Supplementary Information

Sustainable Biopolymer Soil Stabilisation – The Effect of Microscale Chemical Characteristics on Macroscale Mechanical Properties

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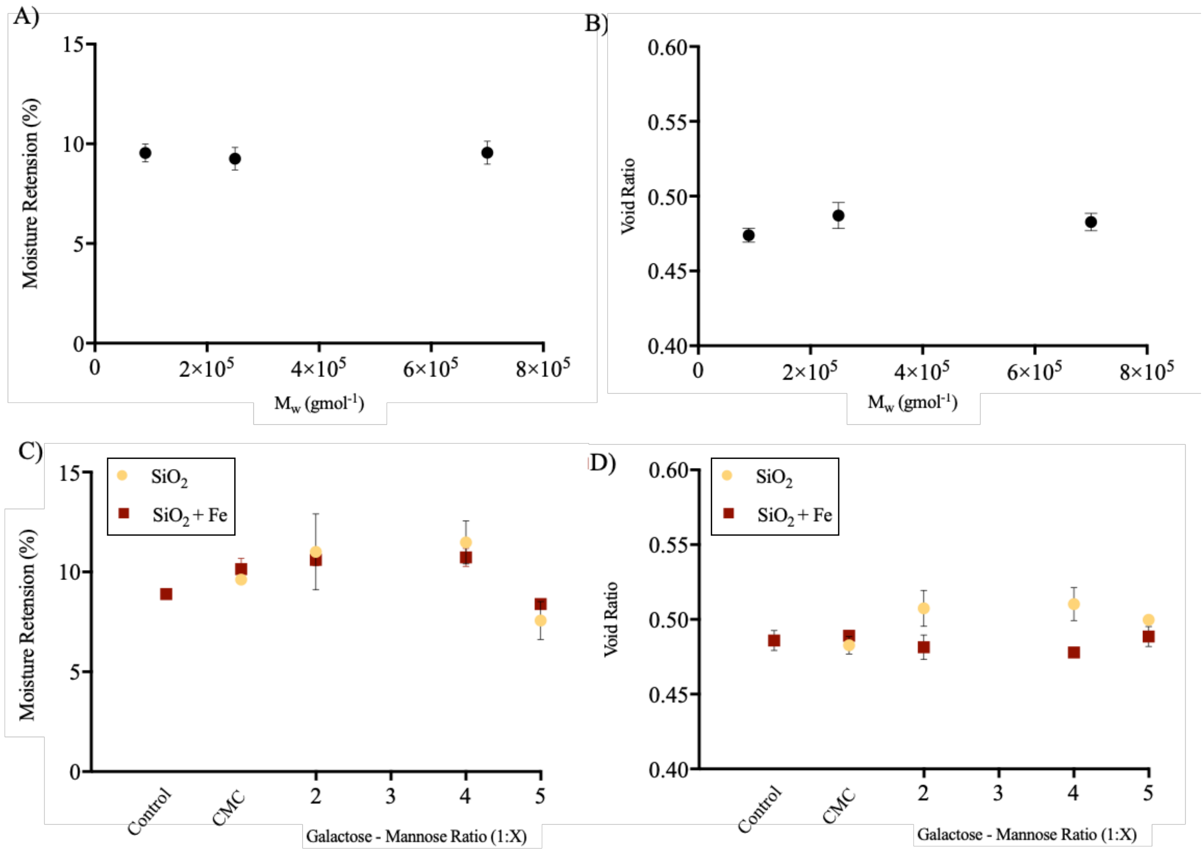
S1. Typical Mine Tailing (MT) Ore, Mineral Composition & pH.

Mine Tailing Site Location	Ore	Fe_2O_3	Al_2O_3	SiO_2	CaO	pH	Reference
China (A)	Fe	14.37	0.8	82.26	0.57	-	[1]
China (B)	Fe	12.61	1.65	75.46	1.70	-	[2]
South Africa (A)	Au	11.7	14.17	58.12	7.5	8.0	[3]
South Africa (B)	Cu	8.07	12.06	65.5	5.91	8.5	[4]
Tanzania	Au	10.40	9.61	50.74	5.34	7.2-7.5	[5]

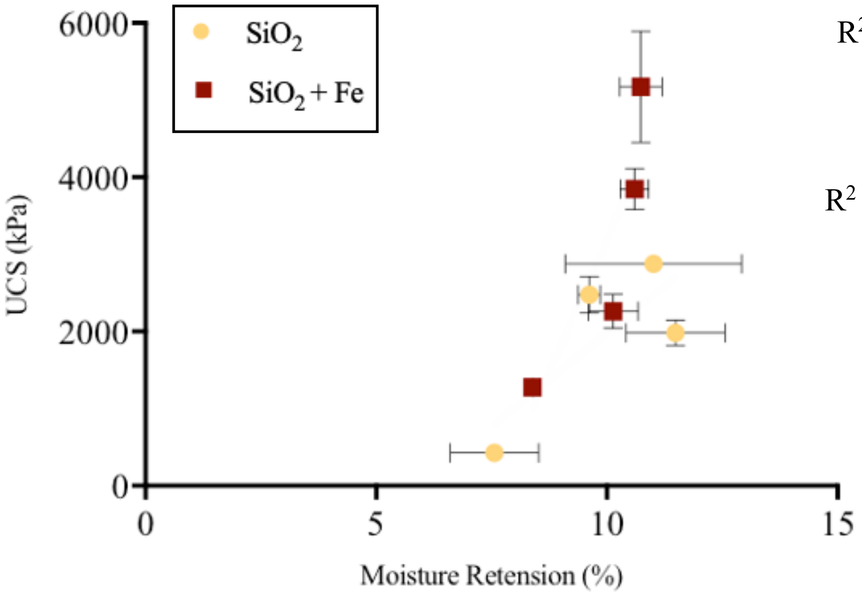
S2. Table showing Silica Sand (SiO_2) properties conforming to BS 1881-131-1998 for testing cement.

	Fraction E
Size	150 μm – 90 μm
Min within Stated range	70 % minimum
Max larger than upper limit	15 %
Max finer than lower limit	15 %
Bulk Density Loose (kg/m^3)	1310
Bulk Density Compact (kg/m^3)	1510
Moisture Content	< 0.1 %
Air Entrainment	< 1.5 %
Clay	-
Silt	-
Organic Matter	-

S3. Moisture Retention and Void Ratios of biopolymer stabilised samples after 7 days curing at 20 degrees. A) Moisture Retention (%) of CMC (1.44%, $Mass_{biopolymer}/Mass_{soil}$) stabilised SiO_2 samples upon an increase in M_w ($gmol^{-1}$). B) Void Ratio of CMC (1.44%, $Mass_{biopolymer}/Mass_{soil}$) stabilised samples upon an increase in M_w ($gmol^{-1}$). C) Moisture Retention (%) of GM (G:M 1:X) stabilised SiO_2 and SiO_2 + Fe soil systems. D) Void Ratio of GM (G:M 1:X) stabilised SiO_2 and SiO_2 + Fe soil systems. CMC was utilized as a positive control due to its previously identified lack of Fe binding.



S4. Relationship between UCS (kPa) and Moisture Retention (%) of GM (1%, $Mass_{biopolymer}/Mass_{soil}$) stabilised SiO_2 and SiO_2 + Fe soil systems after 7 days of curing at 20℃. Linear regression statistical analysis, was carried out on each sample set, with the resultant R^2 and p – values represented.

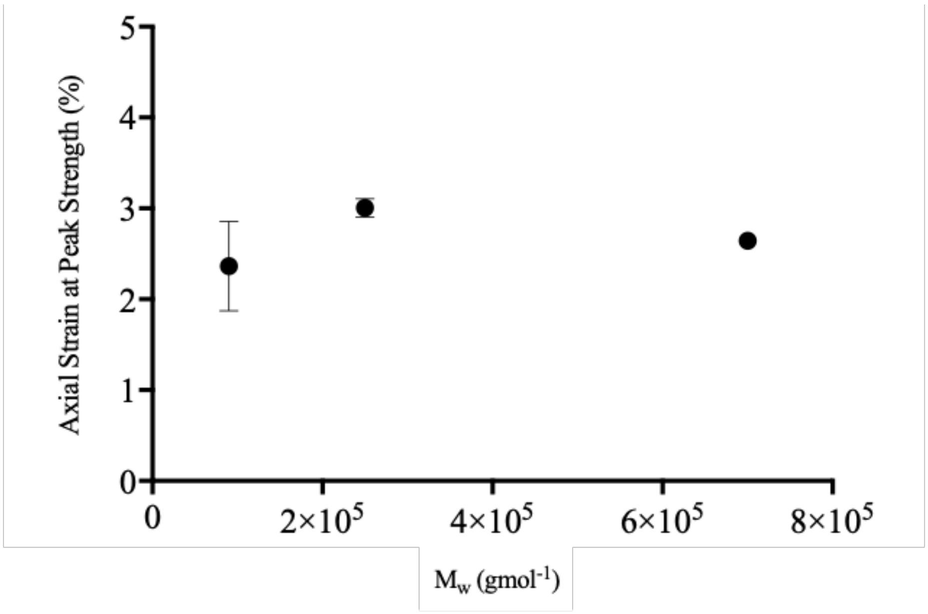


SiO_2
$R^2 = 0.628$, $p = 0.2076$

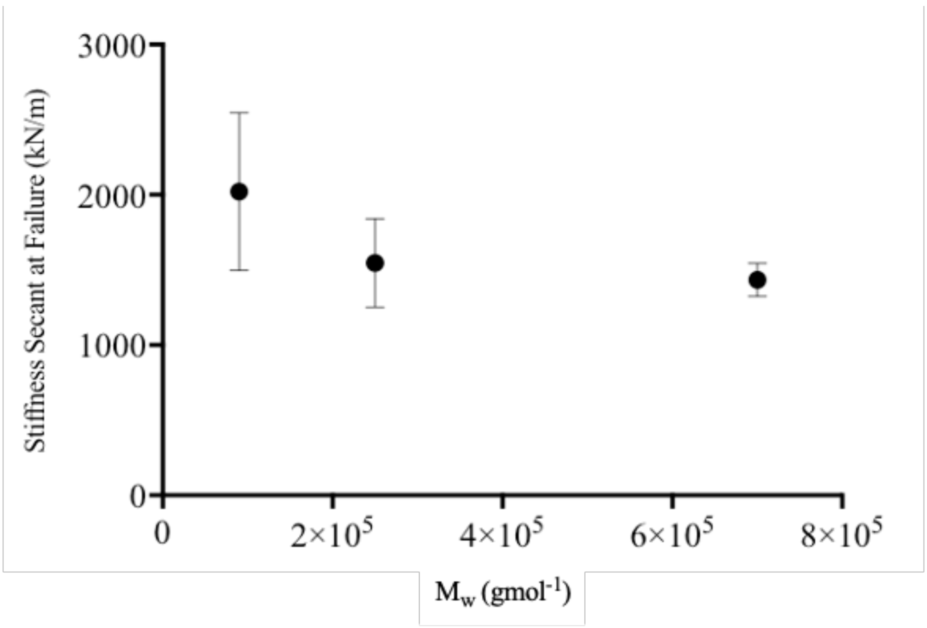
SiO_2 + Fe
$R^2 = 0.7391$, $p = 0.1403$

S5. Strength characteristics of CMC (1.44 %, $Mass_{biopolymer}/Mass_{soil}$) stabilised SiO_2 samples upon increasing molecular weight M_w ($gmol^{-1}$), after 7 days curing at 20℃. A) Axial Strain at Peak Strength (%) B) Stiffness Secant at Failure (kN/m).

A)



B)



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