



ANNAMACHARYA UNIVERSITY, RAJAMPET

Annamayya District, Andhra Pradesh-516126-India,

CIVIL ENGINEERING DEPARTMENT



ACTIVITY REPORT

Name of the Activity: Guest Lecture on "Characterizing Cementitious Materials: Tools, Techniques and Insights"

Alumni Name : Dr. K Chiranjeevi Reddy,

Designation : Post-Doctoral Fellow, IIT Hyderabad.

Date of the Program: 07th August 2025, 09:30 AM – 12:30 AM

Venue : Smart Classroom, Dept. of Civil Engineering, Annamacharya University

ANNAMACHARYA UNIVERSITY, RAJAMPET
DEPARTMENT OF CIVIL ENGINEERING



PROUDLY PRESENTS

A Guest Lecture
on
"CHARACTERIZING CEMENTITIOUS MATERIALS : TOOLS, TECHNIQUES AND INSIGHTS"

Unlocking the Microstructure of the Materials that Build the World

by
Dr. K Chiranjeevi Reddy
Post-Doctoral Fellow, IIT Hyderabad.

Join us for an in-depth session exploring the powerful analytical techniques used to investigate the chemistry, structure, and behavior of cementitious materials. This lecture will introduce and demystify state-of-the-art characterization tools that are revolutionizing research and quality control in cement and concrete science

Topics to be Covered:

- **X-Ray Fluorescence (XRF) & X-Ray Diffraction (XRD):**
Gain insights into the elemental composition and crystalline phases of cement and hydration products.
- **Isothermal Calorimetry:**
Understand the heat evolution patterns during cement hydration – a window into early-age reactivity.
- **Thermogravimetric Analysis (TGA):**
Evaluate mass loss profiles to quantify hydration products and identify thermal stability.
- **Electron Microscopy (SEM/TEM):**
Visualize the microstructure and morphology of cement paste, C-S-H, and interfacial zones at high magnification.
- **Fourier Transform Infrared Spectroscopy (FTIR):**
Explore molecular vibrations to characterize chemical bonds and hydration products.

All the interested candidates are welcome to participate the event
No registration Fee Required

Scan the QR Code to register



 **Date : 07/08/2025**
Time : 09:30 AM to 12:30 PM

 **Smart Classroom, Dept. of Civil Engg.**
Annamacharya University Rajampet

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On **7th August 2025**, the Department of Civil Engineering at Annamacharya University, Rajampet, organized a guest lecture on “*Characterizing Cementitious Materials: Tools, Techniques, and Insights*”. The session aimed to equip students and faculty members with knowledge of advanced analytical methods for studying cementitious materials and their microstructures.

The lecture was delivered by **Dr. K. Chiranjeevi Reddy**, an expert in cement chemistry and microstructural analysis from IIT Hyderabad. His presentation blended scientific depth with practical applications, enabling participants to connect laboratory techniques with real-world construction challenges.

Expanded Lecture Summary

The session began with Dr. Reddy introducing the concept of *cementitious materials* and the significance of their microstructure in determining strength, durability, and long-term performance in concrete structures. He emphasized that many challenges in construction—such as early-age cracking, durability failures, and unexpected strength losses—can be traced back to microstructural factors that are often invisible to the naked eye.

He then introduced **five major analytical techniques** and elaborated on their scientific principles, working procedures, and practical applications:

1. X-Ray Fluorescence (XRF) & X-Ray Diffraction (XRD)

Dr. Reddy explained that XRF is primarily used for chemical composition analysis, while XRD focuses on identifying crystalline phases. Using case studies from his research, he showed how these techniques help distinguish between unhydrated cement particles, hydration products like portlandite and ettringite, and various crystalline additives.

2. Isothermal Calorimetry

This method measures the heat flow associated with hydration reactions. Dr. Reddy presented calorimetry curves for different cement blends, explaining how variations in admixture dosage or curing conditions affect reaction rates. He emphasized its importance in understanding early-age behaviour and predicting potential delays in strength development.

3. Thermogravimetric Analysis (TGA)

He demonstrated how TGA detects mass losses during controlled heating, helping to quantify bound water, carbonation extent, and dehydration of specific hydration products. Examples showed how TGA data can be linked to concrete's thermal stability.

4. Electron Microscopy (SEM/TEM)

Using high-resolution images, Dr. Reddy revealed the microscopic morphology of cement paste, the C-S-H gel structure, and interfacial transition zones between paste and aggregate. He highlighted how SEM/TEM allows researchers to detect cracks, pores, and bond quality—critical factors in durability.

5. Fourier Transform Infrared Spectroscopy (FTIR)

Finally, he explained how FTIR analyses molecular vibrations to identify specific chemical bonds, helping in the detection of carbonation and changes in hydration products over time. He illustrated this with FTIR spectra from various cement samples, explaining how peaks correspond to particular functional groups.



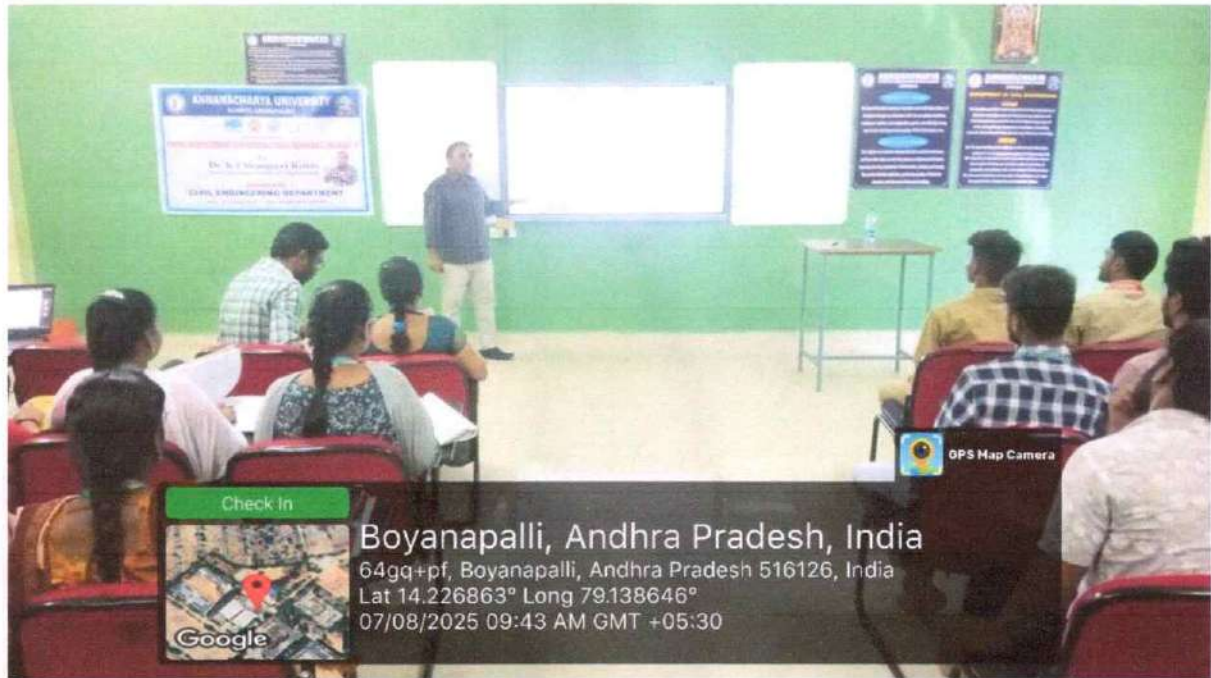
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Throughout the lecture, Dr. Reddy skilfully linked each tool to real-world applications such as **quality control in cement plants, durability assessment in infrastructure projects, and material optimization in sustainable construction.**



Dr. Reddy illustrated the practical relevance of each technique using case studies from research and industrial applications, emphasizing their role in quality control, durability assessment, and material optimization.





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Questionnaire Session

The lecture concluded with a brief but interactive Q&A session, during which students and faculty posed questions on the applications, limitations, and complementarity of the discussed techniques. Dr. Reddy addressed each query with clear explanations and relevant examples.

Outcome

The session provided valuable insights into the tools and techniques essential for cementitious material characterization. It enhanced the participants' understanding of how laboratory-based analyses can directly influence construction quality and durability, inspiring further academic and research interest in the field.

Faculty Coordinator

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