

**Presentation in IRF-IC'S Lecture Series on
Sustainable Materials & Circular Economy in Road Construction**

**SUSTAINABLE ROAD MATERIALS FOR CONSTRUCTION &
MAINTENANCE OF ROADS**



WASTE TO WEALTH
Swachh Bharat Unnat Bharat

India International Centre
16th Nov. 2025

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STEEL SLAG ROAD TECHNOLOGY: FOR GREEN INFRASTRUCTURE



- Around 22.5 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





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 NH 66

- INDIA's First National Highway Steel Slag Road Section in 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 roads
- Processed Steel Slag aggregates are produced at JSW Steel Dolvi plant using customized steel slag valorisation technology developed by CSIR-CRRI



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)

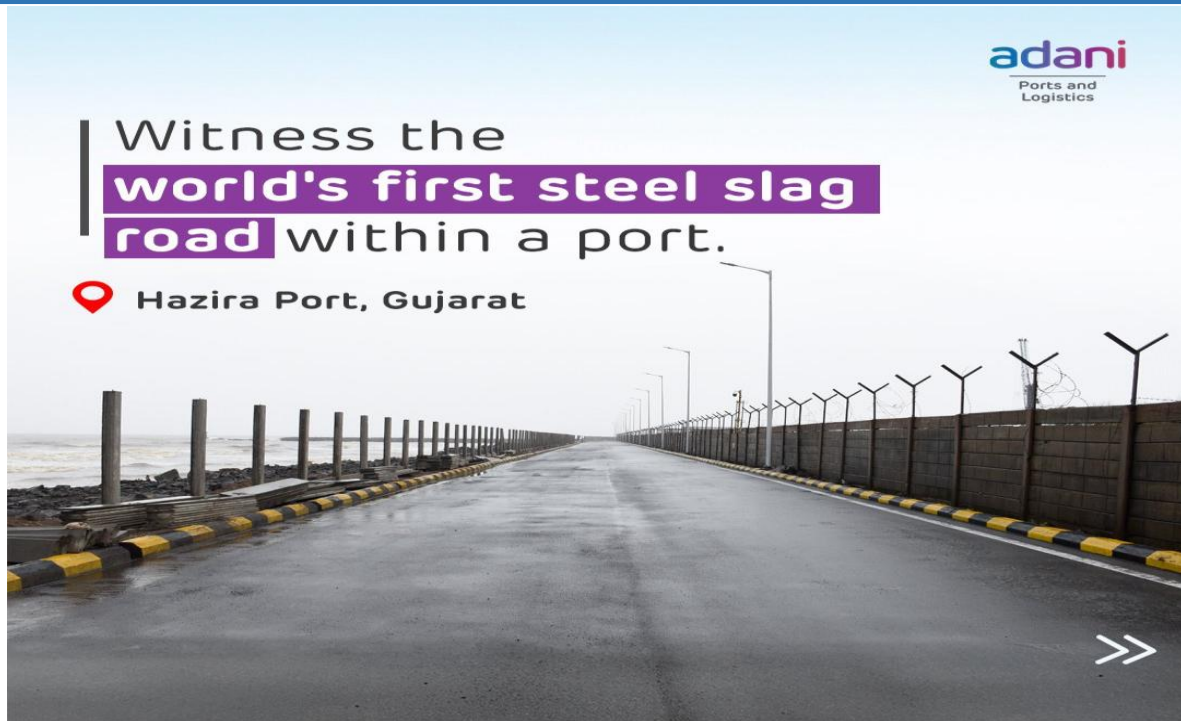


ZIRO, Mar 27: Niti Aayog Member Dr. VK Saraswat said the CSIR-CRRI steel slag road technology will be a boon for the Border

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

Dr. Saraswat made the





- ❑ India's first coastal steel slag road at Adani Hazira Port, Surat
- ❑ Constructed by Adani Ports and SEZ Ltd. under the **technological guidance** of **CSIR–CRRI**
- ❑ Arcelor Mittal Nippon Steel, India, has supplied the steel slag aggregates.
- ❑ First-ever steel slag road section inside a commercial port in India
- ❑ **1.1 km-long, four-lane** bituminous road built using **processed EAF steel slag aggregates**
- ❑ Road section runs adjacent to the **coastline**

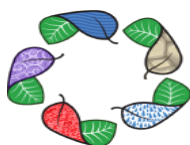
Processed BOF Steel
Slag Aggregate in
Granular Sub Base
in NH-33



Processed BOF Steel
Slag Aggregate in
WMM in NH-33



- 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



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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

- ❑ **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**

Specifications and Launching of Products



GUIDELINES FOR PROCESSING AND UTILIZATION OF STEEL SLAG AS PROCESSED STEEL SLAG AGGREGATES IN ROAD CONSTRUCTION



PREPARED BY

CSIR-CENTRAL ROAD RESEARCH INSTITUTE
NEW-DELHI, 110025

CONSTRUCTION OF ASPHALT ROADS IN LOW TEMP. AREAS



@ LDY Road Indo-China Border 16000 ft, Arunachal Pradesh



@ Sela Tunnel Arunachal Pradesh 13000 ft



द्रास-उम्बाला-सांकू रोड के निर्माण में पेश किया

लद्दाख

@ Tiger Hill, Drass, Kargil, 13000 ft

सड़क निर्माण तकनीक का सफलतापूर्वक परीक्षण किया

में दुनिया के दूसरे सबसे ठंडे बसे हुए स्थान द्रास में स्वदेशी रिजुपेव सड़क निर्माण तकनीक शुरू करने का सफलता



@ Thimpu-Paro Road and Chalelea Pass at Bhutan

- ❑ Limited working window due to **sub-zero and low temperature** in the region
- ❑ **Increased energy requirement** in HMA plants due to cold weather
- ❑ Significant hauling time from HMA plant to project site due to mountainous terrain
- ❑ Difficulty to achieve min. Laying and Rolling temperatures
- ❑ Higher consumption of LDO in HMA burner causing significant GHG emission in the atmosphere
- ❑ Low temperature cracking in the bituminous layer due to UV oxidation and freezing and thawing



Challenges

- ❑ Limited working window in high altitude regions due to **sub-zero and low temperature** conditions
- ❑ **Increased energy requirement** in HMA plants due to cold weather
- ❑ Significant hauling time from HMA plant to project site due to mountainous terrain
- ❑ Difficulty to achieve min. Laying and Rolling temperatures
- ❑ Higher consumption of LDO in HMA burner causing significant GHG emission in the atmosphere
- ❑ Low temperature cracking in the bituminous layer due to UV oxidation and freezing and thawing



REJUPAVE Technology: Winner of Hackathon 2024 of MoRTH

- ❑ Enable the construction of road under **sub-zero and low temperature** conditions
- ❑ Increased working window for road construction agencies
- ❑ Low energy requirement
- ❑ Improved Durability of road due to reduction in UV oxidation and short-term aging



सीएसआईआर
CSIR

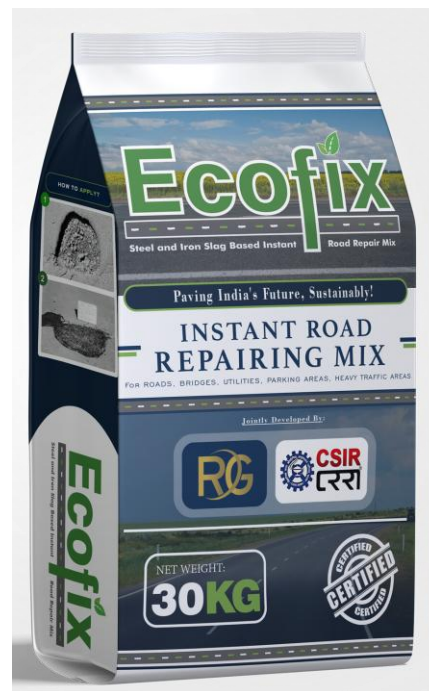
नवाचार इंजन
Engine of India

EcofixTM

Steel and Iron Slag Based Instant Road Repair Mix



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Instant Pavement Repair Mixture

Paving India's Future, Sustainably

INSTANT POTHOLE REPAIR MIX ECOFIX

- Repurposes **industrial waste** into **high-performance durable** road repair material, achieves circular economy goal.
- Lowers **carbon footprint** of road maintenance activities.
- Reduces frequency of repairs, **saving long-term** costs.
- Cost effective, mixture cost reduction up to **29%**.
- Minimizes traffic disruption and associated vehicle emissions.
- Ideal for utility cut repairs in urban areas.



Field Implementation



- ❑ Over the past year, **ECOFIX** has undergone extensive field testing in both urban and rural environments. These trials were conducted in collaboration with local authorities and independent agencies to evaluate its effectiveness in real-world conditions.
- ❑ In the **busy streets of the Delhi Metro Area**, where road maintenance is frequent due to high traffic, ECOFIX was used to repair heavily damaged sections. The results showed that repairs conducted with **ECOFIX lasted significantly longer** than those done with traditional materials, reducing the frequency of repairs by 40%.

CSIR ROAD TECHNOLOGIES FILM

THANKS FOR KIND ATTENTION



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