Influence of E-Coli on Workability and Strength Characteristics of Self-Consolidating Geopolymer Concrete Based On GGBFS, Fly ash and Alccofine

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Introduction

Construction sector across world utilizes cement as one of the most relevant and efficient raw material. It is being estimated that by manufacturing one ton of cement, roughly one ton of CO_2 gas is emitted into atmosphere. With increasing awareness about global warming, development of alternative binding material that can replace cement completely has gained importance in construction sector. Many studies made on Geopolymer concrete (GPC) has proven its ability to replace cement in construction sector. This experimental investigation concentrates on completely replacing cement by alkali activated GGBFS, Fly ash and alccofine in self-consolidating concrete (SCC) mixes. The current investigation studies effect of E-Coli bacteria on workability and strength characteristics of Self-consolidating geopolymer concrete (SCGC).

Methodology

10 different SCGC mix samples were prepared by varying cell concentration of E-coli bacteria in order of 0%, 1%, 2%, 3%, 4%, 5%, 6%, 7%, 8% and 9% of total binder content. Workability tests such as **Slump test, T50 slump test, V-Funnel test, L-Box test and J-Ring** test are conducted to determine the influence of E-Coli bacteria on **workability characteristics** of SCGC**. Compression test, Split-tensile test and Flexural Tes**t are conducted after **7, 14 and 28 days of ambient curing** to determine the influence of E-Coli bacteria on **strength characteristics** of SCGC. **XRD analysis** are conducted to determine the **chemical composition of SCGC**. Bacterial Survivability (Turbedimetric) test was conducted to determine the survivability of bacteria in SCGC after 28 days.

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Results

Table 1: Workability Test Results of All SCGC Mixes

Mix ID	Test Parameters: Slump Flow (mm)	L-Box (mm)	T50 Slump Flow (sec)	J-Ring (mm)	V-Funnel (sec)
M0	638	0.68	5.52	13.5	12.8
M1	658	0.81	4.9	10.2	11.2
M2	668	0.83	4.6	9.8	10.2
M3	672	0.87	4.2	7.8	9.4
M4	678	0.91	3.7	6.3	9.2
M5	685	0.91	3.3	5.2	8.7
M6	694	0.93	2.9	4.7	8.5
M7	702	0.94	2.6	3.9	8.3
M8	728	0.96	2.2	2.3	8.2
M9	802	1.2	1.8	0.1	6.2
Acceptable values as per EFNARC Guidelines					
Minimum	650	0.8	2	0	8
Maximum	800	1	5	10	12

COMPRESSION STRENGTH TEST RESULTS

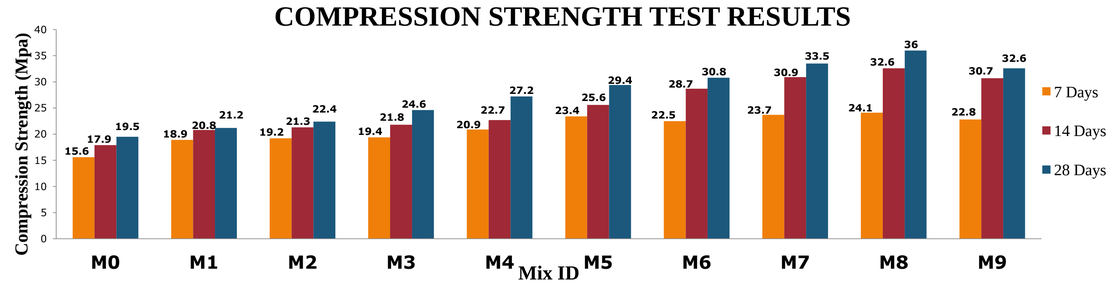

Fig 1: Compression Strength Test Results

SPLIT-TENSILE STRENGTH TEST RESULTS

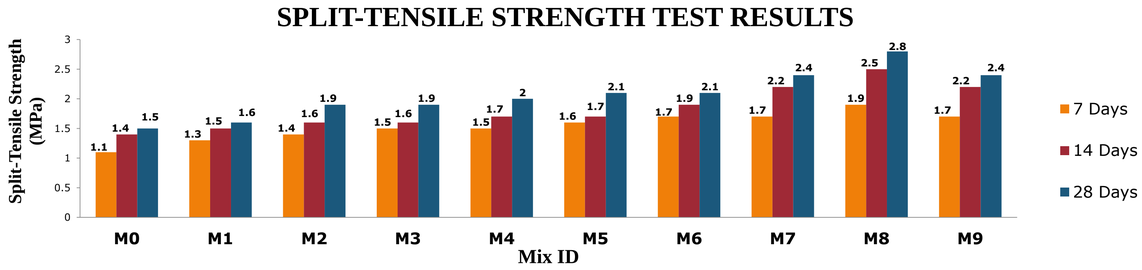

Fig 2: Split-Tensile Strength Test Results

FLEXURAL STRENGTH TEST RESULTS

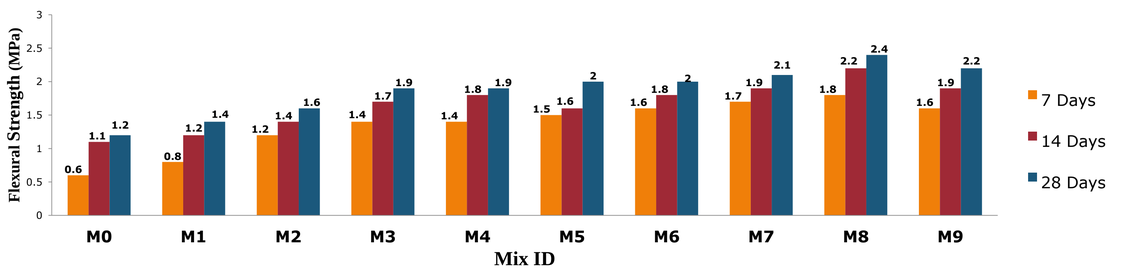

Fig 3: Flexural Strength Test Results

Table 2: Turbidimetric Test Results

Mix ID		M0	M1	M2	M3	M4	M5	M6	M7	M8	M9
OD Values	**7 Days**	0	0.428	0.419	0.523	0.426	0.478	0.515	0.587	0.687	0.537
	14 Days	0	0.587	0.621	0.568	0.592	0.610	0.575	0.564	0.623	0.625
	28 Days	0	0.605	0.594	0.587	0.612	0.606	0.594	0.657	0.789	0.824

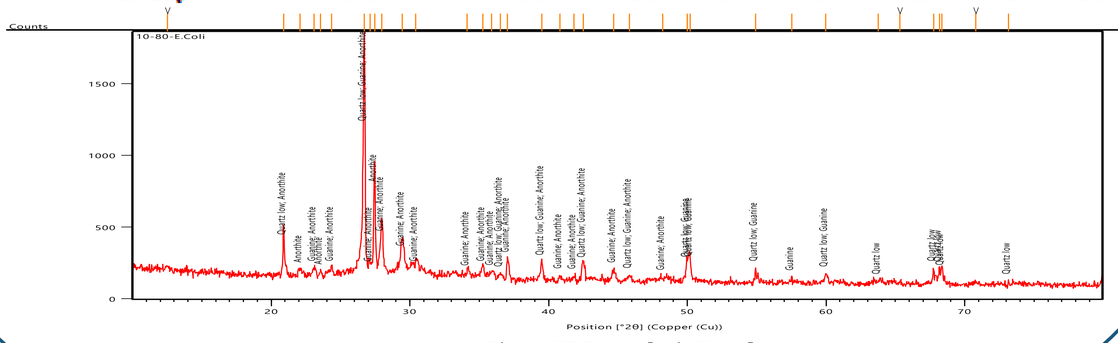

Fig 4: XRD Analysis Result

Conclusion

The effects of varying cell concentration of E-coli bacteria on workability and strength characteristics of self-consolidating geopolymer concrete (SCGC) has been experimentally evaluated in this study. Incorporation of E-coli bacteria tends to enhance workability and strength characteristics of SCGC. The present study shows that addition of E-coli bacteria in cell concentration of 8% of total binder content enhanced workability by 14%, compression strength by 69.8%, split-tensile strength by 73% and flexural strength by 71.42%. Survival of E-coli bacteria in geopolymer matrix even after 28 days proves its ability to adopt for harsh conditions. Addition of E-coli bacteria improves bio-mineralisation process which is evident from XRD analysis by the formation of quartz, guanine and anorthite minerals that helps in enhancing strength characteristics of SCGC. With few more researches concentrating on crack healing ability and durability characteristics, E-coli incorporated SCGC can be considered as a worthy eco-friendly alternative to replace conventional concrete in construction sector.