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MECHANICAL PROPERTIES AND FLOWABILITY OF LWSCC RESTRAIN IRON MINE WASTE

Romus Anal[1], Dr. Sanjeev Singh[2]
Department of Civil Engineering
[1,2]Shri Venkateshwara University, Gajraula (Uttar Pradesh)

Abstract

Materials that cannot be composted should be recycled. Iron mine waste can be used in concrete as a substitute for cement because of its chemical composition. This study's focus is on the rheological and mechanical qualities, as well as the long-term durability, of LWSCC made with iron mine waste as an additive. 5%, 10%, 15%, and 20% of the cement was replaced with IMW (iron mine waste). All combinations tested in 2005 met or exceeded EFNARC's allowed range for LWSCC flowability, viscosity, and filling ability when IMW was employed as a cement substitute. The compression strength of the IMW-replaced cement rose by 8.6% and 20% over the control mixture, respectively. IMW's compressive strength dropped as the percentage of IMW in the material grew. According to these tests, LWSCC demonstrated this pattern for tensile and flexible strength as well as water penetration.

Keywords: IMW, LWSCC, self-compacting concrete, mechanical and flowability properties

1. Introduction

Every mining operation generates a significant amount of trash, which is often buried in waste dams around the mines due to insufficient utilisation. Solid waste, particularly tailings from mineral processing operations, is a major pollution hazard in the mining industry. Therefore, new means of using mining waste are needed **(Yellishetty et a1., 2008).** Recently, instead of using natural soil, more and more embankments for roads, railroads, rivers, and dam projects are being built with mine waste. Backfilling opencast quarries with mine waste is another common application of mine waste. Blended slag cement manufacturing plans were aided by the findings, which revealed that slagmight be used as non-structural concrete

with minor adjustments. High-strength concretes made from blast furnace slag aggregate (BFSA) (HSC).

Compressive strength of BFSA concrète was found to be 60 to 80 percent greater than that of traditional concrète, according to their findings. The solid leftovers of copper slag employed as a substitute for self-compacting concrete showed less water content and higherdurabitlity values. They found that by replacing sand with 20%, 40%, and 60% copper slag, the 28-day compressive strength rose by ll.3%, 15.5%, and 12.4%, respectively.

As recently as the early 1980s, Japan's lack of skilled personnel for compacting concrete structures was widely acknowledged to be the most significant factor in limiting their durability and effectiveness. Since Okamura was able to produce concrete building technique that did not depend on the expertise of the construction worker and was dense enough to support its own weight after numerous experiments done by, **Okamura(1996, 1997, 1999, 2000, 2005),** Concrete of this sort can compact to a high degree on its own, without the need for additional energy. As a component of self-consolidating concrete, lightweight aggregate (LWA) is well researched, with the majority of this study focusing on LWA's workability and rheological properties as well as its mechanical properties (LWSCC). LWSCC's rheological and mechanical qualities have been little studied in relation to mineral admixtures and wastes. Concrete made with mineral admixtures was shown to have better fresh characteristics when self-compacting cold-bonded fly ash lightweight aggregate was employed, **according to Güneyisi et al. (2012)** . Any mineral admixture-containing concrètes had faster slump flow times than the control mixture with only PC. **Shi and Wu (2005)** investigated the composition and qualities of LWSCC using glass powder. Using ground glass powder as an alternative to cement can lower chloride permeability, which can be related to the stronger pozzolan reactivity of glass powder than fly ash, according to their findings..

2. Experimental program

It was found that river sand, LECA, type II Portland cement, silica fume, and type II Portland cement met the ASTM C150 (2001) criterion for LWSCC development. The FM 2.71, the total humidity of 0.1% the water content of 3.2%, and the specific gravity of 2.99g/cm3 were all used in our experiment. Self-compacting concrete made use of LECA aggregates to lighten it. For LECA aggregates, iron mines used expanded clay (created by heating clay to over 12,000 degrees Celsius). Light weight aggregates (LWA) had a maximum diameter of 12.5 millimetres and a specific gravity of 925 kilogrammes per cubic metre. A plot of aggregate gradients depicted in Figure 1.

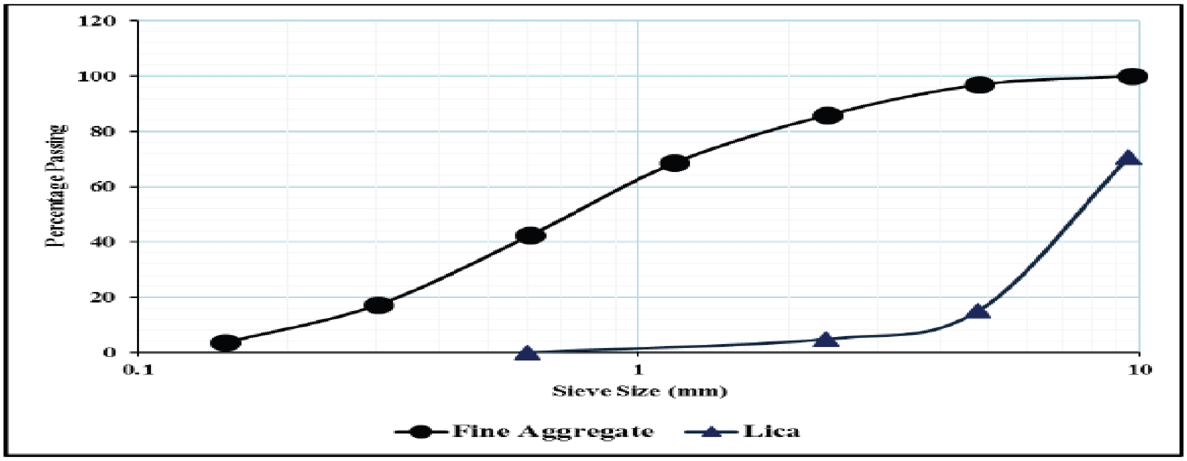


Figure 1Curve of fine and light weight calculatedgrain size

Improved segregation resistance was achieved by the addition of dark grey, 1.95-g/cm^3 silica fume, with a pH of about 9. Cement and silica fume are shown in Table 1 to show their chemical makeup and physical qualities. Glenium51, which has a mass of 1.13 g/cm^3 and a solids substance of 40.2%, used to improves flowability mixes. In this experiment, iron mine waste was substituted for cement in varied proportions.The organicstructure of IMW was find using (XRF) examination results. The organicconfiguration of the IMW depicted in Table 1.

Chemical composition	L.O.I	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	K_2O	Na_2O	Cl	I.R.
Cement (%)	1.33	21.7	4.62	3.95	65.04	1.25	2.78	0.61	0.62	0.019	0.46
Silica fume (%)	1.9	91	0.9	1.25	0.85	1.9	-	0.7	1.6	-	-
SMIW (%)	6.2	39.952	5.907	22.174	9.249	14.16		1.855	0.937	-	-

Physical Characteristics of cement							
Compressive strength (MPa)			Time of setting (min)		Blaine fineness (cm^2/g)	Specific gravity	Autoclave expansion (%)
3 days	7 days	28 days	Initial	final			
26.3	34.3	44.9	140	190	2950	3.12	0.19

Table 1Physical and chemical properties of cement, silica fume and IMW

2.1Mixing plan

A consistent water restraintproportion of 0.38 was used for development of five different mixes in this investigation. All combinations contained 13 weight percent silica fume, as determined through preliminary testing. In order to attain a slump movement diameter of 650-800 mm, several SP concentrations were used in the formulations under consideration (1.5 wt percent of the cement). By weight of cement, the concretes referred to as LWSCC-Iw5, LWSCC-Iwl0, LWSCC-IWI5 and LWSCC-Iw20 are all 5 wt. percent SMIW-containing concrete. Table 2 lists the LWSCC mixture proportions.

Mix No.	Sand (kg/m3)	Lica (kg/m3)	Cement (kg/m3)	Water (kg/m3)	Superplasticizer (kg/m3)	Micro Silica (kg/m3)	SMIW(kg/m3)
LWSCC	708	460	479	206	7.033	62	0
LWSCC-IW5	708	460	455.05	206	7.033	62	23.95
LWSCC-IW10	708	460	431.1	206	7.033	62	47.9
LWSCC-IW15	708	460	407.15	206	7.033	62	71.85
LWSCC-IW20	708	460	383.2	206	7.033	62	95.8

After the concrete had been mixed, tests were carried out to measure its filling, passing, stability, and viscosity, including the "Slump Flow, J-Ring, T500, V-Funnel, and L-Box".

Following validation, all LWSCCs samples cast without mechanical vibration. On 45 10x10x10 cm cubes, compression tests were carried out on third ,seventh and twenty-eighth days after the samples were made. The tensile strength and permeability of 45 10 x 20 cm cylindrical samples and 15 x 15 x 15 cm cubic samples were tested after three, seven, and 28 days. Thirty 50 x 50 x 500 cm flexural samples were examined for flexural strength after three, seven, and 28 days. Within 24 hours after the casting, they were placed in plastic bags and left to air dry at room temperature. demolded and taken to a wet curing facility, where they were stored at 22 °C and 100% relative humidity until they were ready for use...

3Results of fresh concrete tests

The slump flow diameter of an unconfined mixture is an indicator of its flowability (EFNARC, 2005). According to slump flow measurements, the diameter of the SCLC slump flow was between 685-750 mm. As the percentage of SMIW replacement increased, so did the slump flow diameter. Slump-flow values reported by EFNARC (650-800 mm) allowed us to conclude that the flowability of all combinations was good.

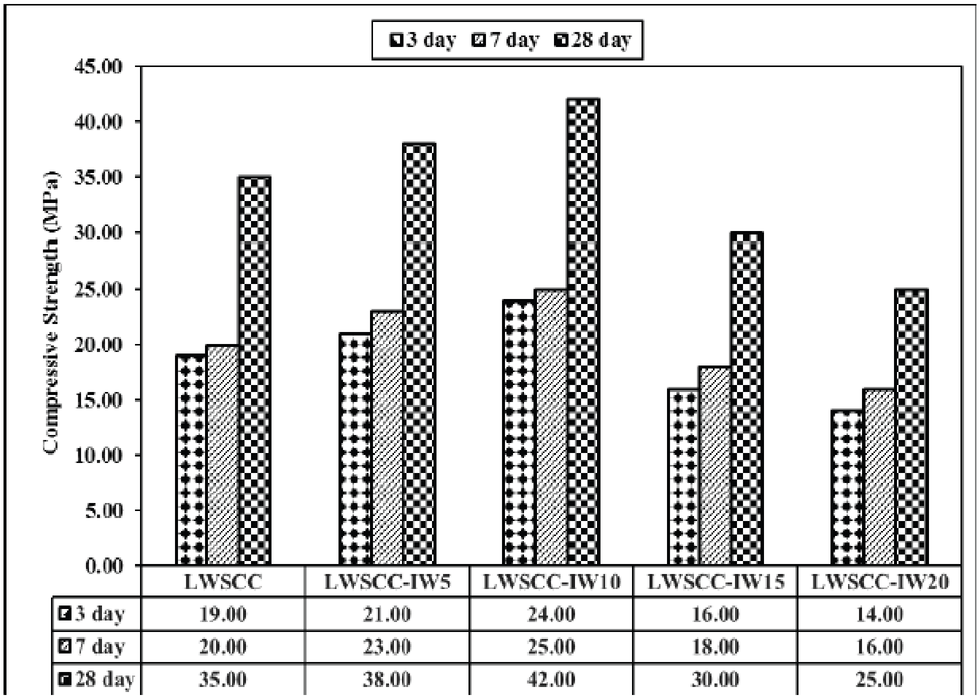
Table 3 shows a comparison of LWSCC T500 and V-funnel flow times with different replacement iron mine waste percentages. Time 500 (T500) was between 1.8 and 3.5 seconds for all mixes in the v-funnel flow test. Time delays in T500 and V-funnel flow rates decreased when iron mine waste was added. A reduction in the viscosity of the mixes was seen, however all of the mixtures met the requirements of EFNARC (6-12 s).

Mix No.	Slump Flow (mm)	V Funnel (s)	J Ring (h2-h1) (mm)	U Box (h2-h1) (mm)	L Box (h2/h1)	T_500 (s)
LWSCC	750	8	10	5	1	1.8
LWSCC-IW5	739	8.2	11	9	0.98	2.4
LWSCC-IW10	730	8.5	12	11	0.92	2.5
LWSCC-IW15	716	9.1	13	15	0.85	2.4
LWSCC-IW20	685	10	13	21	0.8	3.5

"J-Ring, L-Box, and U-Box" experiments were used to assess the flowability of mixes in narrow spaces. Table 3 shows the J-ring and U-box height disparities for combinations ranging from 10 to 13 millimetres and 5 to 21 millimetres, respectively. Whole mixes had an L-box height ratio of more than 0.8. Once IMW was included, all mixes met the H2 /H1 ratio restriction set by EFNARC (2005)

3.1Compressive strength

At 3, 7, and 28 days, the compressive strength of LWSCCs treated with varying doses of IMW is shown in figure 3. LWSCC's compressive strength was improved due to improved concrete ageing. Structural lightweight concrete must have a 7-day compressive strength of at least 16 MPa and a 28-day compressive strength of at least 25 MPa, as shown in Figure 2.



	LWSCC	LWSCC-IW5	LWSCC-IW10	LWSCC-IW15	LWSCC-IW20
3 day	19.00	21.00	24.00	16.00	14.00
7 day	20.00	23.00	25.00	18.00	16.00
28 day	35.00	38.00	42.00	30.00	25.00

Figure 2 Difference of compressive strengths of LWSCCs containing IMW at different ages.

3.2Splitting tensile strength

To demonstrate the splitting tensile strength of light weight SCC containing various dosages of IMW at various ages, the graph in Figure 3 is shown. It was discovered that the 28-day tensile strength of the lightweight SCC containing 5 and 10wt percent IMW was 1.65 MPa and 1.85 MPa that the control self-consolidating concrete contained zero IMW content..

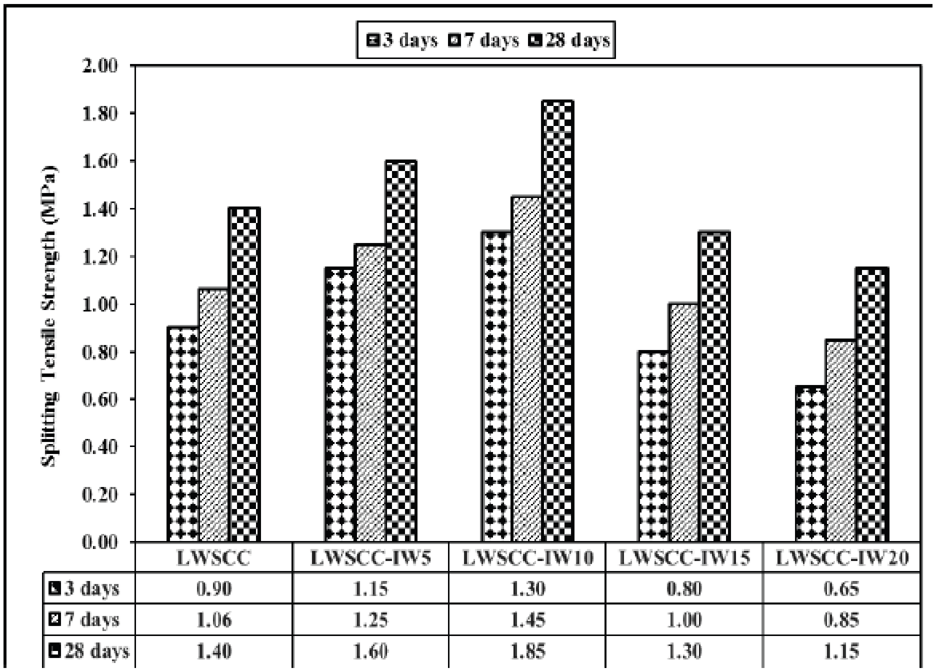


Figure 3different splitting tensile strength of LWSCCs containing IMW at different ages.

3.3Flexural strength

At 3, 7, and 28 days, all of the mixes ruptured twice, according to the research. Figure 4 depicts the rupture module (R) **(Mazaheripour et al., 2011)** and its experimentoutcomes for the all-out force on the model and the calculated stage of rupture. At 3, 7, and 28 days, the rupture module for the control sample with 0% SMIW was 3, 3.5, and 4.30 MPa.

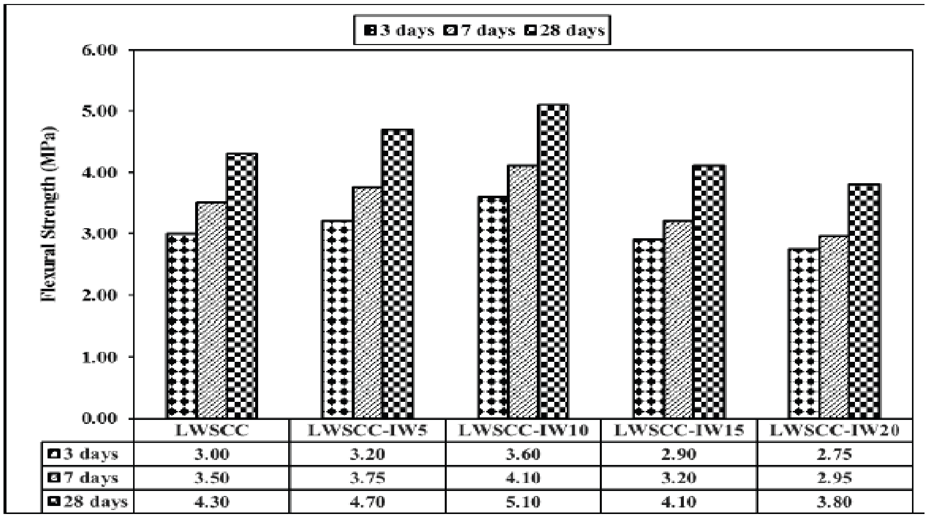


Figure 4 different flexural strength of LWSCCs containing IMW at different ages

3.4Water Penetration

Figure 5depicts the water content and saturation depth of the mixtures twenty eight period of days after curing. 20% of the water saturation depth is reduced twenty eight days after drying with 5% SMIW in the control mixture. Increased level of SMIW in the water at 28 days reduces water penetration depth by 7.5 percent. At 28 days, LWSCC-water IW15's penetration was 5% higher than LWSCC's at the same time..

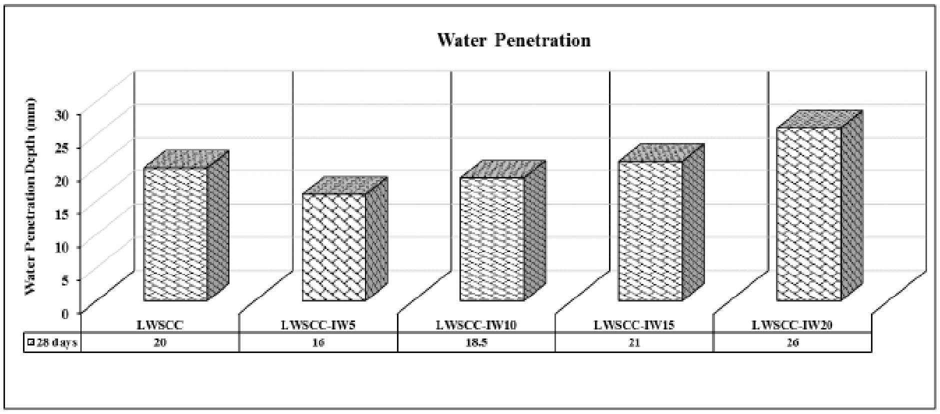


Figure 5 Water penetration depth of LWSCCs containing SMIW at 28 days age.

4. Conclusion

The workability, mechanical characteristics, and long-term durability of lightweight self-consolidating concrete were examined in this report to see how iron mine waste affected such attributes. The following conclusions can be derived from the findings of the experiment.

LWSCCs were more consistent when IMW was added to the mix as a substitute for cement, resulting in reduced slump flow diameter and increased flowability times in tests such as T500 and V-funnel tests. all combinations containing IMW exhibited blocking ratios of between 0.8 and 1 in them. With respect to EFNARC, all of the mixes containing IMW met the standards of SCC. There are a number of assumptions made about the flowability, filling ability and passage of all mixtures containing IMW. When IMW was added to LWSCCs at 10%, the splitting tensile strength and rupture modules increased. At 3, 7, and 28 days, the splitting tensile strength increased by 44.4%, the rupture modules increased by 20.0%, 17.1%, and 18.6%, and the rupture modules increased by 36.8% at 3, 7 days and 32 days with a 10wt percent replacement of IMW.

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