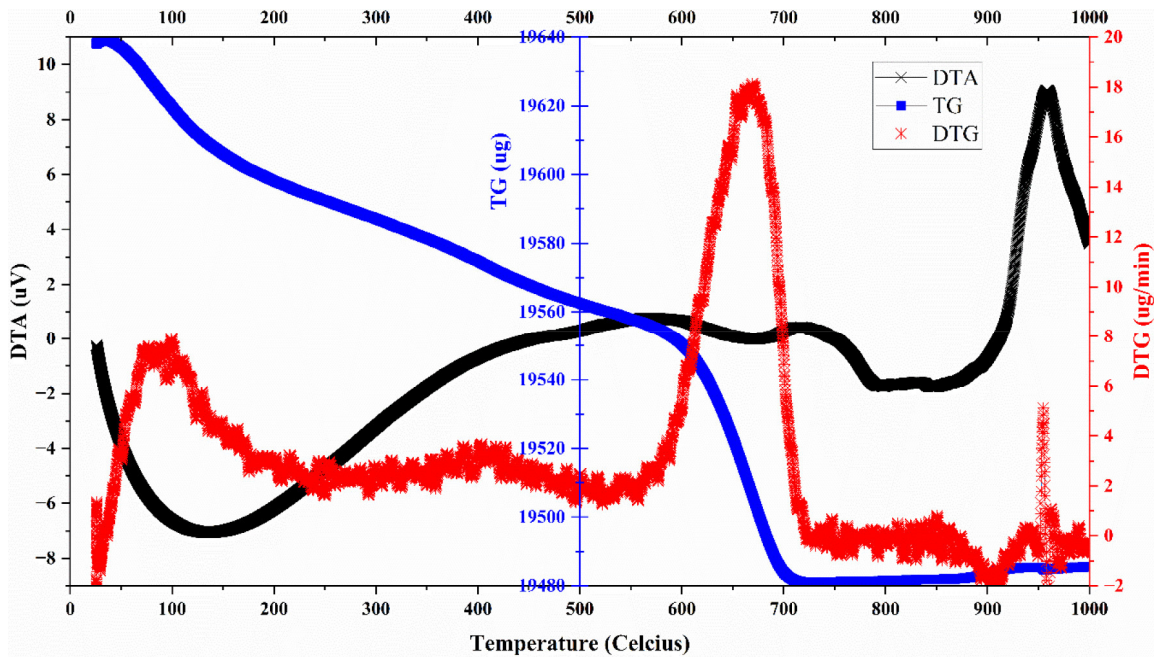




**Fig. S6.** Impact resistance of EGC mixes (a) test specimens (b) impact test setup

**Table S5.** Chemical compositions of BOF, FA, and IOT from XRF Analysis

Materials	Percentage composition (%)												
	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	MgO	CaO	K <sub>2</sub> O	Ti	P <sub>2</sub> O <sub>5</sub>	SO <sub>3</sub>	Mn	Ba	Zr	Zn
BOF	27.8	17.2	0.3	11.5	16.6	0.3	0.2	0.04	0.8	0.09	0.08	0.01	0.006
FA	57.3	34.0	3.7	1.6	1.3	0.9	0.6	0.4	0.1	0.04	0.03	0.02	0.01
IOT	24.9	23.9	32.8	0.6	0.2	1.03	0.4	0.08	0.01	0.08	0.01	0.01	0.008



**Fig. S7.** TGA analysis - BOF slag



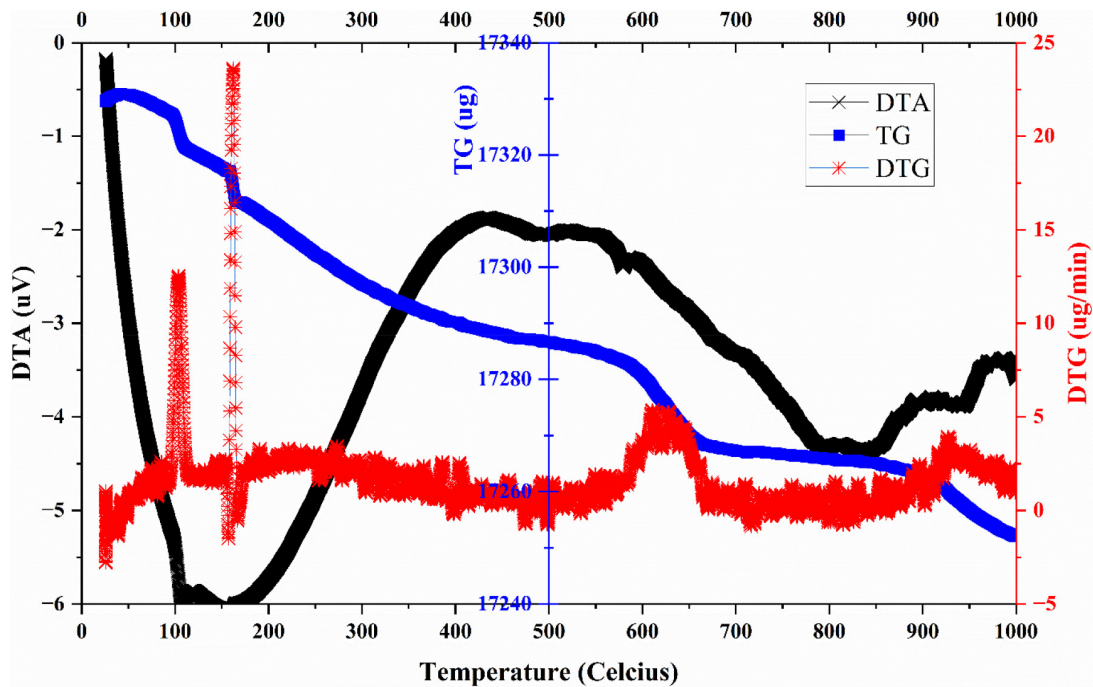


Fig. S8. TGA analysis - FA

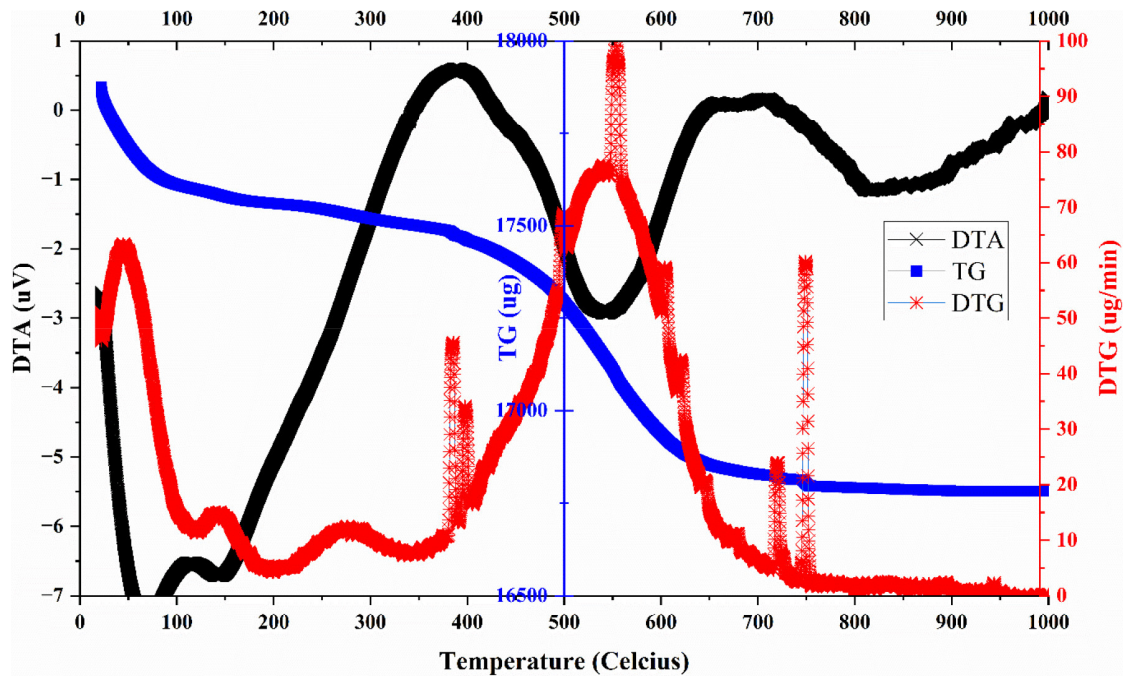
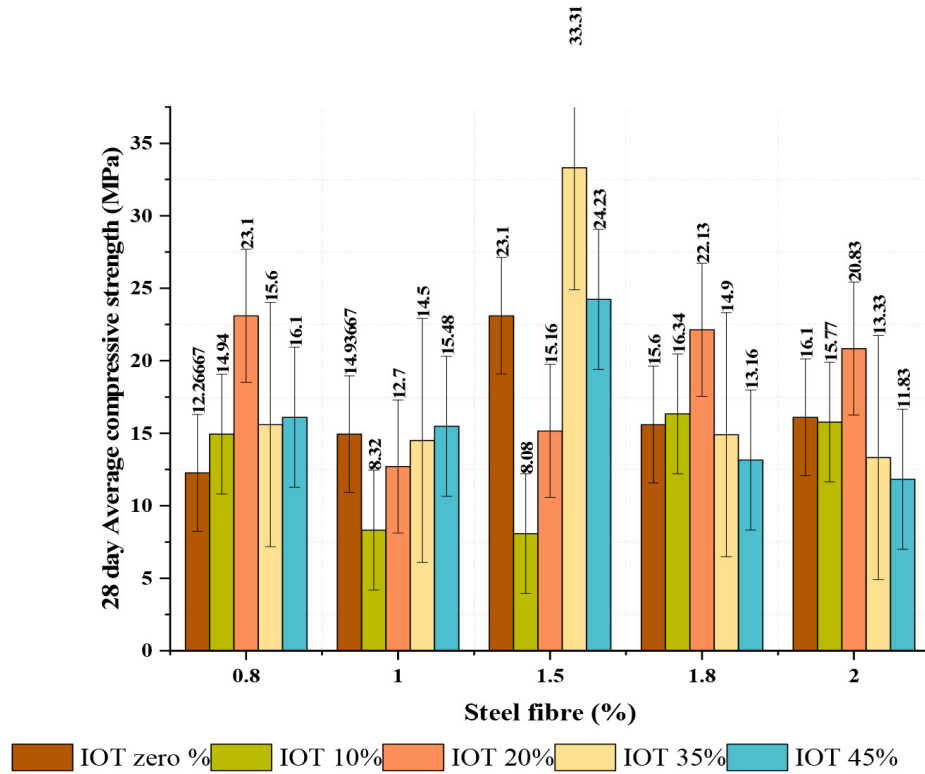
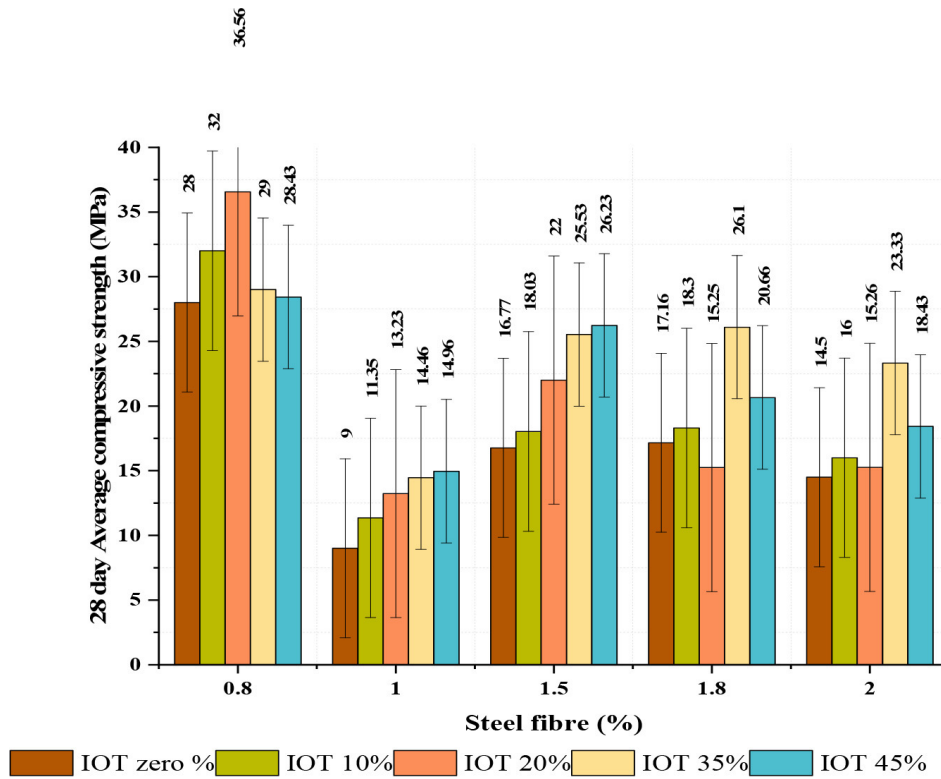


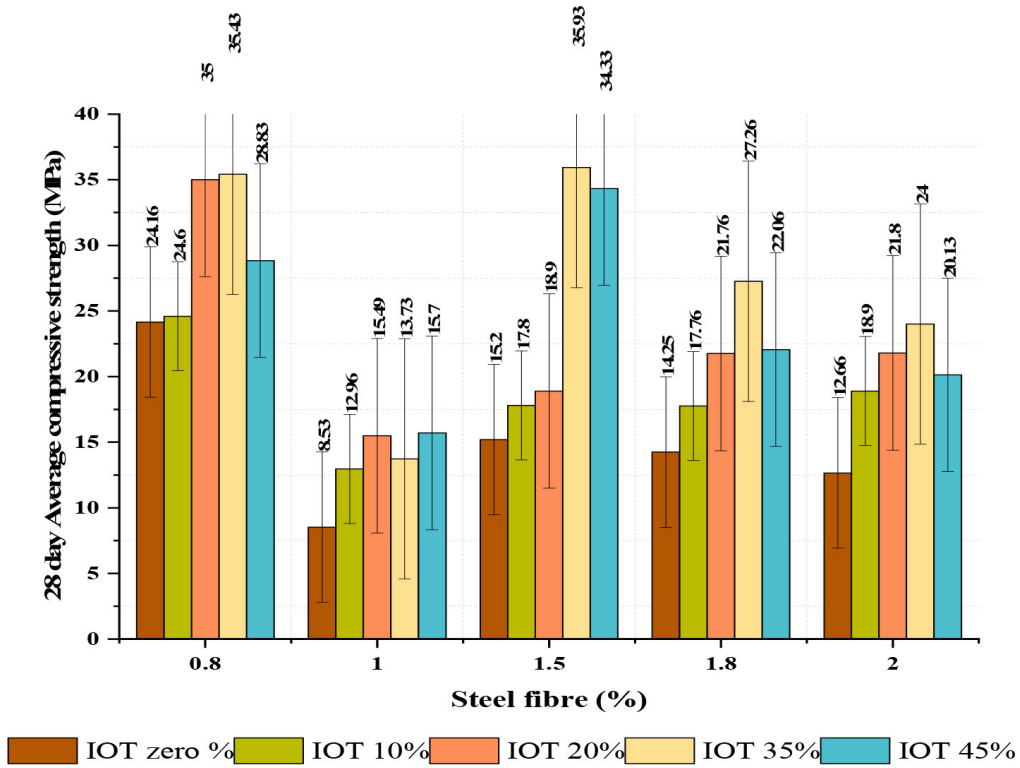
Fig. S9. TGA analysis - IOT



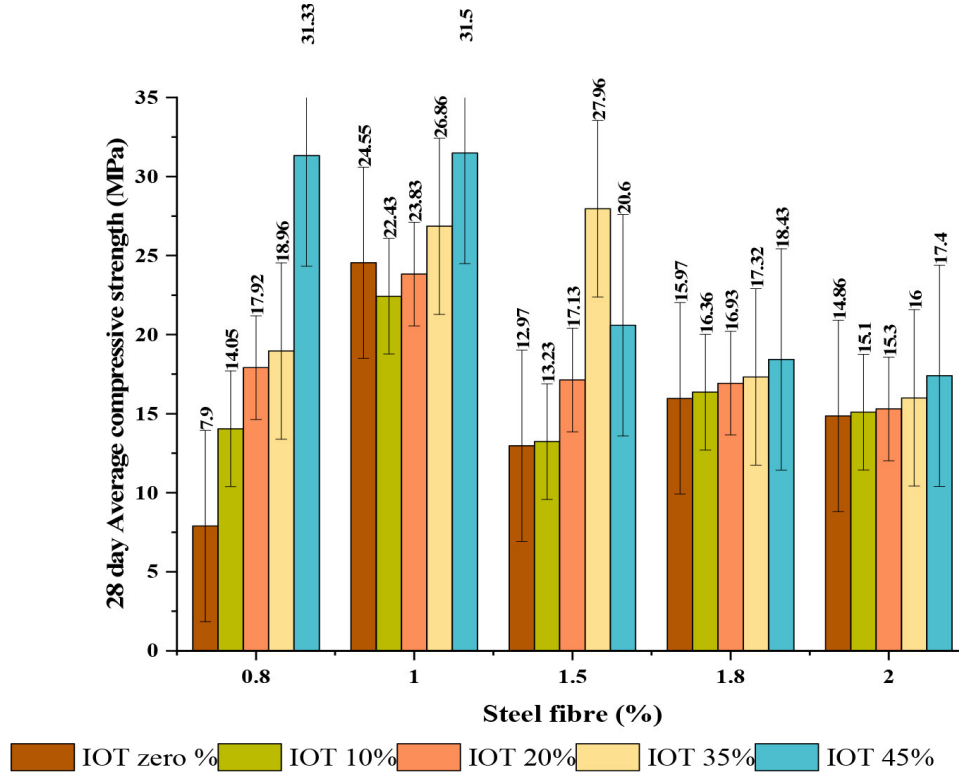
(a) EGC-FA-100



(b) EGC-FA: BOF-90:10

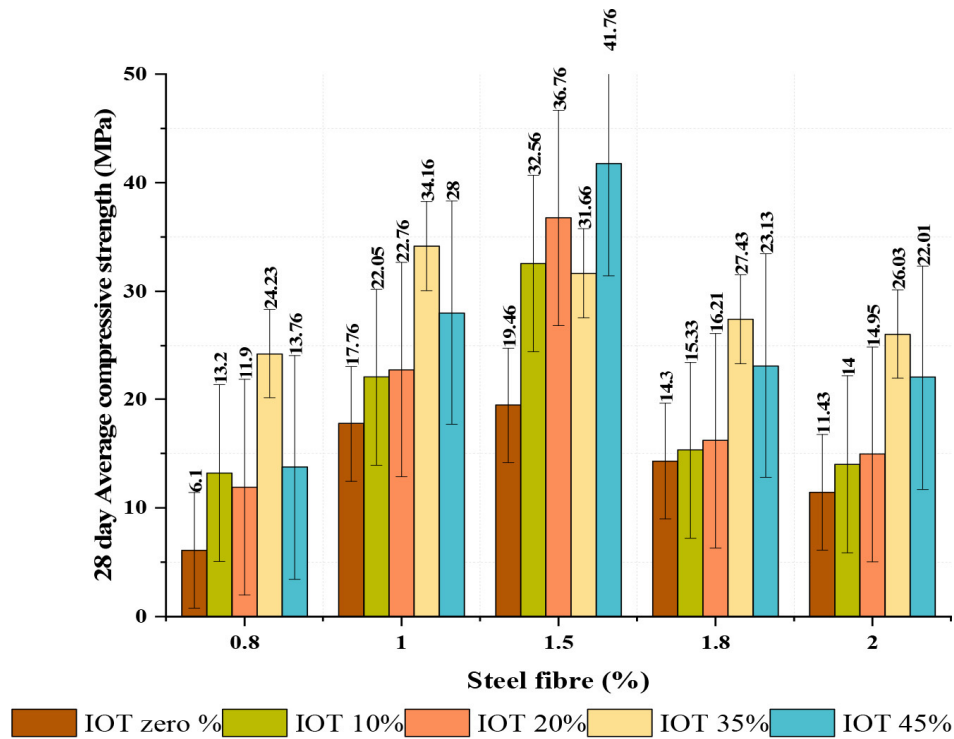


(c) EGC-FA: BOF-80:20

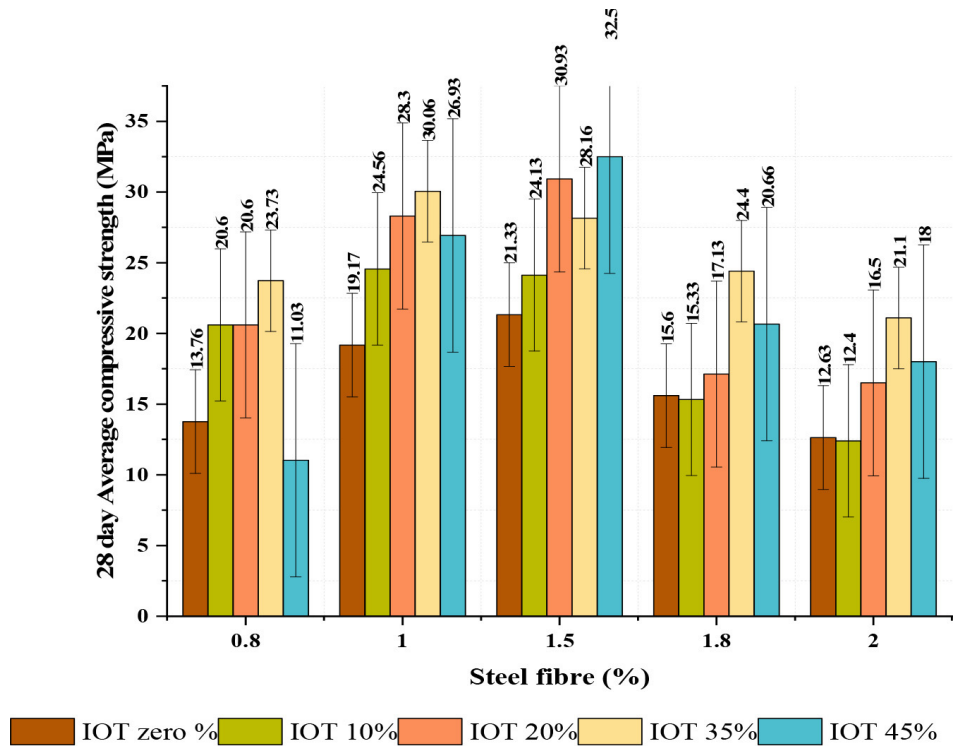


(d) EGC-FA: BOF-70:30





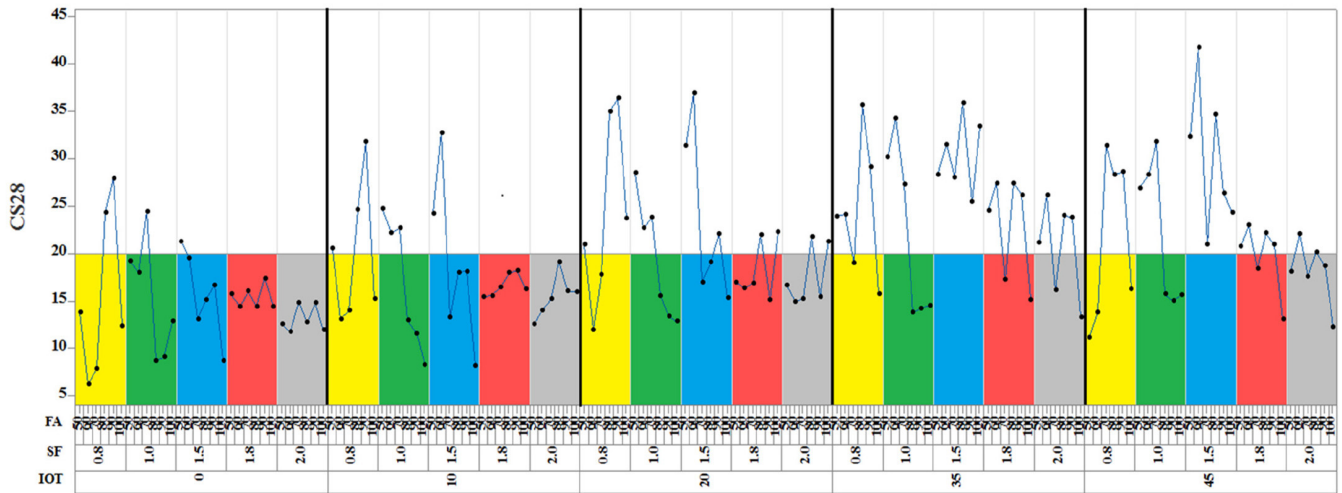
(e) EGC-FA: BOF-60:40



(f) EGC-FA: BOF-50:50

**Fig. S10.** Average 28-day compressive strength of FA: BOF-EGC mixes at various SF and IOT replacements. (a) EGC-FA-100 (b) EGC-FA: BOF-90:10 (c) EGC-FA: BOF-80:20 (d) EGC-FA: BOF-70:30 (e) EGC-FA: BOF-60:40 (f) EGC-FA: BOF-50:50

Average CS28 with Variation by IOT, SF, FA



Each colour panel represents the six variations of Fly Ash percentage – 50;60;70;80;90 and 100

Fig. S11. Multi Vari chart for the average 28-day strength

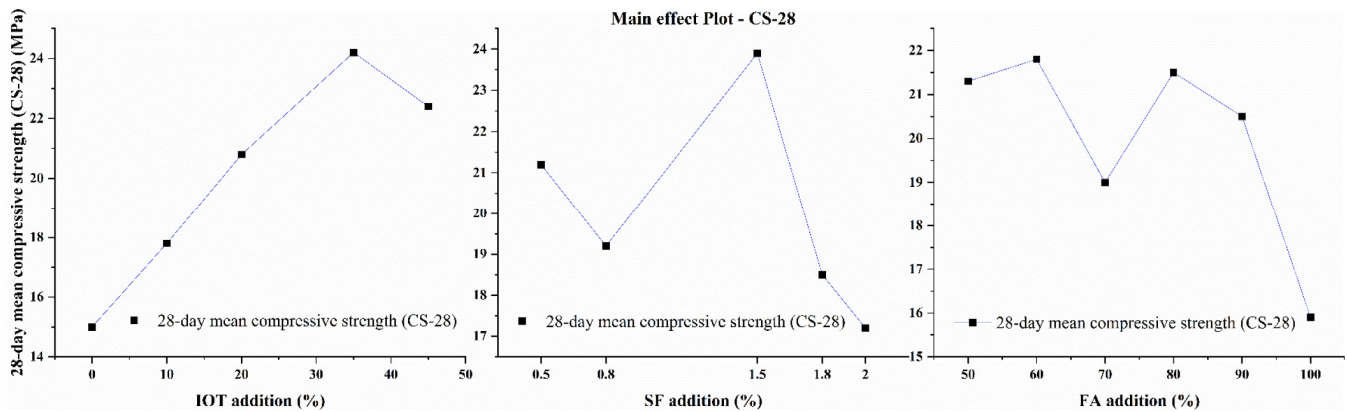
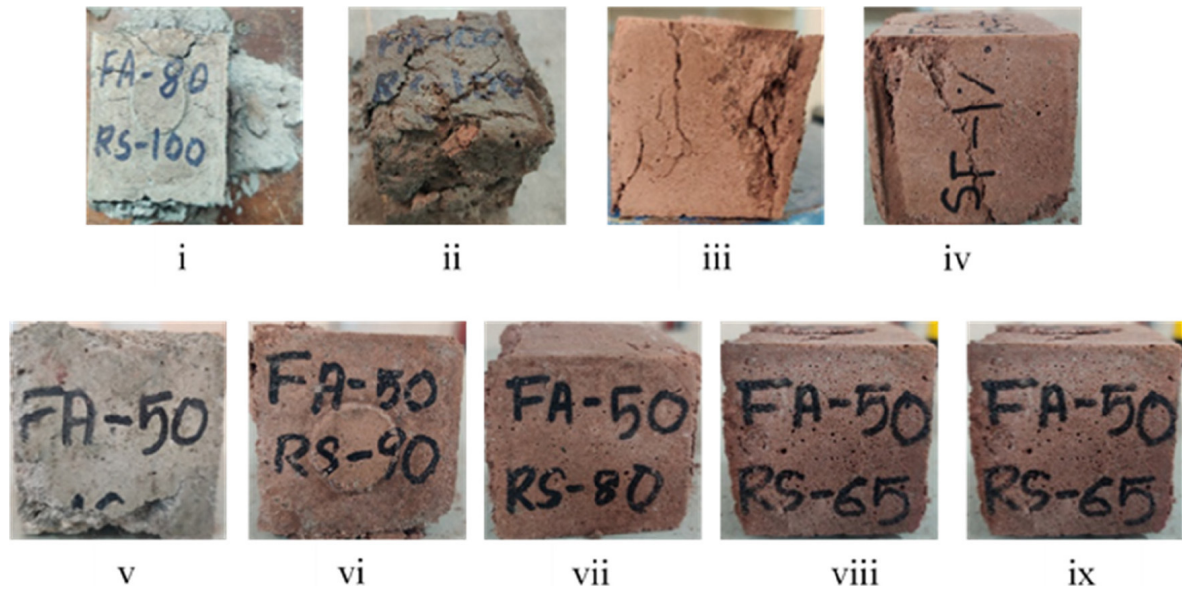
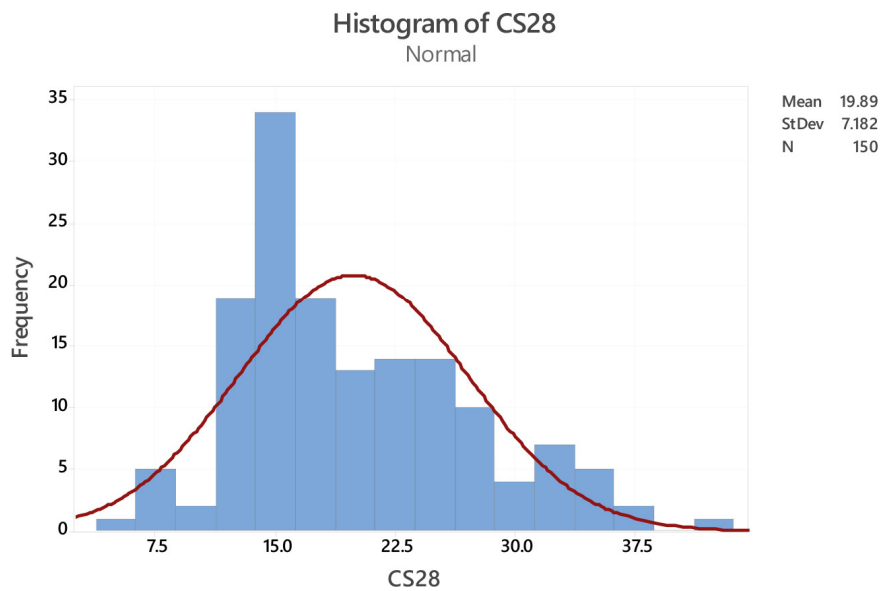


Fig. S12. Main effect plot for CS-28



**Fig. S13.** Compressive strength failure mode (i) EGC-FA: BOF-80:20-MS (ii) EGC-FA100-MS (iii) EGC-FA: BOF-90-10-IOT-20 (iv) EGC-FA: BOF-70-30-IOT-45 (v) EGC-FA: BOF-50-50-MS (vi) EGC-FA: BOF-50-50-IOT-10 (vii) EGC-FA: BOF-50-50-IOT-20 (viii) EGC-FA: BOF-50-50-IOT-35 (ix) EGC-FA: BOF-50-50-IOT-45.



**Fig. S14.** Frequency distribution on the compressive strength 28-day strength attainment



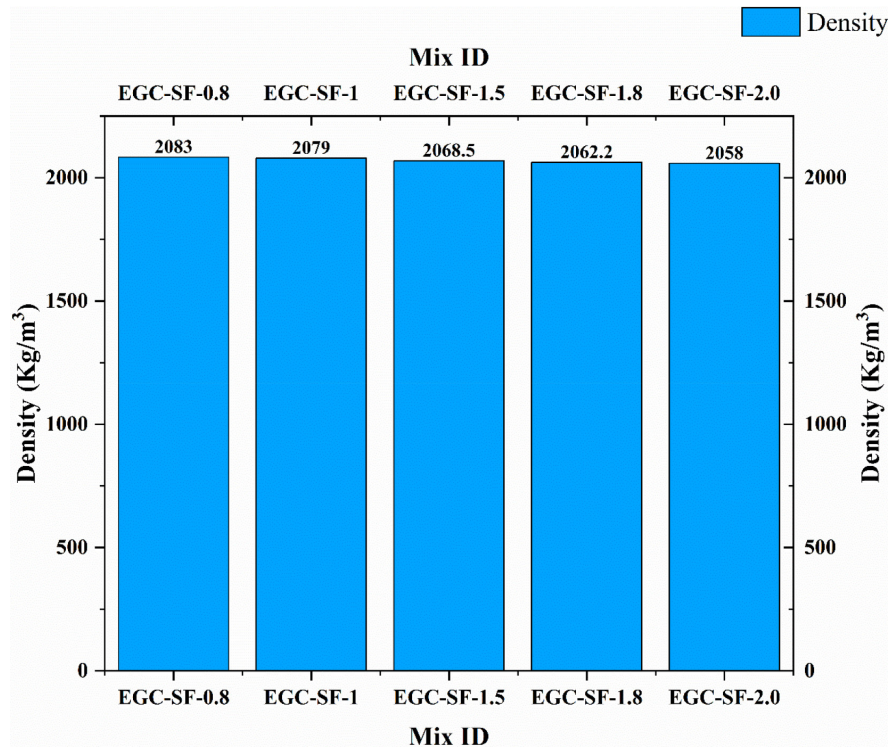
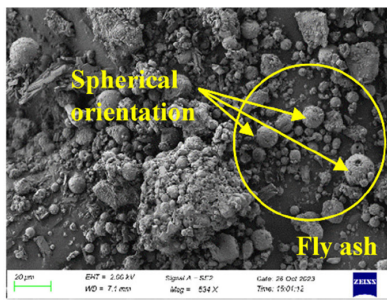


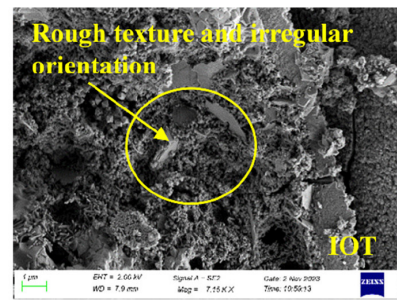
Fig. S15. Density of EGC mixes



a) FA



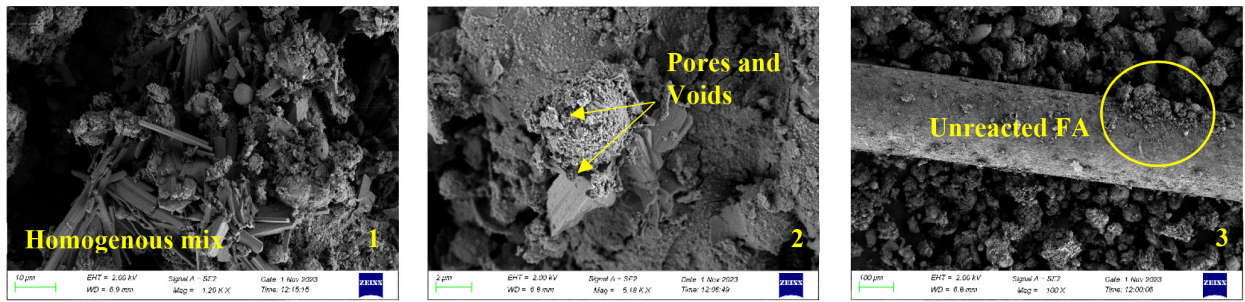
b) BOF slag



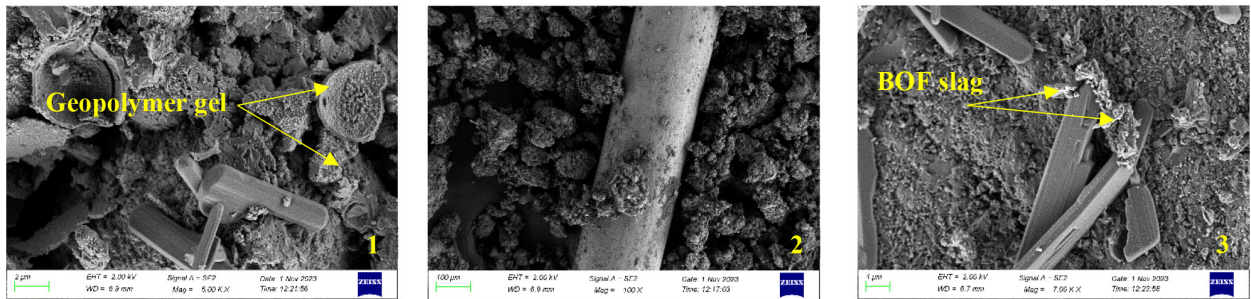
c) IOT

Fig. S16. SEM images - FA, BOF slag and IOT

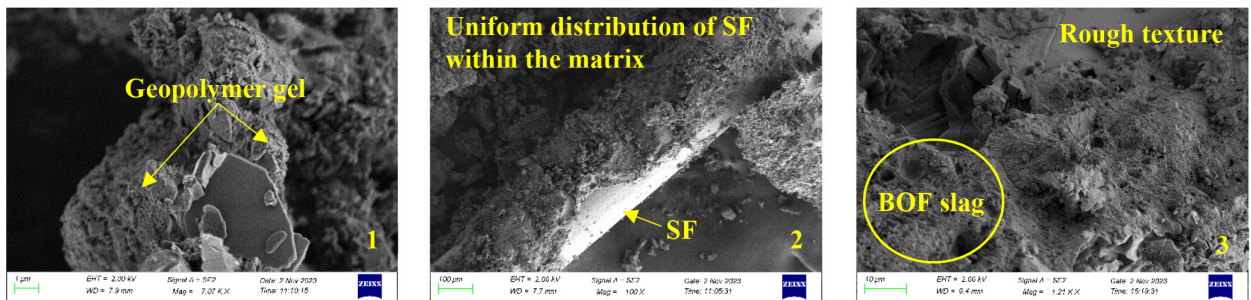




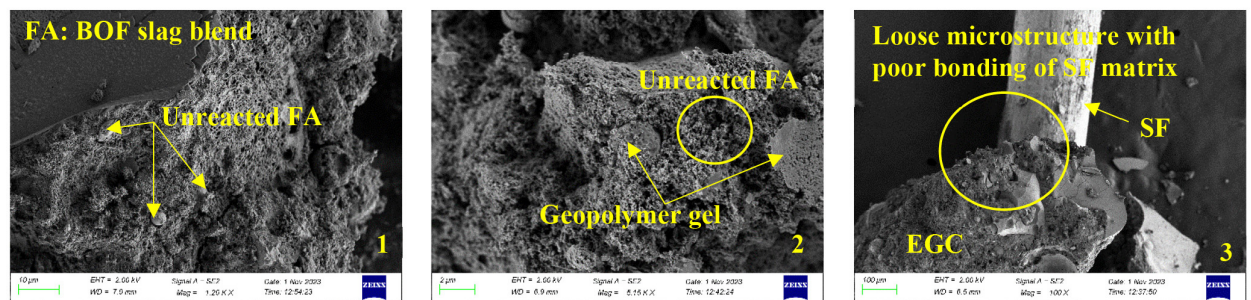
(a) EGC-FA100-MS: IOT-65:35-SF-1.5



(b) EGC-FA: BOF-90:10-MS: IOT-80:20-SF-0.8

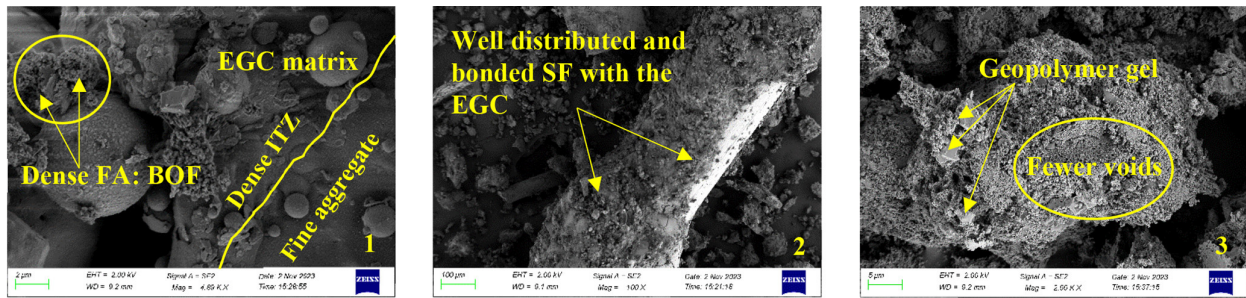


(c) EGC-FA: BOF-80:20-MS: IOT-65:35-SF-1.5

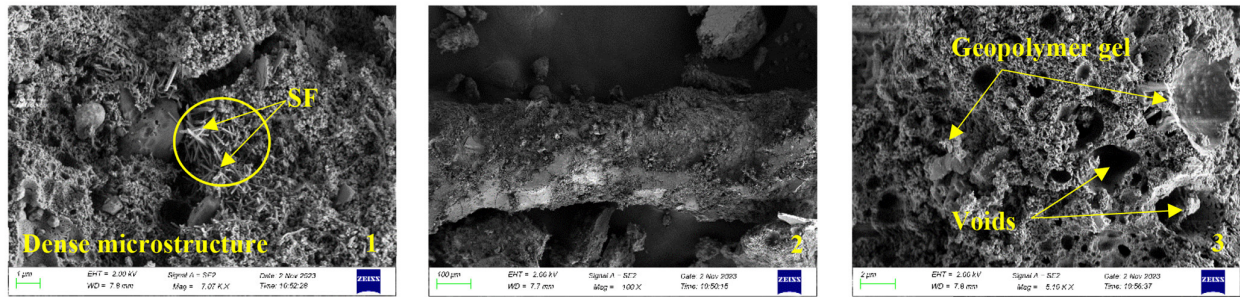


(d) EGC-FA: BOF-70:30-MS: IOT-55:45-SF-1





(e) EGC-FA: BOF-60:40-MS: IOT-55:45-SF-1.5



(f) EGC-FA: BOF-50:50-MS: IOT-55:45-SF-1.5

Fig. S17. SEM images - EGC mixes

Table S6. Total heavy metal composition of raw materials

Material	Heavy metal content (mg/kg)						
	Cr	Cd	Cu	CN	Pb	Zn	As
FA	15.7	<10	15.78	133.49	21.59	41.22	<10
BOF slag	165.29	<10	29.52	621.52	27.55	70.84	<10
IOT	35.74	<10	<10 (1.99)	72.81	<10	21.84	<10



**Table S7.** Leaching concentrations of heavy metals (Cr, Cd, Cu, CN, Pb, Zn and As)

Heavy metal	Leaching concentration (mg/L)	EGC mixes						GSR 801 (E), EPA ( $\leq$ mg/L)
		mix-1	mix-2	mix-3	mix-4	mix-5	mix-6	
Cr	3	0.0182	0.0188	0.0181	0.0650	0.0722	0.0720	0.1
	7	0.0079	0.0075	0.0072	0.0250	0.0380	0.0412	
	14	0.0012	0.0012	0.0017	0.0088	0.0115	0.0110	
	28	Nd*	Nd*	Nd*	Nd*	Nd*	Nd*	
	$\Sigma$ 28	0.0273	0.0275	0.027	0.0988	0.1217	0.1242	
Cd	3	0.0012	0.0102	0.0105	0.0018	0.0980	0.1180	2.0
	7	0.0005	0.0045	0.0047	0.0008	0.0654	0.0980	
	14	Nd*	0.0015	0.0020	Nd*	0.0015	0.0657	
	28	0.0030	Nd*	Nd*	0.0040	Nd*	Nd*	
	$\Sigma$ 28	0.0047	0.0162	0.0172	0.0066	0.1649	0.2817	
Cu	3	0.0398	0.0852	0.0955	0.0985	0.0975	0.0988	3.0
	7	0.0158	0.0512	0.0651	0.0810	0.0845	0.0855	
	14	0.0038	0.0121	0.0335	0.0405	0.0555	0.0601	
	28	Nd*	Nd*	Nd*	Nd*	Nd*	Nd*	
	$\Sigma$ 28	0.0594	0.1485	0.1941	0.2200	0.2375	0.2444	
CN	3	0.0680	0.0705	0.075	0.0758	0.0955	0.0870	0.2
	7	0.0410	0.0228	0.0220	0.0245	0.0245	0.0425	
	14	0.0125	0.0028	0.0077	0.0088	0.0048	0.0088	
	28	Nd*	Nd*	Nd*	Nd*	Nd*	Nd*	
	$\Sigma$ 28	0.1215	0.0961	0.1047	0.1091	0.1248	0.1383	
Pb	3	0.0301	0.0258	0.0289	0.0265	0.0387	0.0252	0.1
	7	0.0115	0.0128	0.0120	0.0130	0.0225	0.0124	
	14	0.0038	0.0018	0.0055	0.0015	0.0048	0.0054	
	28	Nd*	Nd*	Nd*	Nd*	Nd*	Nd*	
	$\Sigma$ 28	0.0454	0.0404	0.0464	0.041	0.0660	0.043	
Zn	3	0.2945	0.6858	0.3105	0.6548	0.6554	0.5112	5.0
	7	0.1165	0.358	0.1185	0.4180	0.586	0.358	
	14	0.0465	0.1002	0.0365	0.1012	0.1002	0.1002	
	28	0.0031	0.0098	0.0045	0.0100	0.0098	0.0098	
	$\Sigma$ 28	0.4606	1.1538	0.4700	1.184	1.3514	0.9792	
As	3	0.0750	0.0805	0.0589	0.0756	0.0695	0.0587	0.2
	7	0.021	0.0328	0.0241	0.0255	0.0295	0.0415	
	14	0.0138	0.0018	0.0078	0.0085	0.0068	0.0088	
	28	Nd*	Nd*	Nd*	Nd*	Nd*	Nd*	
	$\Sigma$ 28	0.1098	0.1151	0.0908	0.1096	0.1058	0.109	

Nd\* - not detected