



INDIA'S FIRST LARGE-SCALE

# **BITUMEN COLD RECYCLING PROJECT**

## Navigating India's Unique Challenges

# India's bustling national highways alone span over 1,46,145km<sup>1</sup>

This expansive infrastructure handles heavy vehicle movement carrying high axial loads, slow moving traffic, and extreme climatic conditions.

The increased maintenance and repair costs, along with the environmental impact, make constructing and managing this infrastructure more complex compared to other parts of the world. These costs ultimately fall on the government and taxpayers who rely on these roadways. The technologies in the construction of these roads have started embracing advancements in recycling and increasingly begun to add a sustainable touch.

To derive India-specific engineering solutions for increasing the longevity of pavements, the pavement engineering laboratory, Transportation Engineering Division, Department of Civil Engineering at IIT Madras has partnered with Ingevity, an R&D partner of IITM Research Park. Ingevity specializes in pavement technologies and works with IIT Madras to provide expertise in developing solutions for pavement engineering. **This is the story of how this collaboration at IITM Research Park is pioneering sustainable technologies.**



## Bridging Industry and Academia for Innovation

IIT Madras and Ingevity's collaboration dates back to 2009, focusing on warm mix asphalt. **Over the past 15 years**, they have conducted numerous advanced projects and research, including hot mix recycling, virgin cold mix, and asphalt emulsions for various applications. Together, they introduced and implemented India's first large-scale bitumen cold recycling project.

For the first time in the country, multiple stakeholders from the IIT Madras, Cube Highways, and Ingevity came together to introduce the technology of **Cold Central Plant Recycling (CCPR) over nearly 100 km in the rehabilitation of Ghaziabad - Aligarh section of NH 34, Uttar Pradesh**. This technology, designed as an environmentally sustainable solution specifically for Indian roads, integrates recycling by using old roads, reduces greenhouse gas emissions, and saves natural resources by limiting the use of additional raw materials. Over the course of this construction, **more than 5 lakh tonnes of recycled material were used.**



The Cube Highways and Ingevity team together at the site.

## Charting the Standard Operating Procedure on CCPR

To begin with, there were no technical guidelines within the context of India for mix design, execution, quality control, and quality assurance for CCPR. **Cube Highways, IITM, and Ingevity** joined together and provided the first detailed technical guideline for mix design and standard operating procedure execution for such technology. This was greatly aided by Ingevity's global expertise, specifically Dr. Stephane Charmot - Director, Ingevity USA. These standardized practices created consistency by detailing every stage of CCPR construction. Such an exercise helped in streamlining the execution of one of the most challenging recycling projects in the world.

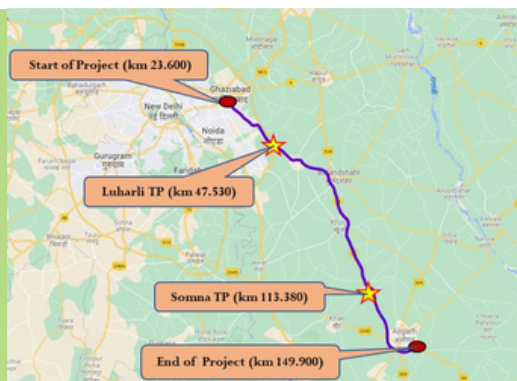


## Introducing CCPR to Indian Highways




Introducing this technology to Indian roads comes at a cost. Conventionally, it costs ₹15 crore per kilometer to construct a new bituminous four-lane highway, with an additional maintenance cost of about ₹4-5 lakh per kilometer. In the current scenario, **recycling is not an option, but a necessity considering the dearth of natural resources** such as aggregates and bitumen. The strategically important National Highways provided the test case for IITM-Ingevity collaboration to put into practice such a massive recycling attempt. This is a clear case of laboratory-to-field implementation in the shortest possible time.

# Ghaziabad Aligarh Expressway Private Limited

is one of the challenging sections in terms of the intensity of axle loads and the extent of vehicle repetitions.



This particular stretch is also exposed to harsh environmental conditions in terms of high summer temperatures and lower winter temperatures. The existing four-lane highway had very little residual life in it, and it was required to be rebuilt in the shortest possible time as well as serve the traffic for a period of ten years.

The team of  **CUBE HIGHWAYS**,  and  **ingevity** decided to use more than **90% of the existing material**. A mixture of existing bituminous material, virgin aggregates, and bituminous emulsion was designed for use here. Noteworthy is the use of hard-grade bitumen and making a bituminous emulsion out of it, which is a challenging task. These mixtures were proposed to be laid at the base course (3rd layer from the surface) of the proposed highway, and detailed experiments were carried out at IIT Madras to simulate the likely load that this layer will be expected to carry during its service. Different mix combinations were worked out and the mixture that met the stringent requirements as decided by IIT Madras and Ingevity was finally identified for use. It should be noted that **this is a 100% cold mixture, with no heating required during execution**.

IIT Madras and Ingevity working in tandem with Cube Highways, ensured that such a technology was deployed in the field and executed as per the specification by the engineering contractor. The site execution process involved screening the reclaimed material from highways, and mixing it with cement and a specially formulated emulsion binder in an in-plant mixing facility.

Every facet of such a technology involved the use of specialty equipment such that the required QC/QA parameters were met. During execution, multiple challenges were faced due to the variabilities in the material, and such issues were resolved by this team working with the contractor. It should be noted that the whole **construction was carried out without any hitch during the harsh summer and winter of 2022-23, in addition to the extreme rainfall** this region received during that time.

## The Sustainable Advantages of CCPR



There is no heating involved at any stage of this process. In such large-scale projects, this has a **substantial impact on reducing fuel consumption and greenhouse gas emissions, thus offering a sustainable solution.** Cold recycling technologies reduce energy consumption by 56-64% and decrease greenhouse gas emissions. The CCPR was executed over 89 kms involving five lakh metric tonnes of cold mix and is a one-of-its-kind recycling project for National Highways in India.

## Path Ahead

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**Dr. Stephane Charmot**

Director, Ingevity-USA

It is impressive how all the project stakeholders came together to collaborate and make this important project successful. There were many details to work out as this cold recycled project was one of the largest in the world ever to be constructed and this process was used for the first time in India. It is remarkable how well the project was executed. It is a demonstration of what can be achieved in India!

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The rehabilitated six-lane section of NH34 between Ghaziabad and Aligarh will stand proof of how collaborative work and integration of advanced technology can lead to the successful execution of innovations in road construction projects. The Cube Highways, IIT Madras, and Ingevity Corporation came together to implement this process of Cold Central Plant Recycling for the first time in the country, exemplifying the potential of CCPR for sustainable highway construction in India. This is the type of transformative innovation that is made possible through industry-academy collaboration facilitated by IIT Madras Research Park.

While this is just one story, the rapid adoption of such innovation and technologies, enabled by government thrust, is key to charting the path towards India's sustainable future.

## Team Involved



**Prof. J Murali Krishnan**  
IIT Madras



**Dr. Stephane Charmot**  
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**Dr. Asif Ahmed**  
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**Arppan B Ghosh**  
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**ALONG WITH THE PAVEMENT TEAM.**



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Watch the Story here 

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