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Impact of Al_2O_3, SiO_2 & Fe_2O_3 Present in Bricks Prepared Using Iron Ore Waste On Its Compressive Strength

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Abstract: *Mining of iron ore invariably produces lot of waste which significantly damages the environment in different ways. To reduce this environmental damage to a certain extent, iron ore waste can be utilized for making bricks in the construction industry by way of mixing it with some additives. In this investigation, an attempt was made to investigate the impact of major chemical composition of prepared iron ore waste (IOW) bricks on its compressive strength. The chemical compositions like total percentage of Al_2O_3, SiO_2 and Fe_2O_3 present in a brick were observed through the output of Java program for different mix ratios. Based on the available data, results of investigation on the impact of chemical composition of bricks on its compressive strength revealed no appropriate relationship with total percentages of SiO_2 and Al_2O_3 present in a brick. However, with increase in total percentage of Fe_2O_3 present in a brick, its compressive strength was found to decrease gradually. Hence, it is suggested to prepare non-fired bricks from iron ore waste fines containing low percentage of Fe_2O_3, which is also desirable from the point of view of mineral conservation. It is suggested to take up detailed investigation in future to study exclusively the influence of different types of chemical constituents which are present in IOW brick and correlate it with compressive strength and water absorption by carrying out regression analysis and arrive at some useful conclusion.*

Keywords: *Iron Ore Waste (IOW), Fly-ash, Compressive Strength, Chemical Composition, Al_2O_3, SiO_2, Fe_2O_3*

1. Introduction

India has large reserves of iron ore which are mined from several states. The production of iron ore in the country at about 152.43 million tons in 2013-14 registered an increase of 11.58 % over the previous year 2012-13 as per the Annual Report 2014-15 of Ministry of Mines, Govt. of India [1].

The mining of iron ore invariably produces lot of waste which significantly damages the environment in different ways. To reduce this environmental damage to a certain extent, numerous efforts have been put up by various investigators worldwide to utilize the waste generated for some useful purpose. Significant amount of work has been carried out in using iron ore waste (IOW) in the construction industry by way of mixing it with some additives. Shreekant et al. (2016) [2] has described in detail about usage of iron ore waste in brick making utilizing cement and fly ash as additives. Therefore, the concept of brick making using iron ore waste or any other mine waste is not new. Though there has been significant amount of work carried out in the area of brick making using iron ore waste, very few studies seem to have addressed the effect of some of the major constituents of iron ore waste in general and brick in particular on the compressive strength of bricks. In the present study attempt was made to investigate the impact of major chemical composition in non-fired compressed brick prepared using cement, fly ash and iron ore waste on its (Bricks) compressive strength.

2.0 Study Area, Collection of Samples and Chemical Composition

2.1 Study Area & Collection of Samples

The study area, different IOW samples and fly ash collection was the same as described by Shreekant et al. (2016) [2], as this work is an extension of the work carried out by the same investigators. Though a total of nine different IOW samples were collected in this work, only six different samples were used in this investigation due to the reasons stated by Shreekant et al. (2016) [2].

2.2 Chemical Composition

The chemical composition analysis of collected iron ore waste (IOW), fly ash and cement was carried out in the Chemical Engineering Department of NITK Surathkal, by sending representative sample obtained through Conning and Quartering in the Mineral Processing Laboratory of Department of Mining Engineering.

2.2.1 Iron Ore Samples

The results of various constituents in different IOW samples as determined in the laboratory are given in Table 1.

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Table 1: *Chemical composition of IOW (% by mass)*

Sample No.	Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	Fe_2O_3
S1	0.03	0.19	22.27	40.70	0.05	4.79	1.20	22.93
S2	0.89	0.10	27.53	33.02	0.08	3.65	0.94	27.24
S3	0.07	0.06	34.00	40.24	0.06	5.54	1.56	15.20
S4	0.06	0.80	21.42	50.80	0.05	6.85	0.55	20.18
S5	0.04	0.36	25.32	50.13	0.03	3.32	0.85	15.38
S6	0.15	0.02	22.98	21.20	0.07	5.40	0.70	58.88
S7	0.12	0.10	30.45	38.80	0.14	6.52	0.65	32.08
S8	0.37	0.30	13.90	29.45	0.05	2.08	0.36	48.10
S9	0.13	0.27	16.40	41.70	0.14	7.11	1.50	29.45

2.2.2 Portland cement

Ordinary Portland cement of 43 grades, confirming to IS: 8112-1989 [3] was used as binding material for the preparation of bricks. The chemical composition of the cement as determined in the laboratory is given in Table 2.

Table 2: *Chemical composition of cement (% by mass)*

Chemical Composition (%)	SiO_2	Al_2O_3	Fe_2O_3	Na_2O	K_2O	MgO	M_nO_2	C_aO	Z_nO	P_b	C_r
Cement	18.71	10.44	6.47	0.34	0.43	0.00	0.12	51.46	1.05	1.68	0.01

2.2.3 Fly-ash

Table 3 gives the chemical composition of fly ash as determined in the laboratory. Fly ash was collected from the nearby thermal power plant Udupi Power Corporation Limited. (UPCL, Udupi Dist. Karnataka).

Table 3: *Chemical composition of fly ash (% by mass)*

LOI (%)	Chemical Composition (%)									
	SiO_2	Al_2O_3	CaO	MgO	K_2O	Na_2O	TiO_2	SO_3	MnO_2	Fe_2O_3
0.14	34.80	14.10	16.16	2.70	1.30	5.30	0.86	0.50	0.20	24.14

Table 1 to Table 3 clearly shows the major chemical constituents as SiO_2, Al_2O_3 and Fe_2O_3 in different IOW samples, fly ash and cement which is also clearly evident from Figure 1. From Figure 1 it is also seen that the mass percentage of S_iO_2 is highest in cement, fly ash and IOW samples of different locations among all the three major constituents.

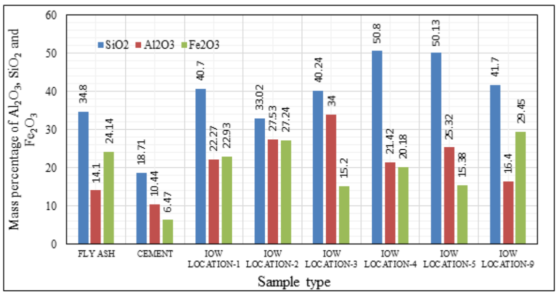

Figure 1. *Mass percentage of S_iO_2, Al_2O_3 and Fe_2O_3 of fly ash, cement and IOW*

Table 4 gives the major chemical composition of fly ash, cement and IOW samples from all six locations. The mass percentage of Al_2O_3 varies from 10.44 to 34.00, the mass percentage of Fe_2O_3 varies from 6.47 to 29.45 whereas that of SiO_2 varies from 18.71 to 50.80 for fly ash, cement and IOW samples of all the six locations.

Table 4: *Major chemical composition of fly ash, cement and IOW*

Items	Major chemical composition (%)		
	SiO_2	Al_2O_3	Fe_2O_3
Fly ash	34.80	14.10	24.14
Cement	18.71	10.44	06.47
IOW, Sample Location-1	40.70	22.27	22.93
IOW, Sample Location-2	33.02	27.53	27.24
IOW, Sample Location-3	40.24	34.00	15.20
IOW, Sample Location-4	50.80	21.42	20.18
IOW, Sample Location-5	50.13	25.32	15.38
IOW, Sample Location-9	41.70	16.40	29.45

3.0 Mixing of Additives with IOW samples, Brick Making and Quality Assessment

3.1 Mixing of Additives (Cement & Fly ash) with different IOW samples

All the collected iron ore waste samples were in the form of powder (less than 300 µ). Hence, it did not require further processing like crushing and grinding and were directly suitable for mixing with additives for brick making. For preparing the bricks, iron ore waste was taken as a major aggregate in combination with fly ash and cement. Five different combinations of above said aggregates i.e. cement, fly ash and iron ore waste by mass percentage as given in Table 5 were used in brick preparation. In the composition of mixture for brick making, the bricks were prepared with IOW of 65, 70, 75, 80, 85 and 90 percentages. The different mixtures prepared with IOW of 65 % were named as A to F (Table 5). Similarly, the mixtures prepared with IOW of 70% were named as A1 to E1; IOW of 75% as A2 to D2; IOW of 80% as A3 to C3; IOW of 85% as A4 to B4 and IOW of 90% as A5 (Table 5).

Table 5: *Composition for different types of mixture*

With 65 % IOW			
Mixture	Cement (C) %	Fly-ash (FA) %	Iron Ore Waste (IOW) %
A	30	05	65
B	25	10	65
C	20	15	65
D	15	20	65
E	10	25	65
With 70 % IOW			
A1	30	00	70
B1	25	05	70
C1	20	10	70
D1	15	15	70
E1	10	20	70
With 75 % IOW			
A2	25	00	75
B2	20	05	75
C2	15	10	75
D2	10	15	75
With 80 % IOW			
A3	20	00	80
B3	15	05	80
C3	10	10	80
With 85 % IOW			
A4	15	00	85
B4	10	05	85
With 90 % IOW			
A5	10	00	90

3.2 Brick Making

All the IOW bricks were prepared and cured as described by Shreekant et al. (2016) [2].

3.3 Assessment of Quality of Prepared IOW Bricks

The quality of bricks was assessed as per BIS Standards which is based on compressive strength (IS 3495 (Part I): 1992) [4] and water absorption (IS 3495 (Part II): 1992) [5] as described by Shreekant et al. (2016) [2].

4.0 Computation of Total Percentage of Al_2O_3, SiO_2 and Fe_2O_3 in a Brick

The total percentages of Al_2O_3, SiO_2 and Fe_2O_3 in a brick were observed through the output of a Java program which was executed in NetBeans 8.1 IDE for all the mix ratios.

This was done to avoid tedious and time consuming calculations over a calculator. The flow chart for developed program is shown in Figure 2. The computational program output in the form of screen shot is shown in Figure 3. The inputs to the developed program were Mass of a brick; Percentages of cement fly ash and IOW; Percentages of Al_2O_3, SiO_2 and Fe_2O_3 in cement, fly ash and different IOW samples. The output of the developed program was total percentage of Al_2O_3, SiO_2 and Fe_2O_3 in a particular brick.

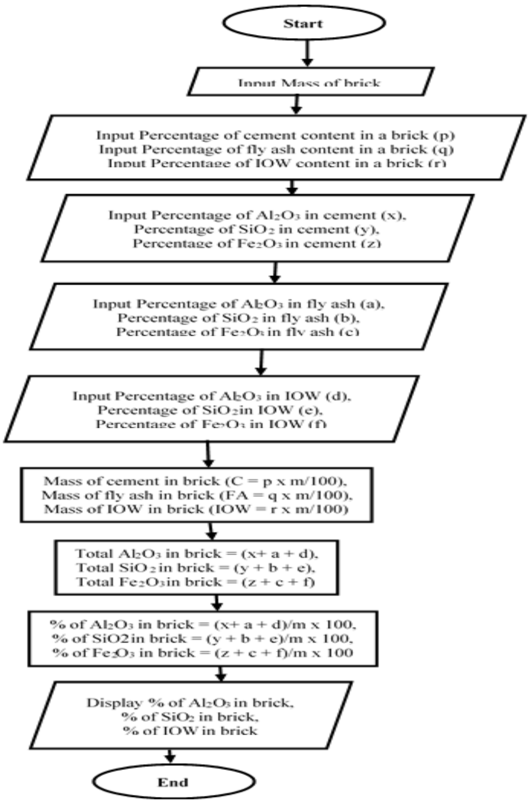

Figure 2. *Flow chart of computer program to find the total percentage of Al_2O_3, SiO_2 and Fe_2O_3 present in brick*

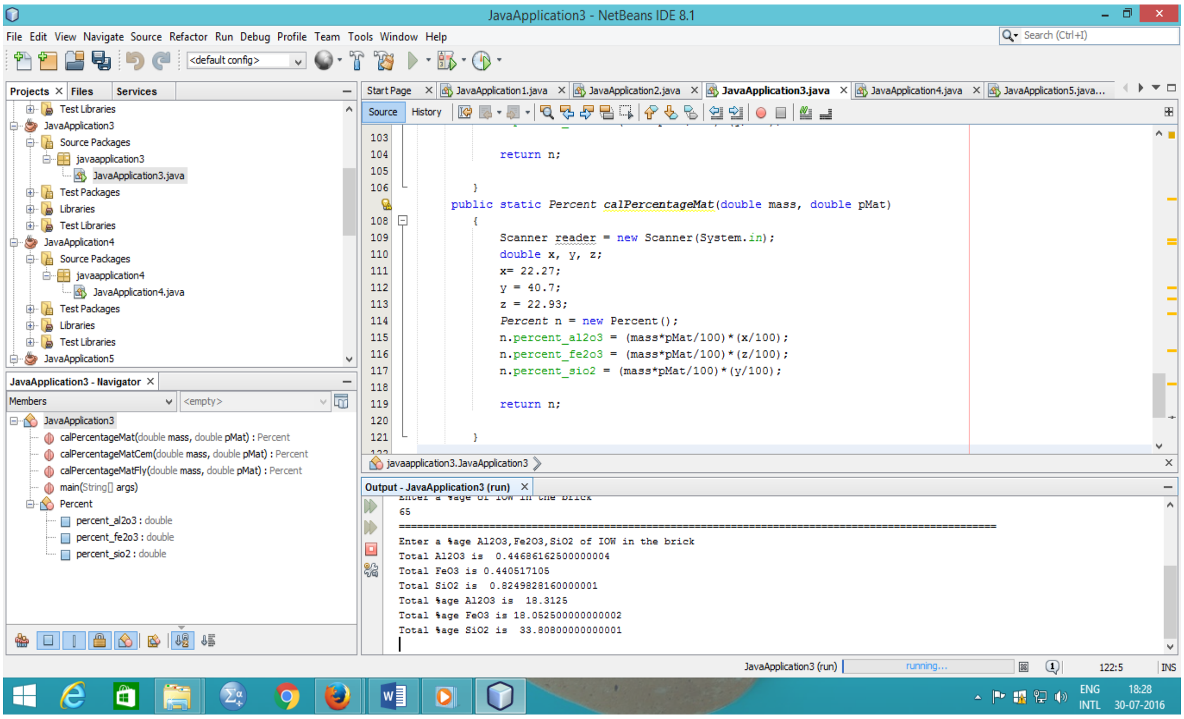

Figure 3. *Program output screen shot to find the total percentage of Al_2O_3, SiO_2 and Fe_2O_3 present in a brick*

5.0 Results and Analysis

The results of the percentage of Al_2O_3, SiO_2 and Fe_2O_3 in bricks prepared from all the six locations are given in Table 6 to Table 11.

Table 6: *Percentage of Al_2O_3, SiO_2 and of Fe_2O_3 in bricks (Sample location-1)*

Sample location No.	Mix ratio (C:FA:IOW)	Avg. Mass of brick (kg)	Total % of Al_2O_3 in a brick	Total % of SiO_2 in a brick	Total % of Fe_2O_3 in a brick	Compressive strength of a brick for 28 days of curing (MPa)
1	**30:05:65**	2.4402	18.31	33.81	18.05	11.69
	25:10:65	2.4368	18.50	34.61	18.94	11.20
	20:15:65	2.4360	18.68	35.42	19.82	10.81
	15:20:65	2.4355	18.86	36.22	20.70	10.55
	10:25:65	2.4340	19.04	37.03	21.59	4.46
	30:00:70	2.4450	18.72	34.1	17.99	11.59
	25:05:70	2.4410	18.90	34.91	18.88	8.69
	20:10:70	2.4385	19.09	35.71	19.76	6.94
	15:15:70	2.4365	19.27	36.52	20.64	4.47
	10:20:70	2.4355	19.45	37.32	21.53	3.84
	25:00:75	2.4475	19.31	35.20	18.82	11.94
	20:05:75	2.4445	19.50	36.01	19.70	9.47
	15:10:75	2.4425	19.68	36.81	20.58	8.38
	10:15:75	2.4395	19.86	37.62	21.47	4.45
	20:00:80	2.4480	19.90	36.30	19.64	5.79
	15:05:80	2.4472	20.09	37.11	20.52	5.49
	10:10:80	2.4455	20.27	37.91	21.41	3.65
	15:00:85	2.4475	20.50	37.40	20.46	5.32
	10:05:85	2.4458	19.57	36.17	20.20	3.53
	10:00:90	2.4482	21.09	38.50	21.28	3.63

Table 7: *Percentage of Al_2O_3, SiO_2 and of Fe_2O_3 in bricks (Sample location-2)*

Sample location No.	Mix ratio (C:FA:IOW)	Avg. Mass of brick (kg)	Total % of Al_2O_3 in a brick	Total % of SiO_2 in a brick	Total % of Fe_2O_3 in a brick	Compressive strength of a brick for 28 days of curing (MPa)
2	**30:05:65**	2.4490	21.73	28.82	20.85	11.05
	25:10:65	2.4455	21.91	29.62	21.74	9.35
	20:15:65	2.4435	22.10	30.43	22.62	8.84
	15:20:65	2.4398	22.28	31.23	23.50	8.22
	10:25:65	2.4366	22.46	32.03	24.39	5.40
	30:00:70	2.4462	22.40	28.73	21.01	12.31
	25:05:70	2.4424	22.59	29.53	21.89	11.02
	20:10:70	2.4401	22.77	30.34	22.78	10.45
	15:15:70	2.4387	22.95	31.14	23.66	7.94
	10:20:70	2.4365	23.14	31.95	24.54	6.70
	25:00:75	2.4470	23.26	29.44	22.05	10.06
	20:05:75	2.4459	23.44	30.25	22.93	9.36
	15:10:75	2.4445	23.62	31.05	23.81	7.92
	10:15:75	2.4405	23.81	31.86	24.70	6.70
	20:00:80	2.4490	24.11	30.16	23.09	8.96
	15:05:80	2.4481	24.30	30.96	23.97	8.08
	10:10:80	2.4469	24.48	31.77	24.85	5.37
	15:00:85	2.4495	24.97	30.87	24.97	6.55
	10:05:85	2.4478	23.77	30.03	23.77	5.46
	10:00:90	2.4502	25.82	31.59	25.16	4.15

Table 8: *Percentage of Al_2O_3, SiO_2 and of Fe_2O_3 in bricks (Sample location-3)*

Sample location No.	Mix ratio (C:FA:IOW)	Avg. Mass of brick (kg)	Total % of Al_2O_3 in a brick	Total % of SiO_2 in a brick	Total % of Fe_2O_3 in a brick	Compressive strength of a brick for 28 days of curing (MPa)
3	**30:05:65**	2.4462	25.94	33.51	13.03	16.49
	25:10:65	2.4449	26.12	34.31	13.91	15.52
	20:15:65	2.4428	26.30	35.12	14.80	11.12
	15:20:65	2.4311	26.49	35.92	15.68	7.59
	10:25:65	2.4302	26.67	36.73	16.56	4.92
	30:00:70	2.4475	26.93	33.78	12.58	14.41
	25:05:70	2.4457	27.12	34.59	13.46	12.59
	20:10:70	2.4436	27.30	35.39	14.35	11.40
	15:15:70	2.4321	27.48	36.19	15.23	10.75
	10:20:70	2.4300	27.66	37.00	16.12	4.94
	25:00:75	2.4482	28.11	34.86	13.02	9.29
	20:05:75	2.4468	28.29	35.66	13.90	8.40
	15:10:75	2.4449	28.48	36.47	14.78	6.43
	10:15:75	2.4429	28.66	37.27	15.67	6.13
	20:00:80	2.4497	29.29	35.93	13.45	7.75
	15:05:80	2.4491	29.47	36.74	14.34	6.88
	10:10:80	2.4477	29.65	37.54	15.22	5.18
	15:00:85	2.4506	30.47	37.01	13.89	5.87
	10:05:85	2.4497	28.95	35.80	14.01	5.06
	10:00:90	2.4517	31.64	38.09	14.33	4.16

Table 9: *Percentage of Al_2O_3, SiO_2 and of Fe_2O_3 in bricks (Sample location-4)*

Sample location No.	Mix ratio (C:FA:IOW)	Avg. Mass of brick (kg)	Total % of Al_2O_3 in a brick	Total % of SiO_2 in a brick	Total % of Fe_2O_3 in a brick	Compressive strength of a brick for 28 days of curing (MPa)
4	**30:05:65**	2.4435	17.76	40.37	16.27	17.09
	25:10:65	2.4420	17.94	41.18	17.15	10.55
	20:15:65	2.4408	18.13	41.98	18.03	10.02
	15:20:65	2.4378	18.31	42.79	18.92	8.81
	10:25:65	2.4345	18.49	43.59	19.80	5.18
	30:00:70	2.4469	18.13	41.17	16.07	18.69
	25:05:70	2.4455	18.31	41.98	16.95	16.59
	20:10:70	2.4429	18.49	42.78	17.83	15.75
	15:15:70	2.4400	18.68	43.59	18.72	12.38
	10:20:70	2.4360	18.86	44.39	19.60	8.86
	25:00:75	2.4479	18.68	42.78	16.75	12.34
	20:05:75	2.4463	18.86	43.58	17.64	9.86
	15:10:75	2.4435	19.04	44.39	18.52	8.07
	10:15:75	2.4405	19.22	45.19	19.40	11.93
	20:00:80	2.4490	19.22	44.38	17.44	11.92
	15:05:80	2.4482	19.41	45.19	18.33	8.65
	10:10:80	2.4445	19.59	45.99	19.23	6.14
	15:00:85	2.4500	19.77	45.99	18.12	7.70
	10:05:85	2.4491	18.89	44.25	18.00	5.17
	10:00:90	2.4510	20.32	47.59	18.81	5.79

Table 10: *Percentage of Al_2O_3, SiO_2 and of Fe_2O_3 in bricks (Sample location-5)*

Sample location No.	Mix ratio (C:FA:IOW)	Avg. Mass of brick (kg)	Total % of Al_2O_3 in a brick	Total % of SiO_2 in a brick	Total % of Fe_2O_3 in a brick	Compressive strength of a brick for 28 days of curing (MPa)
5	**30:05:65**	2.4469	20.30	39.94	13.15	9.28
	25:10:65	2.4449	20.48	40.74	14.03	8.25
	20:15:65	2.4406	20.66	41.55	14.91	6.56
	15:20:65	2.4370	20.84	42.35	15.80	5.45
	10:25:65	2.4330	21.03	43.16	16.68	4.37
	30:00:70	2.4477	20.86	40.70	12.71	10.14
	25:05:70	2.4469	21.04	41.51	13.59	8.16
	20:10:70	2.4448	21.22	42.31	14.47	7.47
	15:15:70	2.4395	21.41	43.12	15.36	6.35
	10:20:70	2.4355	21.59	43.92	16.24	6.06
	25:00:75	2.4474	21.60	42.28	13.15	8.91
	20:05:75	2.4454	21.78	43.08	14.04	6.96
	15:10:75	2.4439	21.97	43.88	14.92	6.03
	10:15:75	2.4411	22.15	44.69	15.80	5.34
	20:00:80	2.4497	22.34	43.85	13.60	8.75
	15:05:80	2.4475	22.53	44.65	14.48	7.16
	10:10:80	2.4410	22.71	45.46	15.37	4.64
	15:00:85	2.4511	23.09	45.42	14.04	6.33
	10:05:85	2.4487	22.01	43.72	14.16	5.72
	10:00:90	2.4519	23.83	46.99	14.49	4.30

5.1 Impact of Percentage of SiO_2 Present in a Brick with its Compressive Strength:

As the aim of this investigation was to find out the impact of major chemical constituents in a prepared IOW brick on its compressive strength, hence using Table 6 to Table 11, critical study was carried out to see the variation of a particular chemical constituent with compressive strength keeping the other two chemical constituents constant. For instance, Table 12 was arrived at by careful study of Table 6 and Table 9. It was found that for constant value of $Al_2O_3 \approx 19$ % and $Fe_2O_3 \approx 19$ %, there is variation in SiO_2 with compressive strength. A plot of total percentage of SiO_2 vs. compressive strength data of Table 12 is shown in Figure 4. From Figure 4 it is observed that there is no particular relationship i.e., either increase or decrease of compressive strength with the total percentages of SiO_2 present in a brick.

Table 11: *Percentage of Al_2O_3, SiO_2 and of Fe_2O_3 in bricks (Sample location-9)*

Sample location No.	Mix ratio (C:FA:IOW)	Avg. Mass of brick (kg)	Total % of Al_2O_3 in a brick	Total % of SiO_2 in a brick	Total % of Fe_2O_3 in a brick	Compressive strength of a brick for 28 days of curing (MPa)
6	**30:05:65**	2.4448	14.50	34.46	22.29	17.61
	25:10:65	2.4432	14.68	35.26	23.17	15.98
	20:15:65	2.4395	14.86	36.07	24.06	14.47
	15:20:65	2.4350	15.05	36.87	24.94	11.87
	10:25:65	2.4317	15.23	37.68	25.82	5.56
	30:00:70	2.4470	14.61	34.80	22.56	15.40
	25:05:70	2.4445	14.80	35.61	23.44	12.40
	20:10:70	2.4412	14.98	36.41	24.32	11.81
	15:15:70	2.4380	15.16	37.22	25.21	10.01
	10:20:70	2.4345	15.34	38.02	26.09	5.66
	25:00:75	2.4479	14.91	35.95	23.71	14.34
	20:05:75	2.4445	15.09	36.76	24.59	13.50
	15:10:75	2.4424	15.28	37.56	25.47	13.04
	10:15:75	2.4384	15.46	38.37	26.36	7.42
	20:00:80	2.4482	15.21	37.10	24.85	11.34
	15:05:80	2.4466	15.39	37.91	25.74	10.39
	10:10:80	2.4439	15.57	38.71	26.62	4.97
	15:00:85	2.4490	15.51	38.25	26.00	7.88
	10:05:85	2.4455	14.87	36.97	25.41	5.72
	10:00:90	2.4525	15.80	39.40	27.15	5.71

Table 12: *Variation of SiO_2 with compressive strength ($Al_2O_3 \approx 19$ % $Fe_2O_3 \approx 19$ %)*

Total percentage of SiO_2	Compressive strength (MPa)
34.61	11.20
34.91	8.69
35.20	11.94
43.59	5.18
43.59	12.38
44.39	8.86
44.39	8.07
45.19	11.93
45.19	6.14

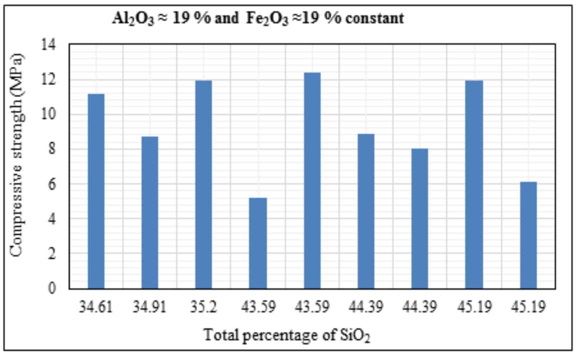

Figure 4. *Total percentage of SiO_2 vs. compressive strength*

5.2 Impact of Percentage of Al_2O_3 Present in a Brick with its Compressive Strength

To find out the impact of percentage of Al_2O_3 on compressive strength of bricks, Table 11 was considered. It was found that for constant value of $SiO_2 \approx 38$ % and $Fe_2O_3 \approx 26$ %, there is variation in Al_2O_3 with compressive strength. A plot of total percentage of Al_2O_3 vs. compressive strength data is shown in Figure 5. From Figure 5, it is again observed that there is no particular relationship i.e., either increase or decrease of compressive strength with the total percentages of Al_2O_3 present in a brick.

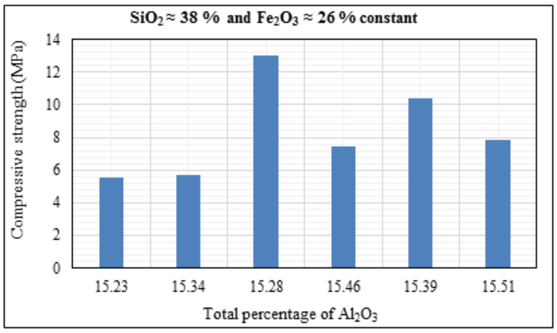

Figure 5. *Total percentage of Al_2O_3 vs. compressive strength*

5.3 Impact of Percentage of Fe_2O_3 Present in a Brick with its Compressive Strength

To find out the impact of percentage of Fe_2O_3 on compressive strength of bricks, Table 7, Table 9, Table 10 and Table 11 were considered. Systematic study of Table 7 ($Al_2O_3 \approx 24$ % and $SiO_2 \approx 30$ %; Fe_2O_3 varying with compressive strength); Table 9 ($Al_2O_3 \approx 19$ % and $SiO_2 \approx 44$ %; Fe_2O_3 varying with compressive strength); Table 10 ($Al_2O_3 \approx 22$ % and $SiO_2 \approx 44$ %; Fe_2O_3 varying with compressive strength); and Table 11 ($Al_2O_3 \approx 15$ % and $SiO_2 \approx 37$ %; Fe_2O_3 varying with compressive strength) was carried out. A plot of total percentage of Fe_2O_3 vs. compressive strength data for Table 7, Table 9, Table 10 and Table 11 are shown in Figure 6, Figure 7, Figure 8 and Figure 9 respectively.

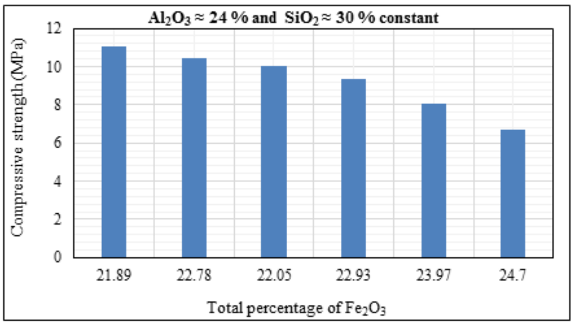

Figure 6. *Total percentage of Fe_2O_3 vs. compressive strength*

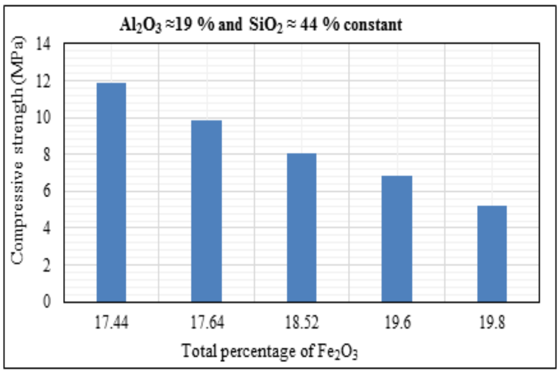

Figure 7. *Total percentage of Fe_2O_3 vs. compressive strength*

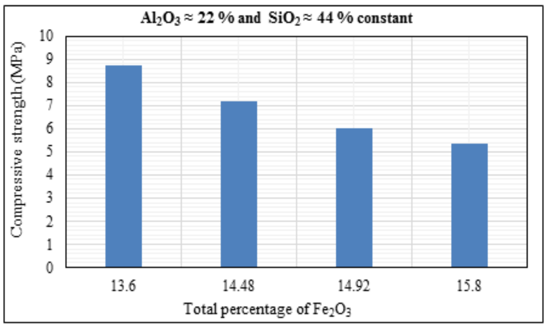

Figure 8. *Total percentage of Fe_2O_3 vs. compressive strength*

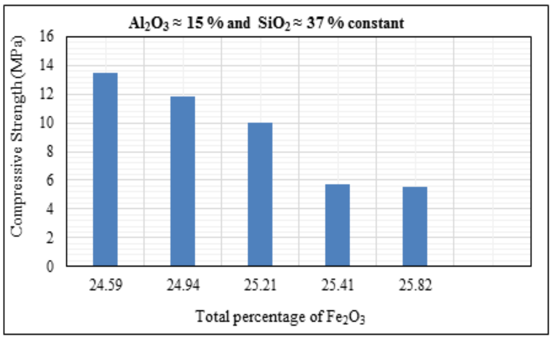

Figure 9. *Total percentage of Fe_2O_3 vs. compressive strength*

From Figure 6 to Figure 9, it is clearly observed that with increase in total percentage of Fe_2O_3 in a brick, its compressive strength decreases gradually. Hence, it is concluded that percentage of Fe_2O_3 present in a brick certainly has a negative impact on its compressive strength.

6. Conclusions

Through this investigation, an attempt was made to investigate the impact of major chemical composition of prepared IOW bricks on its compressive strength. The chemical compositions like total percentage of Al_2O_3, SiO_2 and Fe_2O_3 present in a brick were observed through the output of Java program for all the mix ratios. Based on the available data, results of investigation on the impact of chemical composition of bricks on its compressive strength revealed no appropriate relationship with total percentages of SiO_2 and Al_2O_3 present in a brick. However, with increase in total percentage of Fe_2O_3 present in a brick, its compressive strength was found to decrease gradually. Hence, it is suggested to prepare non fired compressed bricks from iron ore waste fines containing low percentage of Fe_2O_3, which is also desirable from the point of view of mineral conservation.

The authors are of the opinion that detailed investigation can be taken up in future to study exclusively the influence of different types of chemical constituents which are present in IOW brick and correlate it with compressive strength and water absorption by carrying out regression analysis and arrive at some useful conclusion.

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