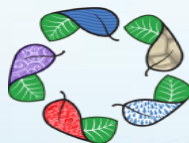


Presentation on

STEEL SLAG ROAD: A SUSTAINABLE GREEN INFRASTRUCTURE TRANSFORMING WASTE TO WEALTH

NATIONAL CONFERENCE ON
STEEL IN INFRASTRUCTURE 16th MARCH 2024



WASTE TO WEALTH
Swachh Bharat Unnat Bharat

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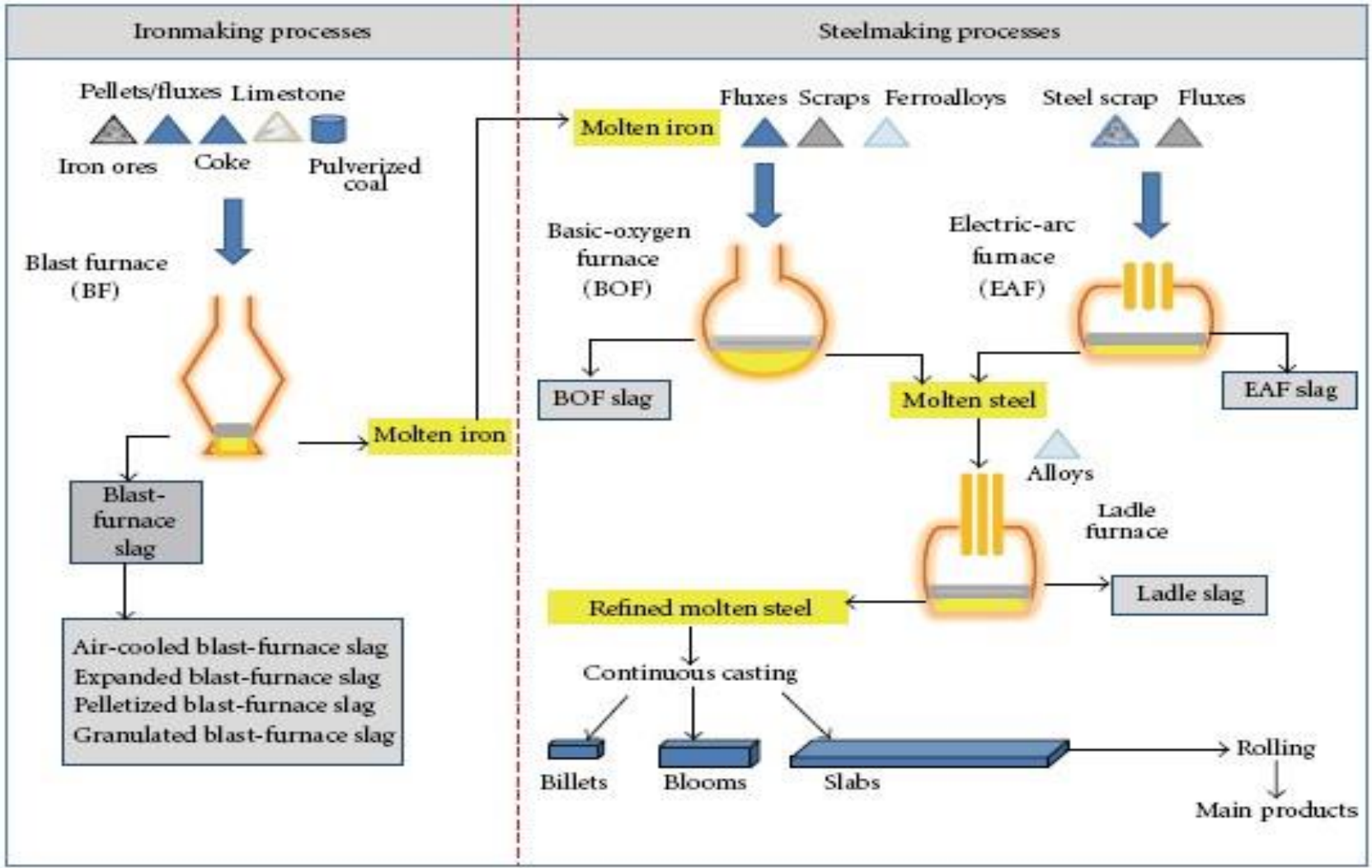


Overview of Steel Slag in INDIA

- Around 19.5 million tonnes of, steel slag is generated every year in India from various integrated steel plants
- National steel policy 2017 envisages the crude steel production in the country will be nearly 300 million tonnes by 2030-31
- Accordingly, the steel slag production is also likely to increase to 60 Million tonnes by 2030-31
- Disposal of steel slag is a **major concern** for steel industries as it is considered as a waste material and largely disposed of as a land fill or piled up inside the steel plants
- Conversion of RAW steel slag as **Processed Steel Slag Aggregates** exhibits **great potential** as a **substitute of natural aggregate** for **Steel Slag Road Construction**
- Massive National Highway Development program posed a unsustainable demand of of natural aggregate for road construction, which is presently around **1.1 billion tonnes** per annum
- This demand is slated to increase by **2.2 billion tons** by 2025. Potential utilization of processed steel slag aggregate as substitute of natural aggregates can meet out this demand partially



Metallurgical Slag in Steel Plant



IRON AND STEEL SLAG GENERATION IN STEEL PLANT



BOF Steel Slag



EAF Steel Slag

CONARC Steel Slag



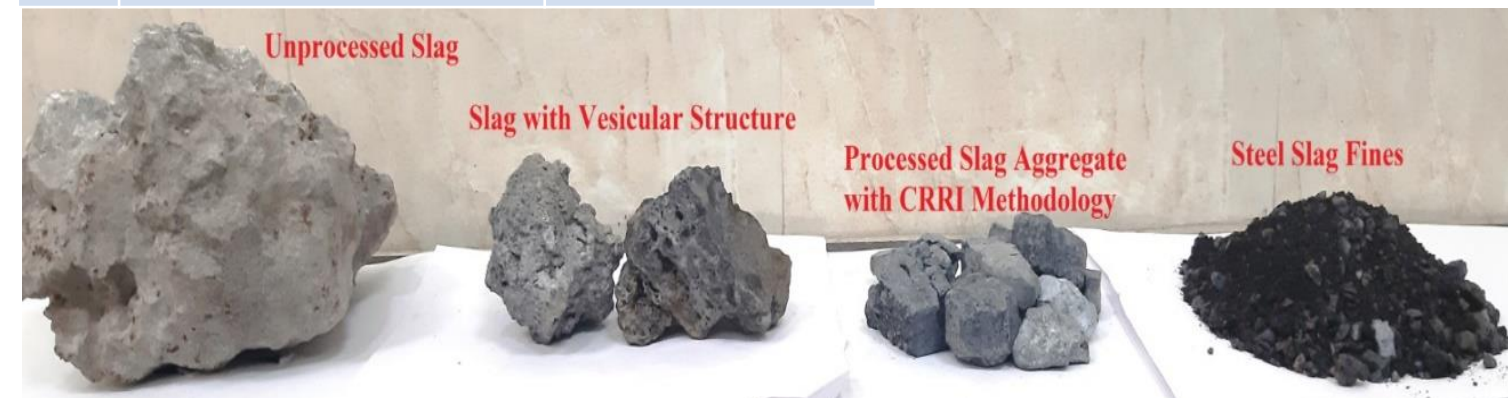
Steel Slag Road: Valorizations of Steel Slag as Aggregates

Typical Mineralogical Phases in Steel Slag

SN Q	Mineral Name	Structural Formula
1	Larnite	$\beta\text{-Ca}_2\text{SiO}_4$
2	Srebrodolskite	$\text{Ca}_2\text{Fe}_2\text{O}_5$
3	Tricalcium silicate	Ca_3SiO_5
4	Spinel (Fe,Mg,Mn,Al)	$\text{Me}^{2+}\text{Me}^{3+}_2\text{O}_4$
5	Wustite	FeO
6	Calcite	CaCO_3
7	Periclase	MgO

Steel Slag Specific Customized Slag Processing Methodology

- To curb **Volumetric Expansion**
- To Reduce **Vesicular Structure**
- To Minimise propensity of **TUFA Formation**
- To reduce **Corrosion Potential**
- To **Maximize Crystalline structure** to improve mechanical properties
- To reduce the propensity of **Heavy Metal and High pH Leaching**



STEEL SLAG ROAD: FOR GREEN INFRASTRUCTURE





Success Story published by Australian Slag Association

INDIA'S FIRST 'SLAG ROAD' A RESOUNDING SUCCESS

In October 2021, India became the world's largest producer of crude steel. In the FY21, production of crude steel and finished steel stood at 102.49 million tonnes (MT) and 94.66 MT; and it's only meant to expand further. In the FY22, crude steel production in India is estimated to increase by 18%, driven by rising demand and education.

With predicted increases of production, means an increase in the amount of its by-product, slag. In past years, tonnes of slag have been stored as a waste product until recently when a new research project led to the first steel slag road in India's history.

The country's first steel slag road was finalised in the city of Surat, stretching across 1.2km of road, and consisting of 6 lanes. The now-famous road acts as a connectivity stretch for the Deepwater Hazira Port and connects to nearby highways. This stretch has been built by substituting natural aggregates with 100% processed steel slag aggregates in all layers of bituminous pavement. Considering its higher strength, the thickness of the road has also been reduced by 30%.

The successful implementation of the road is set to pave the way for the utilisation of more steel slag in upcoming projects, that would otherwise have been sitting in large mounds around the country. In addition, the use of slag is solving a nationwide shortage of virgin material that is consequently holding back the finalisation of various infrastructure projects.

The revolutionary project would not have been possible without intensive research conducted under the steel ministry. This research project was additionally sponsored by ArcelorMittal Nippon Steel under the technical guidance of the Central Road Research Institute (CSIR-CRRI) and has begun to change the way roads are constructed in India.

Almost a year from completion, Satish Pandey, principal scientist at CSIR-CRRI says the road is still upholding structural integrity. "Around 1,000-1,200 heavy commercial vehicles are using the road per day for the last one year and still it is performing well on different serviceability parameters. Around one hundred thousand tonnes of processed steel slag aggregates have been utilised in this project. We will soon come up with guidelines for widespread usage of processed steel slag in road and highway construction," he said.

The future of slag in India is promising. Hopefully in the future, more projects like this one recognise the benefits of using slag to not only reduce waste, but to also improve the strength and durability of asphalt mixes in India.



- INDIA's First National Highway Steel Slag Road Section is built on NH 66 Mumbai Goa National Highway
- This is four lane road comprising **Asphalt and Cement Concrete Steel Slag Road Sections**
- Processed **CONARC Steel Slag Aggregates** are utilized as 100 % substitute of natural aggregates
- Around 80000 tonnes processed steel slag aggregates are utilized in the construction of road
- Slag Cement is utilized for construction of Cement Concrete steel slag road section
- Steel Slag aggregates are produced at JSW Steel Dolvi plant using customized steel slag valorisation technology developed by CSIR-CERRI



Niti Aayog Member Dr. Saraswat inspects Joram-Koloriang road Steel slag road tech to be boon for BRO to build roads in border areas: Dr. Saraswat

statement on the sidelines of the inspection of the 1-km stretch of pilot project steel slag road built by BRO at Joram-Koloriang road in Arunachal Pradesh along with a team of CSIR-Central Road Research Institute, Border Road Organization, Tata Steel and Lower Subansiri Deputy Commissioner Bamin Nime today.

Dr. Saraswat emphasized using alternative road materials like (Cont. P.6)



ZIRO, Mar 27: Niti Aayog Member Dr. VK Saraswat said the CSIR-CRRI steel slag road technology will be a boon for the Border

Roads Organisation (BRO) to build long-lasting heavy duty roads in strategic border areas.

Dr. Saraswat made the



STEEL SLAG ROAD, JAMSHEDPUR, JHARKHAND: TATA STEEL

Processed BOF Steel Slag
Aggregate in Granular
Sub Base in NH-33

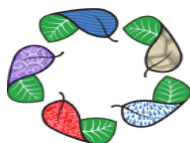


Processed BOF Steel Slag
Aggregate in WMM in
NH-33



Benefits of Steel Slag Road Technology

- Reduction in overall **Bituminous Road Thickness by 30 to 40 %**
- Conservation of around **80000 tons of Natural Aggregates** for construction of 1 Km six lane road
- Reduction in construction cost **by 40 to 45 % in Bituminous and Cement Concrete Steel Slag Road**
- Improved Durability of **Road by 4 to 5 times**
- Negligible Maintenance cost
- Reduction in **Green House Gases Emission by 48 %** by substituting natural aggregates with processed steel slag aggregates
- Cheaper, economical option of **Natural Aggregates** for Road Construction



WASTE TO WEALTH
Swachh Bharat Unnat Bharat

A portrait of Narendra Modi, the Prime Minister of India, wearing a blue kurta and glasses, with a white beard. The background is blurred, showing orange and white vertical stripes.

Appreciation from Hon. Prime Minister

STEEL SLAG ROAD BRO PROJECT: Infra creation and circular economy, both will get an impetus. Compliments to all those involved with this effort

ENVIRO ANNOTATIONS

NEW DELHI, 5th, May to 11th May, 2021

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ISSUE NO. 2

CSIR-CRRI bags SKOCH Gold Award 2021 for Utilization of BOF Steel Slag in Road Construction

New Delhi: CSIR-Central Road Research Institute (CRRI) has received SKOCH Gold Award 2021 under Environment and Sustainability category for utilization of BOF steel slag of Tata steel Jamshedpur as substitute of natural aggregate in road construction. SKOCH Gold award has been conferred to CSIR-CRRI by eminent jury of Skoch group on 30th April 2021 for successfully converting applied research projects in to practices by facilitating the utilization of processed BOF steel slag aggregate in bituminous road construction.

Satish Pandey, Principal Scientist, CSIR-CRRI who lead the research studies has further informed us that the TATA Steel Jamshedpur sponsored two research projects to CRRI to explore possible utilization of BOF steel slag in road construction. According to an estimate around 150 to 200 kg. of steel slag is generated for 1 ton of carbon steel production. Tata Steel Jamshedpur plant which has annual steel production of 10 million ton per annum generates around 1.5-to-2-million-ton BOF steel slag per annum which largely considered as industrial



waste material.

BOF Steel slag which cannot be used as such as road construction material owing to its vesicular structure and volumetric expansion characteristics has been successfully converted as road making aggregate using the steel slag processing methodology suggested by CRRI to Tata steel. Subsequently processed steel

slag aggregate has been successfully utilized as 100 % substitute of natural aggregate in the construction of granular layers of NH-33 (passing from Jamshedpur city) under the supervision of CSIR-CRRI team. The periodic performance monitoring of this 1.5 km long test section was carried out by CSIR-CRRI for three years and test section found

to be performing well on different test parameters. Based on the research study TATA Steel branded the processed steel slag aggregate as TATA Aggreto and around 4 lakh ton of processed BOF steel slag aggregate so far has been supplied by Tata Steel for the construction of National, state highways and PMGSY roads in Jharkhand.



SKOCH GOLD AWARD SHARED WITH TATA STEEL MD, Shri T.V. Narendran

- ❑ **INDIA'S FIRST STEEL SLAG ROAD, GUJARAT:** Surat-Hazira port road, CSIR-CRRI AND AMNS INDIA
- ❑ **INDIA'S FIRST NATIONAL HIGHWAY:** Steel Slag Road NH-66, MUMBAI-GOA, Maharashtra: CSIR-CRRI and JSW Steel
- ❑ **CHINA-INDIA BORDER ROAD:** Ziro Valley, Arunachal Pradesh :CSIR-CRRI, TATA STEEL and BRO
- ❑ **STEEL SLAG ROAD NH-33, JHARKHAND:** CSIR-CRRI, TATA STEEL and National Highway Authority of India
- ❑ **STEEL SLAG ROAD NH-53, Gujarat:** AMNS INDIA, CSIR-CRRI AND MANGLAM BUILDCON
- ❑ **STEEL SLAG ROAD NH-53: BHANDARA BYPASS (Near Nagpur), Maharashtra**

UPCOMING STEEL SLAG ROAD PROJECT:

- ❑ **STEEL SLAG ROAD INDIAN NAVY VISAKHAPATNAM NNAVAL BASE:** CSIR-CRRI, RINL AND INDIAN NAVY
- ❑ **STATE HIGHWAY SH 234 NEAR TADIPATRI ANDHRAPRADESH : CSIR-CRRI, ARJAS STEEL AND PWD ANDHRA PRADESH**

THANKS FOR KIND ATTENTION



Satish Pandey

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