PRESS RELEASE

IIT Mandi team develops methods of soil stabilization using soil bacteria

The study will help in designing microbial methods to improve soil shear strength at the field scale to protect the soil from erosion in hilly areas and during geo-disasters.

Video Link: **https://drive.google.com/drive/u/0/folders/1Q_q0Z1SddCyore7EUt20eTeaiHbnCREV**

MANDI, 11th April 2022: IIT Mandi researchers work towards developing sustainable techniques for soil stabilization using a harmless bacteria called S. Pasteurii that hydrolyse urea to precipitate calcite. The process does not involve hazardous chemicals and natural resources can be used sustainably.

The findings of the research team have been recently published in the journal 'Geotechnical and Geo-environmental Engineering of the American Society of Civil Engineers (ASCE)'.The research was led by Dr. Kala Venkata Uday, and co-authored by his MS scholar, Mr. Deepak Mori.

Soil stabilization is the process of conferring long-term permanent strength to the soil by artificial means. It is used when construction work must be carried out on unstable grounds or to protect soil from erosion. Traditionally, mechanical processes such as compression and chemical processes such as the injection of chemical grout fluids into the soil are used for soil stabilization

In the past decades, an eco-friendly and sustainable soil stabilization technique – Microbial Induced Calcite Precipitation (MICP) – is being investigated worldwide. In this method, bacteria are used to produce calcium carbonate (calcite) within soil pores, which cements the individual grains together, thereby enhancing the soil/ground strength.

Speaking about his research, Dr K. V. Uday, Assistant Professor, School of Engineering, said, "Our study will be helpful in designing microbial methods to improve soil shear strength at the field scale, to protect the soil from erosion in hilly areas and during geo-disasters. We are also working on the microbe-driven production of construction material from quarry waste."

Further, Dr. K.V. Uday, said, “While there are studies worldwide on the development of MICP techniques for soil stabilization, the factors that affect the efficacy of the process are still not completely understood.”

The researchers used a harmless bacteria called S. Pasteurii that hydrolyse urea to precipitate calcite. The use of urea is particularly attractive because it does not involve hazardous chemicals and natural resources can be used sustainably. Their experimental setup consisted of a column of sand through which was percolated a mixture of the bacteria and cementing solution comprising urea, calcium chloride, nutrient broth, etc.

Explaining the research work, Mr. Deepak Mori, research scholar, IIT Mandi, said, “The Calcite Precipitation Efficiency (CPE) depends on a number of parameters including and not limited to the concentration of the cementing solution, its flow rate through the column, the supply rate, applied pore volume, and the sand grain characteristics. We set out to understand the effects of various parameters on the CPE.”

Since there were numerous parameters involved, researchers used the Taguchi method to analyse the effects of these various parameters on the strength enhancement of soil by MICP. This method involves the use of orthogonal arrays to organize the parameters affecting any process and the levels at which they should be varied. The Taguchi method enables the analysis of many influential parameters without the corresponding need for many experiments.

The researchers found that the amount of calcite formed is not as important as the size and location of the calcite grains formed in the pores during the process.

The higher cementing solution concentration resulted in higher strength improvement. Similarly, the flow rate and the supply rate of the cementing solution also affected the enhancement of strength. There was an optimum value for these parameters that produced maximum calcite deposition and thereby best strength enhancement.

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About IIT Mandi

IIT Mandi has four Academic Schools and three major Research Centers. The Schools are: School of Computing and Electrical Engineering, School of Basic Sciences, School of Engineering, and School of Humanities and Social Sciences. The Centers are: Advanced Materials Research Centre (AMRC; set up with an investment of Rs. 60 crores), Centre for Design and Fabrication of Electrical Devices (C4DFED; has Rs. 50 crores worth of fabrication tools), and BioX Centre (has acquired research equipment worth Rs. 15 crores).

The unique, project-oriented B.Tech. curriculum is centred around its 4-year long Design and Innovation stream. From August 2019, IIT Mandi started 3 new and unique B. Tech. programmes in Data Science and Engineering, Engineering Physics, and Dual Degree in Bioengineering. Since the inception of the Institute, IIT Mandi faculty have been involved in over 275 Research and Development (R&D) projects worth more than Rs. 120 crore.

IIT Mandi set up the IIT Mandi iHub and HCI Foundation (iHub; a section-8 company) on its campus at Kamand with significant funding of INR 110 crores from the Department of Science and Technology (DST), Government of India. The iHub is planned to fuel research and technology development, skill development, startup and innovation, and collaborations in the HCI and allied AI/ML areas in India. IIT Mandi is the only second-generation IIT to be featured at rank no. 7 in the Atal Ranking of Institutions on Innovation Achievements of the Innovation Cell, Ministry of Education, Govt. of India.

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