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MESSAGE FROM THE CHAIRMAN



Dear Colleagues,

Historically the manufacturing sector all over the world has been the turf of men and men only of which our refractory industry is no such exception. From time to time ILO shares data on women employed in manufacturing sector and trend suggests participation of women is increasing.

Yet there remains substantial gap or unwritten barriers when it comes to getting more women in the job of manufacturing. Access to higher skilled, better paid manufacturing jobs would allow women to share more equally the benefits of economic advancements and raise their status both at personal as well as corporate level. In this backdrop I was pleasantly surprised to discover at the recently concluded Annual General Meeting of IRMA that all the student awards have been bagged by the girls. The paradigms of the industry is changing and

evidently for the better.

The Indian refractory fraternity always looks forward for the next IREFCON as soon as one finishes and I am happy to inform you that the 15th India International Refractories Congress will be held in the beautiful coastal state of Goa from 13th-15th November 2024. The theme of the Congress is “Powering a greener future together”, a theme which is very pertinent as the world moves towards a carbon neutral economy. The spadework for the event has already started and I am pretty confident that with your bountiful support, IREFCON24 is going to be a resounding success.

Ish Mohan Garg
Chairman



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Non Ferrous



Power Generation



Sponge Iron

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ASSOCIATION ACTIVITIES

IRMA Annual General Meeting

The 10th IRMA Annual General Meeting was held on 16th September 2023 at Kolkata under the chairmanship of Mr Ish Mohan Garg. A good number of persons from the member companies joined the AGM which was held in physical mode. All the normal business transactions were carried out as per the existing legal norms.

IRMA Award to past Chairman

As per usual practice Mr Parmod Sagar, the immediate past Chairman of IRMA was felicitated at the IRMA Annual General Meeting for his contribution towards the cause of the Association as well as the industry during his stint as Chairman.

IRMA Lifetime Excellence Award

This year, Mr Ghanshyambhai Dholaria has been awarded IRMA Excellence Award for his immense contribution towards promotion of refractories industry in the SME sector. The award was handed over to him during the IRMA Annual General Meeting.

IRMA Board of Directors Meeting

IRMA Board of Directors meeting was held on 22nd April 2023 on Zoom platform. The issues discussed were plans for IREFCON24, review of market conditions etc.

IRMA N Sahoo memorial Award

The existing IRMA award for the students of Ceramic Technology has been renamed in memory late Dr N. Sahoo, the celebrated refractory technologist. This year, the winners were:

1. Ms. Debarati Dutta, Govt. College Of Engineering & Ceramic Technology, Kolkata for "Role of Additives on Densification Characteristics of Zinc-

Aluminate Refractory Aggregates".

2. Ms. S. Janani, Alagappa College of Technology, Anna University, Chennai for "Reduction of Blowholes in Pre-Cast Pre-Fired Blocks".
3. Ms. Nandhini T, Alagappa College of Technology, Anna University, Chennai for "Study On Development Of Sintered Zircon Mullite Grog & Evaluation Of Its Properties".

IRMA M R Hariharan Memorial Award

IRMA has prepared a White Paper on proper usage of refractories in secondary steel sector as per the suggestion of Ministry of Steel. The paper contains theoretical framework for selection of refractories as well as practical outline of the solutions to the possible problems faced by the steel makers in secondary sector.

This year the Award was won by Ms Parnashi Biswas, Govt. College Of Engineering & Ceramic Technology, Kolkata for being the overall topper of the Ceramic Engineering Stream by Chairman.

IREFCON 2024

The 15th India International Refractories Congress (IREFCON 2024) will be held from 13th to 15th November, 2024 at Taj Resort and Convention Centre, Goa. The theme of the Congress will be the "Powering a greener future together. The chairman of the Organizing Committee is Mr. Sunanda Sengupta (TRL Krosaki Refractories Ltd) and the co-chairman is Mr. G. Manari (Totale Global Pvt. Ltd.). The Chairman of the Technical committee is Dr. Arup Kumar Samanta (TRL Krosaki Refractories Ltd).

IN THE NEWS

India's Crude Steel Production

India's crude steel production rose 14.7 per cent to 69.65 million tonne (MT) during April-September period of 2023-24 fiscal year, according to SteelMint India. The steel output in the year-ago period was 61.06 MT, the market research firm said. The increase in production was mainly on account of improved capacity utilisation rates coupled with the ramping up of capacities by key Indian steel players. As per mining major BHP, production of steel in India could go up to 500 million tonnes by 2050, nearly four times the current output.

JSPL

As per its Managing Director Mr Bimlendra Jha, Jindal Steel and Power (JSPL) is planning to make its Angul unit India's largest single-location steel manufacturing facility. Currently, the capacity of the Odisha plant is being ramped up to 11.6 million tonnes per annum (MTPA) from the existing 5.6 MTPA.

NMDC Steel Plant

NMDC's Nagarnar steel plant (NSP) in Chhattisgarh's Bastar district has commenced production. The 3 million tonne per annum capacity steel plant has been built at a cost of approximately Rs 24,000 crore over an area of 1,980 acres in Nagarnar village, more than 300 km away from capital Raipur.

AMNS India

Arcelor Mittal Nippon Steel India (AM/NS India) is looking to expand to 40 million tonnes of capacity by 2035 from 9 million tonnes at present. At present the company is doubling its capacity to 15 million tonnes and then to 22. In the next

phase it will have greenfield expansion in Odisha.

Infra push to drive cement demand

Continuing the robust ride of the past two fiscals, cement demand is likely to grow 10-12 per cent year-on-year to 440 million tonne in fiscal 2024, driven by strong offtake from the infrastructure segment, Crisil Ratings said in a note. Cement demand grew by 12 per cent in fiscal 2023 and by 8 per cent in fiscal 2022.

Birla Corporation

MP Birla Group flagship company Birla Corporation has drawn up a strategy to augment its cement production capacity to 25 million tonnes by the 2025-26 fiscal from the existing 20 million tonnes.

Ultratech Cement

UltraTech Cement is targeting a production capacity of 200 million tonnes per annum (MTPA) as it looks to become one of the largest cement companies in the world, as per its Chairman Kumar Mangalam Birla. The company has already commenced work on the next growth phase of adding 22.6 MTPA additional capacity and after its completion, UltraTech will have over 160 MTPA cement production capacity.

Grindwell Norton

The Board of Directors of Grindwell Norton Limited at its meeting held on October 19, 2023, have considered and approved the sale of 49% of equity stake held in SG Shinagawa Refractories India Private Limited, subject to completion of closing condition for a consideration of INR 80 million.

OVERSEAS NEWS

Calderys China

Calderys China and LZRefractories have signed a strategic partnership to provide high quality and energy efficient refractory bricks to

customers in China. Through this agreement, Calderys China is expanding its solution portfolio and capabilities in order to address the growing market of green energy related value chain.

RHI Magnesita

RHI Magnesita has completed the acquisition of the Germany, Czech Republic and Slovenia based refractory businesses of the Preiss-Daimler Group (“P-D Refractories”). P-D Refractories is a producer of high quality alumina-based refractories for industrial applications in process industries, with a leading market position in the glass and aluminium sectors. In 2022, P-D Refractories has recorded revenues of €171 million.

Nabaltec AG

Nabaltec AG's half-year report 2023 shows consolidated revenues went down to EUR 106.1 million, compared to EUR 110.7 million in the same period of the previous year (-4.2%). In terms of consolidated operating profit (EBIT), EUR 8.5 million were generated in the first half of 2023, compared with EUR 15.7 million in the same period of the previous year (-45.9%). The

EBIT margin (EBIT as a percentage of total performance) was thus 8.1% in the first six months of 2023, compared with 14.0% in the corresponding prior-year period.

China's output of BFA & WFA

Statistics from CMTBA Abrasive Product Makers' Sub Association show that in H1 2023, China's brown fused alumina output was about 440,000 tons and white fused alumina output was about 320,000 tons.

Japan refractories output

According to the Japan Refractories Association, in 2022, the output of Japan's refractories was 828,100 tons, a decrease of 13.38% compared with 2021. Among them, the output of monolithic refractories was 578,200 tons, and the output of shaped refractories was 249,900 tons.

MEMBERSCAN

TRL Krosaki Refractories

TRL Krosaki Refractories Limited received the coveted “CAPEXIL - Top Export Award for 2017-18 and 2019-20” and “CAPEXIL - Special Export Award for 2018-19, 2020-21 and 2021-22” by Ministry of Commerce and Industries, Government of India.

RHI Magnesita India

RHI Magnesita has operationalised its Global Shared Service centre (GSS) in India. The centre, set up at Gurugram, is the 5th global shared service centre of the company, with the other four located in China, Europe, North and South America. The Q1 FY 2023-24 revenue of the company stood at Rs.928 crore as compared to Rs.602 crore during the Q1 FY 2022-23. Adjusted EBITDA stood at Rs.142.5 crore during the period as against Rs.119.9 crore during Q1 FY 2022-23, registering a 19% growth.

Vesuvius India

Vesuvius India Limited (VIL) has reported a net profit of INR 522.40 million (\$6.38 million) in the first quarter (April-June) of the fiscal year 2023-24, up 77.51 percent year on year. The company reported a total income of INR 4.13 billion (\$50.54 million) during the quarter, up 23.58 percent over the corresponding quarter of the previous fiscal year.

IFGL Refractories

The company has reported total income of Rs. 427.30 crores during the period ended June 30, 2023 as compared to Rs. 375.89 crores during the period ended March 31, 2023. The company has posted net profit of Rs. 29.61 crores for the period ended June 30, 2023 as against net profit of Rs. 29.42 crores for the period ended March 31, 2023.

ECONOMY AT A GLANCE

- The Union Ministry of Finance in its Monthly Economic Review for August 2023 is said to remain comfortable with a 6.5 percent real GDP growth estimate for FY24 with symmetric risks.
- As per Fitch Solutions, acceleration in India's real GDP growth to 7.8% y-o-y in Q2 2023 will be the peak for growth this fiscal year. A weak monsoon, tight credit conditions, and prolonged sluggishness in global demand will soon cause the economy to lose steam.
- Real GDP or GDP at Constant (2011-12) Prices in Q1 2023-24 is estimated to attain a level of A 40.37 lakh crore, as against 37.44 lakh crore in Q1 2022-23, showing a growth of 7.8 percent as compared to 13.1 percent in Q1 2022-23.
- Nominal GDP or GDP at Current Prices in Q1 2023-24 is estimated at 70.67 lakh crore, as against 65.42 lakh crore in Q1 2022-23, showing a growth of 8.0 percent as compared to 27.7 percent in Q1 2022-23.
- In terms of Index of Industrial Production, mining which had a growth of 9.1% in Q1 2022-23 have witnessed a growth of 6.4% in Q1 2023-24. For manufacturing, the figures are 12.8% and 4.7% respectively, for electricity the figures are 17.1% and 1.3% respectively while for metallic minerals the figures are -6.4% and 12.1% respectively.
- Gross domestic product (GDP) in the G20 area grew by 0.7% quarter-on-quarter in the second quarter of 2023 according to provisional estimates, down from 1.0% in the previous quarter. Despite the slower growth in the G20 area, GDP grew strongly in Turkey in Q2 2023 (by 3.5%, compared with a contraction of 0.1% in Q1), mainly reflecting an acceleration of private consumption (5.2% in Q2, compared with 3.0% in Q1). Growth also increased in France, Japan, Korea, South Africa and the United Kingdom. In Germany, there was zero GDP growth in Q2 2023 after two quarters of contraction. Compared with the first quarter, growth remained unchanged in Indonesia and Mexico (at 0.8% in both countries), in the United States (at 0.5%), and in Australia (at 0.4%).
- Moody has lowered India's 2024 growth forecast from 6.5 percent to 6.1 percent since the second quarter outperformance creates a high base in 2023. Though several economists have expressed concern over the overall impact of inflation and erratic weather on economic growth, India's manufacturing, services and export sectors have witnessed strong growth, in addition to robust tax collection.

PHOTO GALLERY:



10th IRMA AGM held on 16th Sept,2023 at ITC Sonar Bangla,Kolkata



Interactive Session on the topic "Future of Indian Refractory Industry & Role of IRMA"



IRMA Award for lifetime services to refractories given to Mr. Ghanshyam Dholaria of Noble Refractories.



IRMA Award to immediate past Chairman Mr Parmod Sagar.



Audience at 10th IRMA AGM



Students of Ceramic Technology receiving IRMA Award

BUSINESS SECTION:

EXCERPTS OF IRMA CHAIRMAN MR ISH MOHAN GARG'S SPEECH AT 10TH IRMA AGM

It is my proud privilege as Chairman of IRMA, to extend a warm welcome to you all at this 10th AGM of Indian Refractory Makers Association. IRMA started its journey in 1958 and became a non profit company in January 2023 for which this AGM is technically the 10th AGM of IRMA as a company. We all know due to the dark clouds of Corona virus that completely threw routine corporate life out of gear, the Association was forced to organize the AGM on a virtual mode for three consecutive years. Now the clouds have finally dissipated, the Sun is again shining brightly on the azure horizon, powering us to assemble here once again this fine day. While acknowledging that virtual world is now a reality, the fact of the matter remains there is no alternative to physical interactions.

I will take this occasion to make a quick review of the domestic refractory industry's performance during 2022-23. Indian refractory industry is now a Rs 15000 crore+ turnover industry if we consider all private and public sector units, SME clusters etc. This is indeed harbinger of good times for us as 'size does matter' especially when you need to attract the attention of the policy makers.

The import of refractories which stood at Rs. 3747 crores in 2021-23 went up to Rs 4812 crores in 2022-23. The main items imported were high alumina bricks and shapes, monolithic and basic bricks. As more and more domestic companies kick off basic bricks manufacturing, we expect the import figure to ebb in coming years.

The total export for the year was approximately Rs 3195 crores, a decent increase from Rs. 2778 crores in the previous year. Increase has been noted in high Alumina bricks & shapes, monolithics and flow control refractories.

Steel industry continues to have its bull run in the past few years. Crude steel production which was around 118 million tonnes in 2021-22

rose to around 126 million tonnes in 2022-23. We expect this growth gradient will continue keeping in mind the huge investment Government of India has lined up in infrastructure sector.

We were truly mesmerized by the overwhelming response that we received for IREFCON22. We bow our head with humility before the refractory fraternity for showering your unstinted love on us. Over the years, IREFCON has evolved as a platform about which Indian refractory industry can feel proud of. Today I am happy to inform you that IREFCON2024 will be organized from 13th-15th November 2024 at Goa. IREFCON24 Organizing Committee under the able chairmanship of Mr Sunanda Sengupta has already started the initial spadework and I am confident the conference will deliver an eclectic mix of ideas and thoughts that we have always witnessed in the past.

Refractory industry is an extremely heterogeneous and fragmented industry, and IRMA is the only common platform where we can meet and share our moments of happiness or periods of difficulty. We need to strengthen this body for our own needs. We request you to share your valued suggestions which will help us chart our path in a much more effective way.

Thank you very much.

TECHNICAL SECTION

ACHIEVING EXTENDED SELF-FLOW IN A LOW CEMENT CASTABLE BY USING SIOXX™-FLOW

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Abstract

Modern installation techniques like pumping or shotcreting are gaining popularity with refractory users and manufacturers. The (rheology) flow characteristic of the castables is important to obtain better placement properties and to improve the quality of refractory in the application. The retention of self-flow of a refractory monolithic is a key parameter to help us adapt modern installation practices. Selfflow in the castable mix is sometimes achieved through higher water addition, which results in the segregation of mix and inferior hot properties. Optimum particle size distribution and dispersant selection are the key factors that affect the rheology of the castable. This work focuses on development of bauxite-based low cement castable mix to achieve enough self-flow by using SioxX™ - Flow. The task involves a comparison of decay in self-flow based on SioxX™-Flow versus other commercial metaphosphate and polyethylene glycol-based additive. Aging analysis is also done for a complete understanding and benefit of using a well-designed self-flow refractory with SioxX™-Flow.

Keywords: Self-Flow Castable, Low Cement Castable, SioxX™-Flow, Flow decay.

1. Introduction

In the late 1990s, Low cement self-flowing castables joined the family of refractory monolithics. Due to the ease of application over vibration castable, self-flow castables gained demand in the market. A self-flow castable can be used in shotcreting installations, where refractory aggregates, binders & dispersing agents are premixed in a mixer with water and pumped through a nozzle. At the end of the nozzle, setting accelerator drop flowability of castable immediately after it exits from nozzle, in order to reduce rebound losses. But the mix must remain

plastic in nature for trowelling or levelling of the surface. Similarly, in pumping castables the wet mix is directly transported through piston pump at the application site. Hence, for good self-flowing castable, rheological properties are a key factor. Often, the loss in flow is compensated by more addition of water, which leads to grain segregation, prolonged setting time, higher porosity after firing and longer curing time to avoid explosion during preheating.

The rheology of castables is affected by particle size distribution, selection of dispersant and hardening time controller (i.e accelerator or retarder, water to matrix ratio, sequence of water addition, ambient temperature at the time of application and storage or ageing condition of castable). In this work, a low cement self-flow castable mix is designed using SioxX™-Flow to achieve optimum initial self-flow and working time for the application. The rheological properties with SioxX™-Flow are compared with commercially available other dispersants. The effect of ageing on the castable properties when stored at site was also studied.

2. Experimental Work

2.1 Castable mix design

Indian grade bauxite (90% Al₂O₃) is selected for coarse to midsize aggregate, fine matrix includes reactive, calcined alumina, bauxite fines and tabular alumina fines. Calcium alumina cement (70% Al₂O₃) selected as hydraulic binder, microsilica 971U (97% SiO₂, origin Norway) was used as silica fume.

Table 1 Composition of self-flow castable

Raw Material	Mix-A	Mix-B	Mix-C
Bauxite 3-5mm	10	10	10
Bauxite 1-3mm	28	28	28
Bauxite 0-1mm	15	15	15

Raw Material	Mix-A	Mix-B	Mix-C
Tabular Alumina 0.2-0.6mm	10	10	10
Bauxite 200 mesh	11	11	11
CT 800SG	8	8	8
CA14M	5	5	5
MS 971U	6	7	7
CL 370	6	6	6
Dispersant – SioxX™-Flow	1		
Dispersant –SHMP		0.2	
Dispersant –FS 20			0.075
Setting Retarder- Boric acid		0.05	0.1
	100.0	100.52	100.175

Here, three dispersants are selected to compare the rheology of the castable, Mix-A with SioxX™ -Flow, which is a microsilica-based dispersant for low cement and ultra- low cement system, Mix- B with lab grade sodium hexametaphosphate (SHMP) and Mix C with polyethylene glycol-based additive (Castament FS 20). Details of formulation is shown in table 1.

During the application of self-flow castable, flow decay is an important factor, as it has to flow over long distances inside a pipeline and face high shear rates and restricted volume. The wet mix must maintain fluidity without clogging the pipe, segregation of grains. The reason of fixing 6.5%water is discussed in 2.3

1.1 Experimental procedures

Mix preparation

To conduct comparative study of placement properties of three additives, trial batches of 6kg prepared. To measure to 60min and ageing analysis up to 1 months at frequency Day 0, 7, 14, 30 days. Investigation of ageing was performed using microsilica 971U. All the raw materials were mixed in a planetary mixer as per the composition and mixed with water 6.5% in two steps (80% addition of water to achieve mix wet-out & rest 20% to achieve self-flow). The total mixing time for castable is 5min. Dry mix & water temperature was maintained at 22±2°C during all trials.

Flow measurement and casting

To measure the flowability of castable i.e self-flow and vibration flow, flow cone (ASTM C230) used. Wet mix sample poured in flow cone, levelled it to surface, cone is removed and then due to gravity, the castable spread on the flat surface. After the spread of the castable up to 30s, diameter is measured using vernier calliper. Similarly, the vibration flow is measured after 15s of vibration using a vibration table. To measure the flow after 30min and 60min, the castable is poured into a zip lock bag and secured from evaporation. Hardening time is measured through ultra- sonic IP 8 tester, where the change in velocity of sound(m/s) plotted against time(min) and deviation in velocity curve determines it

To understand the impact of ageing, all 24 batches were packed in a 25kg HDPE bag with additional inner liner and stored in a warehouse, where no temperature and humidity conditioning facility is available, to replicate the site condition. Thrice a day the ambient temperature and the humidity of warehouse were measured using hygrometer and recorded.

1.2 Determination of optimum water demand and selection of dispersants

To determine the optimum water demand of the refractory mix, Mix A trials conducted with water addition of 8%, 7% and 6.5%. With 6.5% of water, desired wet-out time and self-flow of castable achieved as per table 2.

Table 2 Self-flow with different water addition

Mix-A	Targets	Water addition 8%	Water addition 7%	Water addition 6.5%
Wet-out time (s)	<90	37	60	70
Initial Self-Flow F0(%)	≥100	118	110	108

Further study was conducted at 6.5% of water addition to compare the self-flow up to 30 min with SHMP and FS 20, without any use of setting time controller which is shown in table 3.

Table 3 Comparison of self-flow with different additive

	Targets	Mix-A	Mix-B	Mix-C
Wet-out time (s)	<90	70	70	129
Initial Self- Flow_F0(%)	≥100	108	78	85
30min Self- Flow_F30(%)	≥ 80	86	61	34
Setting time (min)		140	100	95

As Mix-B and Mix-C could not achieve the desired flow without retarder, trials conducted with Citric acid, tri- sodium citrate and Boric acid, where with optimal dosage of boric acid (>99.5% H₃BO₃) offered better results.

1. Result and Discussion

1.1 Flowability

Rheological properties with SioxX™-Flow in Mix-A achieved without any addition of retarder whereas with SHMP in Mix-B and with FS-20 in Mix-C of Boric acid (BA) is added with dose of 0.05% and 0.1% respectively. Following are the initial results of flow comparison with microsilica 971U with different additives in table 5.

Table 5 Self-flow with different additives

	Targets	Mix-A (SioxX™-flow)	Mix-B (SHMP + BA)	Mix-C (FS-20 + BA)
Wet-out time (s)	<90	80	145	120
Initial Self- Flow_F0(%)	≥100	107	79	90
30min Self- Flow_F30(%)	≥ 80	97	65	88
60min Self- Flow_F60(%)	≥60	80	38	62
Setting time (min)	< 420	290	1000	450

1.1 Ageing Analysis

Investigation of the change in rheology of low cement castable is important due to the presence of HAC, microsilica, dispersants and set controller additives, which are more prone to interact with each other and alter the

castable behaviour. Fig 1 shows the plot of ambient temperature and relative humidity of the storage facility.

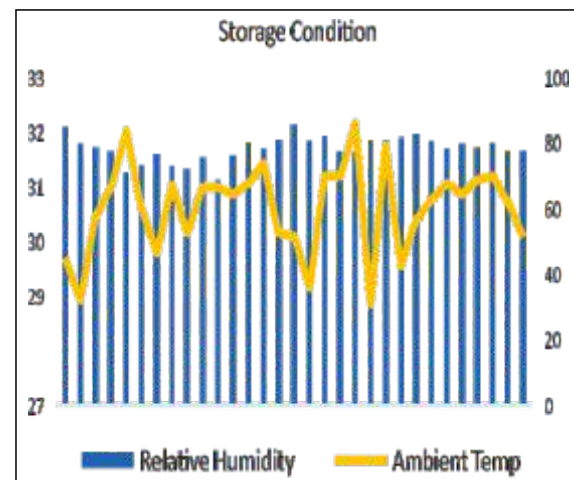


Fig. 1 Plot of avg. ambient temperature and relative humidity



Fig.2 Storage facility for ageing analysis

On the day of the trial, dry castables were mixed in a planetary mixer for 1 min, before adding water to break any agglomeration formed during storage. Impact of ageing of 30 days on wet-out time and flowability in all mixes are shown in Fig 3 to Fig 6.

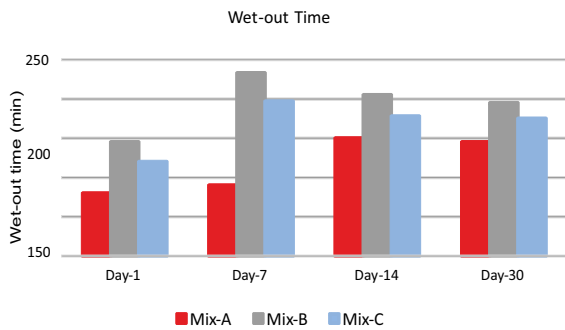


Fig. 3 Impact of ageing on wet-out time for all mixes

Wet-out time of mix with SiOX™-Flow is lower than with SHMP and FS-20. With increasing in storage days, delay in wet-out was observed in Mix-A predominantly (145s) on 30th day, whereas in Mix-B and C deviation was observed on 7th day itself.

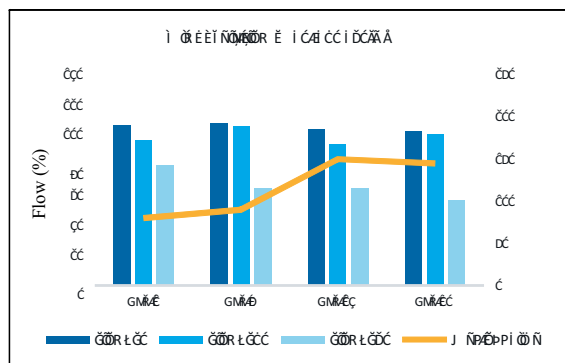


Fig. 4 Impact of ageing on wet-out and flow in Mix-A

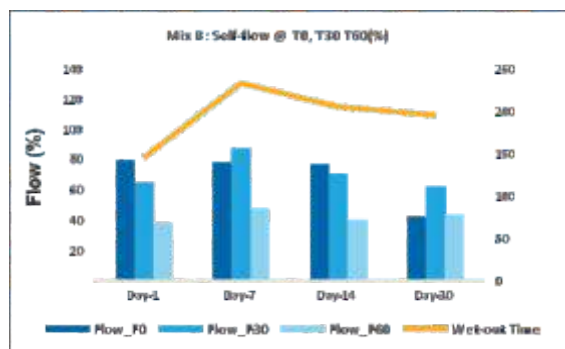


Fig. 5 Impact of ageing on wet-out and flow in Mix-B

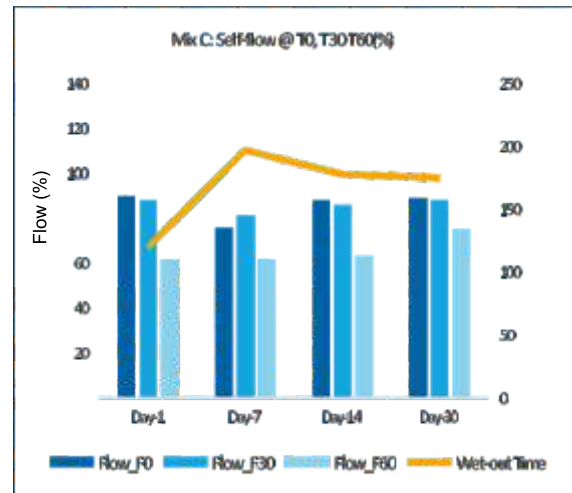


Fig. 6 Impact of ageing on wet-out and flow in Mix-C

Immediate flow after mixing (F0) in Mix-A is aligned with target ($\geq 100\%$), whereas Mix-B is 40% less and Mix-C is 10% than the target value. A reduction in initial flow in Mix-B is evident, whereas in the rest of the mix, drop in F0 is insignificant. Flow decay after 30min of mixing (F30) is approximately 10%. Flow decay after 60min of mixing (F60) was observed highest in mix-B (approx. 50% of initial flow), whereas in mix-A drop in workability is 40% from initial flow, whereas in mix-C it is 20%. During the application, the loss in plasticity helps in better sticking of the castable on surface.

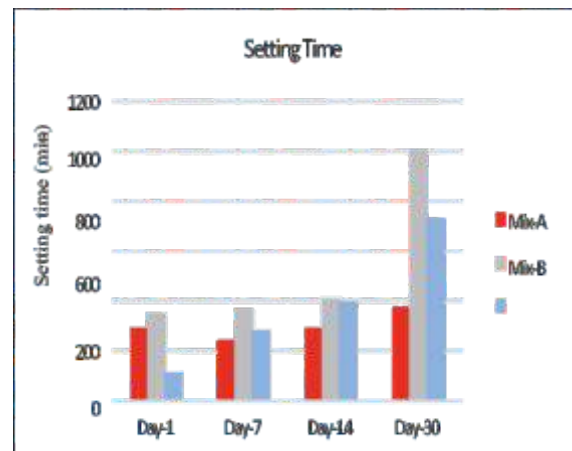


Fig. 7 Impact of ageing on wet-out and flow in Mixes

Optimum setting time helps quick installation and change over on site. Mix-A and Mix-C indicate the apt thickening time & setting time, which enable the mix to coagulate, but flow and stick onto the surface, providing high strength and low porosity. Mix-B indicates short thickening and long setting, which will not allow flow and proper sticking of the castable. Additionally, long setting hinders the panel removal or demoulding. After 30 days, Mix-B setting time is approximately 16hr, Mix-C 12hr and Mix-A 6hr, which indicated that with SioxX™-Flow, effect of ageing is not significant.

Following is the graph of velocity (m/s) vs time (min) for SioxX™-Flow generated through ultrasonic IP tester. Up to 150min, no change on velocity was observed which indicates that the castable can retain flow up to 2 hrs. Final peak 370min indicates the complete hardening of the castable.

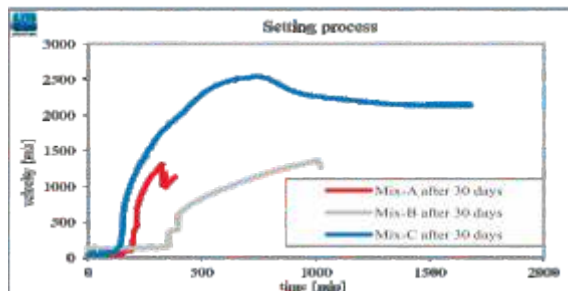


Fig. 8 Setting curve of SioxX™ Flow after 30days in Mix-A

4 Conclusions

The rheological behaviour of bauxite based low cement self-flow castable has been studied and conclusion are

- 1) Selection of admixture / dispersants is important to achieve suitable flow and working time for application of self-flow monolithics. SioxX™ - Flow with 1% dosage in a well-designed self-flow mix demonstrates superior initial flow and workability compared to other dispersants.
- 2) SioxX™-Flow can eliminate the small quantities of dispersants / retarders and reduces variability of refractory mix design

- 3) A mix of reactive alumina-silica fume-hydraulic binder-dispersant is more susceptible to ageing, which may increase wet-out time and setting as well to reduce working time. Mix with SioxX™ - Flow demonstrates superior and stable ageing behaviour as compared to other dispersants.
- 4) Further ageing study upto 180days (i.e 60 days,90 days and 180days is under progress) considering normalise 6 months of shelf life of monolithic castable.

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STATISTICS

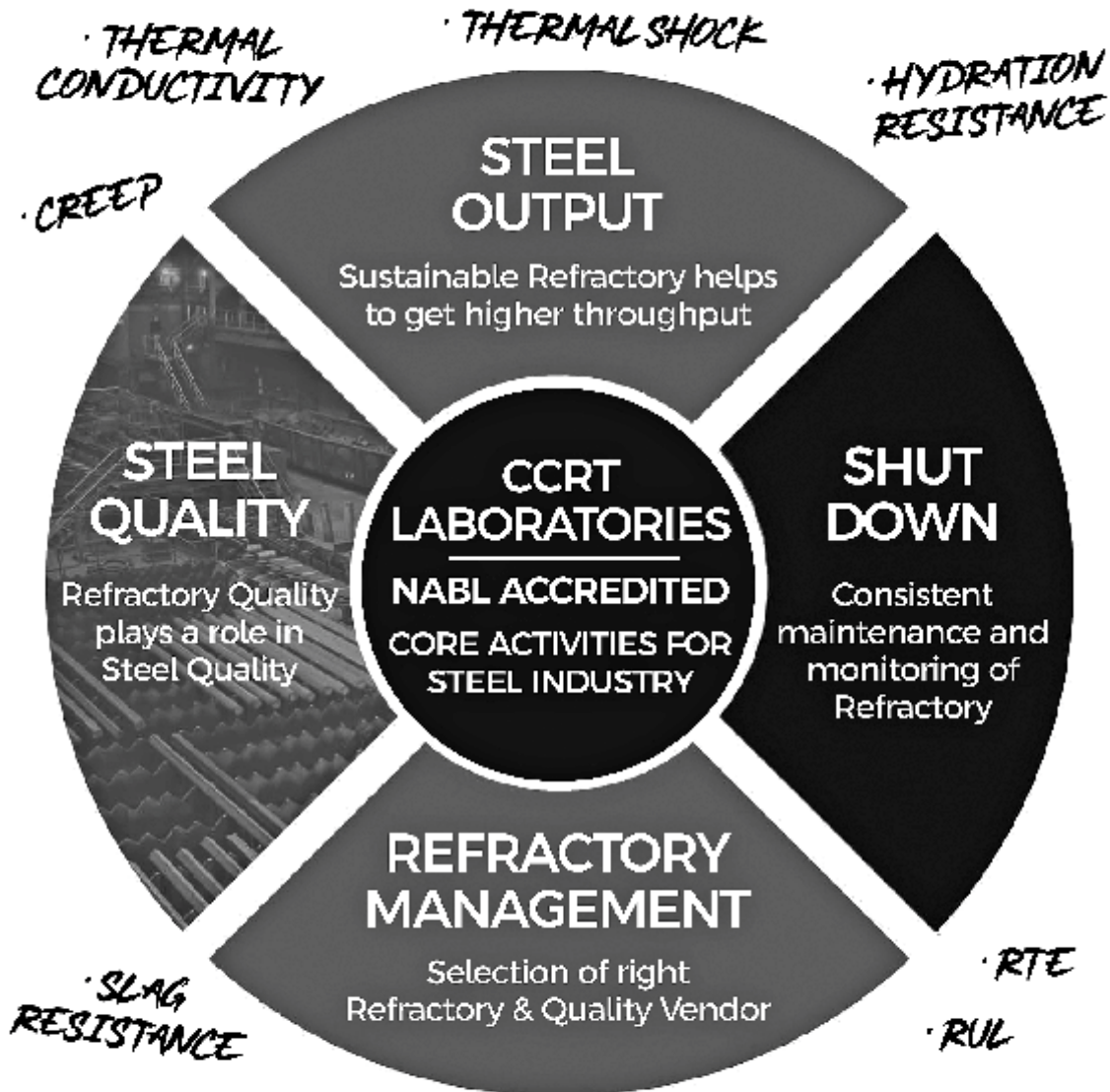
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S.No.	Country	Rs. Lacs	Country	Values in Rs. Lacs	Country	Quantity in thousands	Country	Quantity in thousands
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1	MADAGASCAR	3,212.17	MADAGASCAR	2,091.17	MADAGASCAR	6,011.00	MADAGASCAR	3,477.00
2	CHINA P RP	2,110.98	CHINA P RP	2,730.73	CHINA P RP	2,532.10	CHINA P RP	3,672.74
3	GERMANY	347.27	GERMANY	461.37	GERMANY	113.75	GERMANY	122.74
4	BRAZIL	171.65	MOZAMBIQUE	194.62	BRAZIL	252	TANZANIA REP	250
5	JAPAN	138.93	TANZANIA REP	159.95	JAPAN	36.94	MOZAMBIQUE	203.06
6	CANADA	58.54	JAPAN	123.77	CANADA	21.06	JAPAN	39.56
7	U S A	55.93	CANADA	42.79	U S A	25.92	CANADA	11.94
8	AUSTRIA	46.95	U S A	78.02	AUSTRIA	59.2	U S A	33.12
9	ITALY	31	AUSTRIA	22.32	ITALY	16.33	AUSTRIA	20
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