ChemDist

Green Technologies for Sugar Industry: Sustainability for Profitability

SUNIL DHOLE, PHD (CHEM ENGG)

CO-FOUNDER AND DIRECTOR

CHEMDIST

ChemDist

Science. Engineering. Technology

Delivering Separation & Process Technology

Team

Director & Co-Founder

Dr. Sunil Dhole

PhD (Chemical Engineering), IIT Kanpur

Panel Member

- Board of Director at Water Quality India Association
- Committee Member of Bureau of "Indian Standard for Community Water Purifier"

Director & Co-Founder

Tushar Wagh

MBA, Chemical Engineering

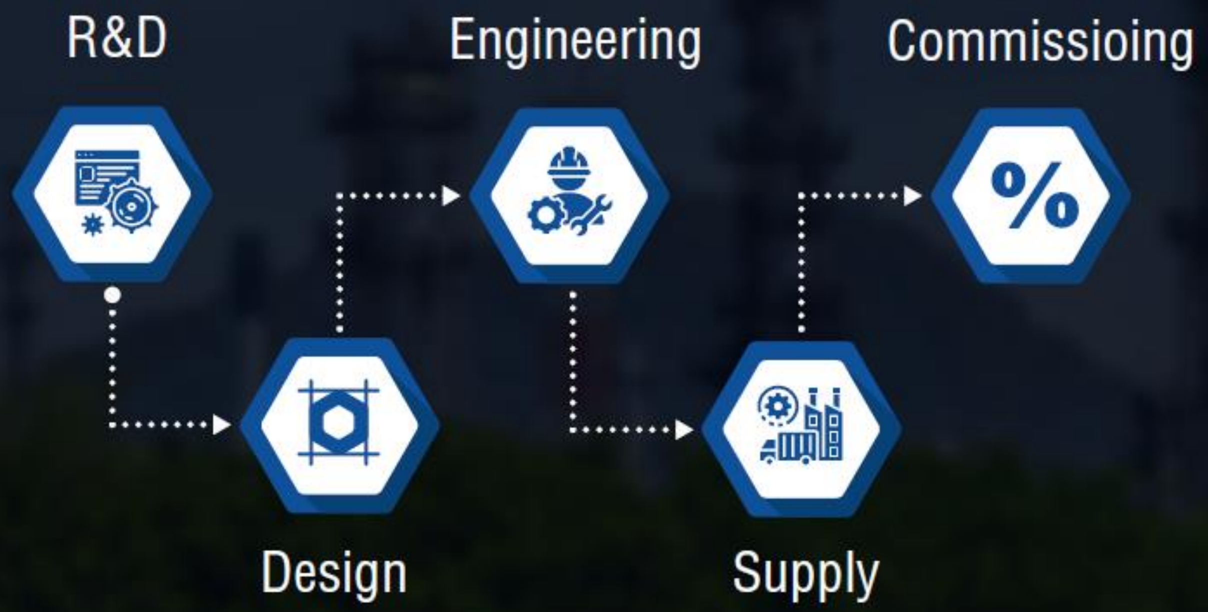
Mentor

Prof. J B Joshi (Padma Bhushan)

- International Member of the National Academy of Engineering of the United States of America
- Emeritus Professor of Eminence,ICT

What We Do

Delivering Separation & Process Technologies



Capabilities

Area of Expertise

Heat & Mass Transfer

- Heat Exchanger
- Mass Transfer Internals
- Turbulator
- Reactors & Agitators

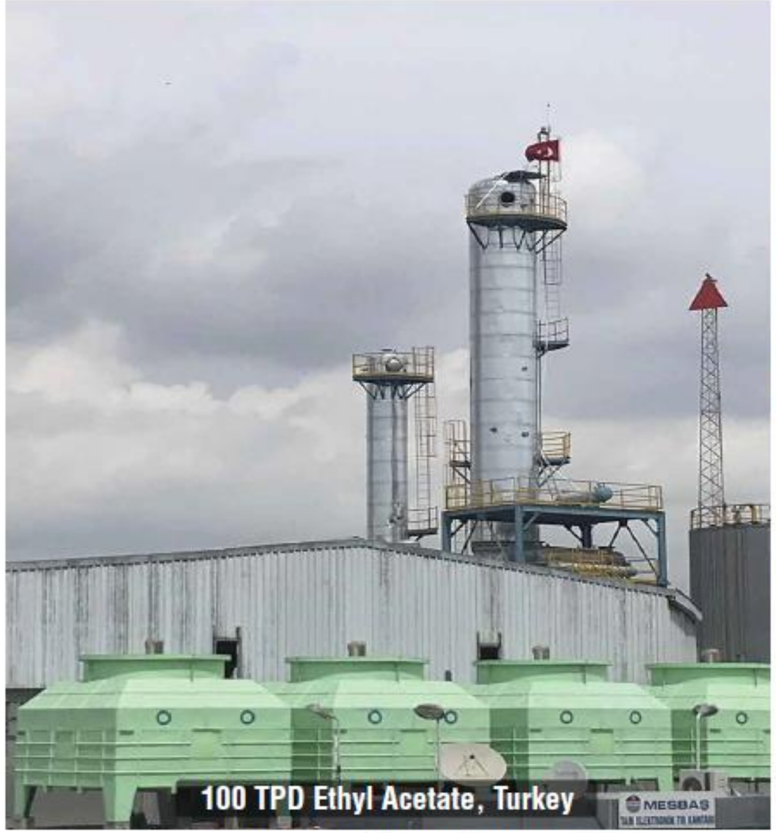
Membrane Technology

- Gas Separation
- Membrane Distillation
- Ultrafiltration-NanoFiltration
- Pervaporation

Process Technologies

- Distillation
- Evaporation
- Reaction & Mixing
- Oil & Gas Technology

Commissioned Projects



100 TPD Ethyl Acetate, Turkey

HPCL, Vizag India

Anisole Plant, Saudi Arabia

200 TPD Fractionation Plant, Dubai

Distillation Plant, USA

Team & Facilities

- 100+ Engineers
- 250+ workers

Infrastructure

- 3 Fabrication Units
- 1 Lakh Sq. Ft. Area

Journey So Far

50+
Successful Turnkey Projects Installation

500+
Clients Served

12+
Industrial Segments

10+
Patents

30+
Products

10+
Technologies

6000+
Oxygen Concentrators Running

6 Mn
Tata Swach Serving People Per Day

100 Mn
Mask Delivered

Collaborations

Our R&D Network

Dr. Dipankar Bandopadhyay
Professor, IIT Guwahati
(Clean Energy - Fuel and Solar Cells)

Dr. Amol Kulkarni
Scientist, CSIR-National Chemical Laboratory
(Continuous Manufacturing and Scale-up)

Dr. Srinivas Mettu
Senior Research Fellow, RMIT University
(Bio-Technology)

Dr. Akshai Kumar Alape Seetharam
Assistant Professor, IIT Guwahati
Catalysis (Heterogeneous and Homogeneous)

Dr. Nageswara Rao Peela
Associate Professor, IIT Guwahati
(Biomass Conversion to Value Added Chemicals)

Dr. Vivek Vitankar
Ph.D, ICT Mumbai & Director at FluiDimensions
(Computational Fluid Dynamics)

Dr. Sandip Patil
Ph.D, IIT Kanpur & Director, E-Spin Nanotech Pvt. Ltd.
(Nano Technology)

Dr. Uttam Manna
Professor, IIT Guwahati
(Bio-inspired Polymer Materials)

Dr. Tapas K. Mandal
Professor, IIT Guwahati
(Micro-Nano Technology for Energy Harvesting)

Our Focus

- To innovate and scaleup green technologies which are commercially feasible in today's market scenario
- The Net Zero technologies giving green consumable products along with the green Hydrogen as a by product
- Use of Green Hydrogen in the existing chemical industry
- To Convert captured carbon (CO_2) into valuable Agro-products of mass consumption

Why Sugar Industry?

Fermentation

Ethanol

Ethyl Acetate
Sustainable Aviation Fuel
Acetic Acid
Green Hydrogen
(Patented)

Molasses

Spent Wash

CO_2

Sugar

Carbon capture to
Nano Urea
Technology (CD-GreeNu)
(Patented)

Bio-Methanation

NH_3

CBG

Green Methanol

Bagasse

Molasses

Green Plastics

Our Technologies

1. Captured CO_2 and NH_3 (from Sugar Factory) to Nano-Urea
2. Bio-ethanol to Bio-Aviation Fuel (SAF) and Green Hydrogen*
3. Bio-ethanol to Acetic Acid and Green Hydrogen*
4. Bio-ethanol to Ethyl Acetate and Green Hydrogen*
5. Low temperature cracking of Ammonia to Hydrogen and Nitrogen (no emissions of Nox)
6. Methanol cracking to Formic Acid and Hydrogen (with no emissions of CO and CO_2)* (Bagasse)
7. Bio-mass to Green Plastic (no CO_2 emissions in the process)

*** Green Hydrogen is a by-product, the commercial feasibility comes from the main product**

Nano-Fertilizer Market Driver

Problems with the Existing Fertilizers:

1. Wastage – up to 70%
2. Efficiency – up to 30%
3. Carbon foot print – One of the highest carbon foot print product
4. GHG emissions – Up to 6% of the total emissions
5. Pollution: Water, air and Soil
6. Soil Fertility and Productivity – Reduction due to over use

Market Potential

ChemDist – Green Nano-Urea Technology		
Sr. No.	Patented Technologies	Product Market by 2030
1	Waste CO_2 to Nano-Urea	Bn 200 USD (nano-fertilizer)

Competitive Advantages

- Bio raw materials (CO_2 and Ammonia captured from Sugar Factory) to produce **Carbon Neutral Nano-Urea**
- Low temperature process
- The catalyst invented by us is based on the abundantly available metals
- Catalyst will be manufactured inhouse to have a complete control on the business chain
- Affordable Nano-Urea

CD Nano - Urea Process

$$NH_3 + CO_2 \rightarrow NH_4COONH_2$$

Captured from Bio-Methanated Spent Wash

CO2 captured from Industry

$$NH_4COONH_2 \rightleftharpoons CO(NH_2)_2 + H_2O$$

Urea Conversion to Nano-Urea Using CD-Bind slow release binder

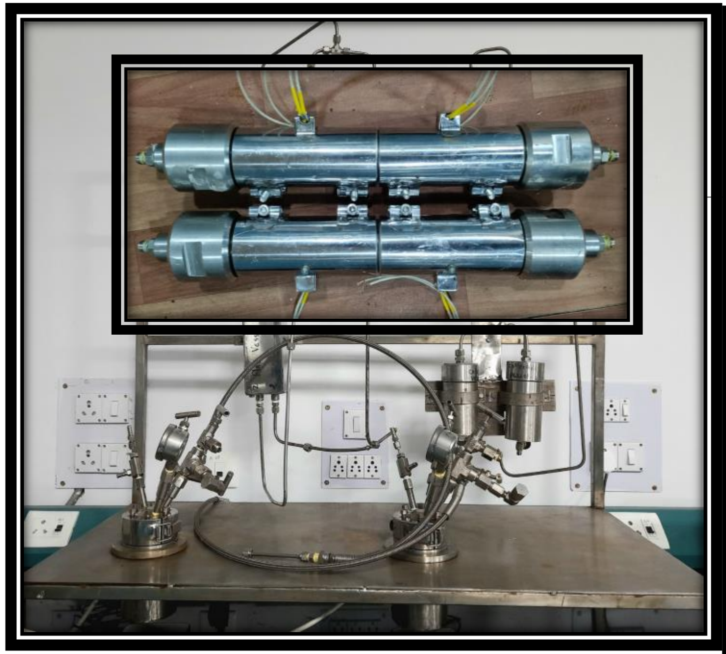
Nano Urea with 20%-30% Nitrogen

Conventional Urea : Challenges

	Conventional Urea
Environmental Pollution	Soil, Water and Air
CO2 Footprint	Very High
Renewable and Green	No
Nitrogen Convey	30-50 % to plants
Sustain Release	No. Due to which more urea wasted in climate
Available Form	Solid
NOx	NOx formation during use
Soil Yield / Fertility	Continuous use decreases soil yield

Labs

Pilot and Lab Plants



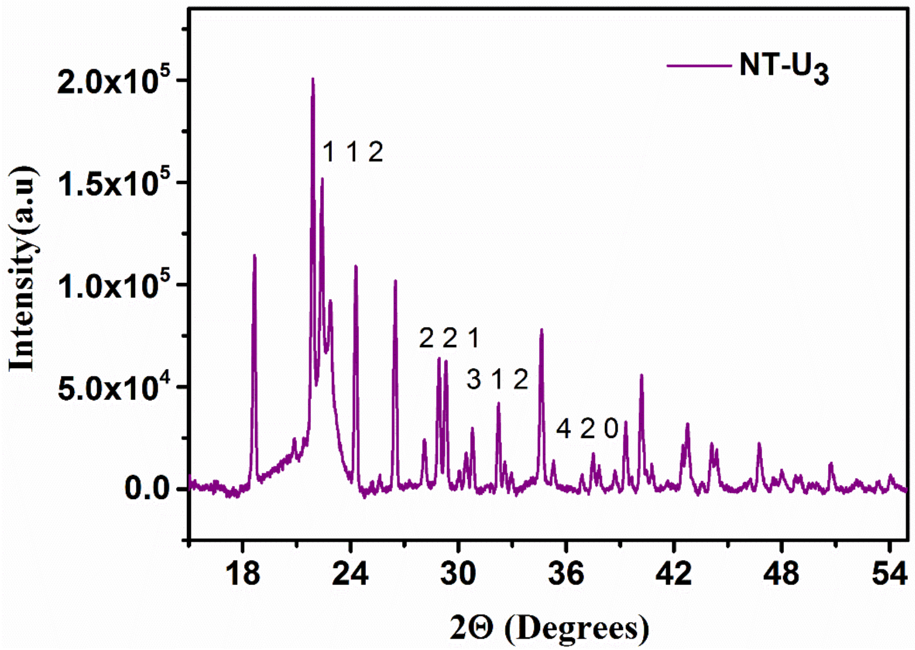
Synthesis of Nano-Urea

Nitrogen
Weight % = 20-30 %

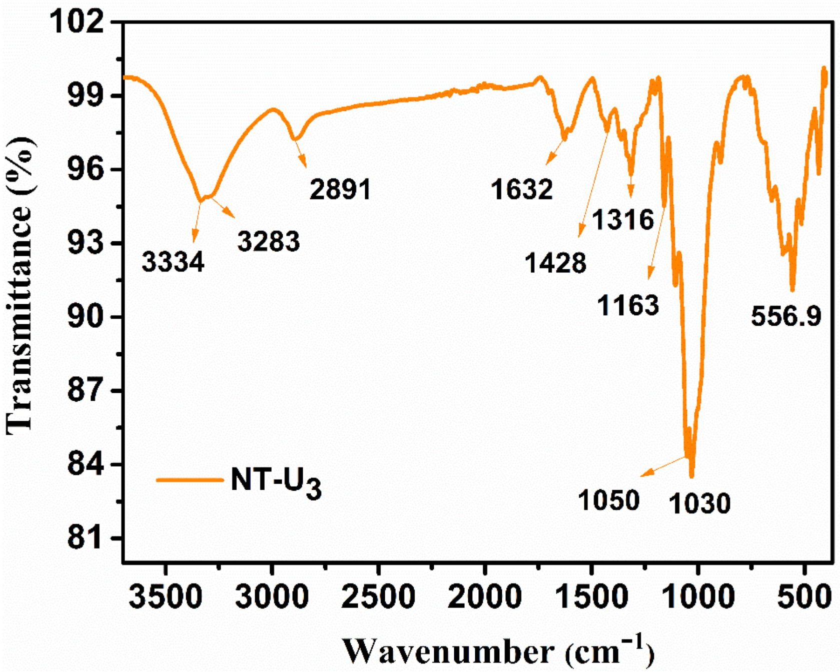
Nano fringes of ~30-40 nm

Highly crystalline material

Synthesis of Nano-Urea- Nano Urea : Binder (1:1)

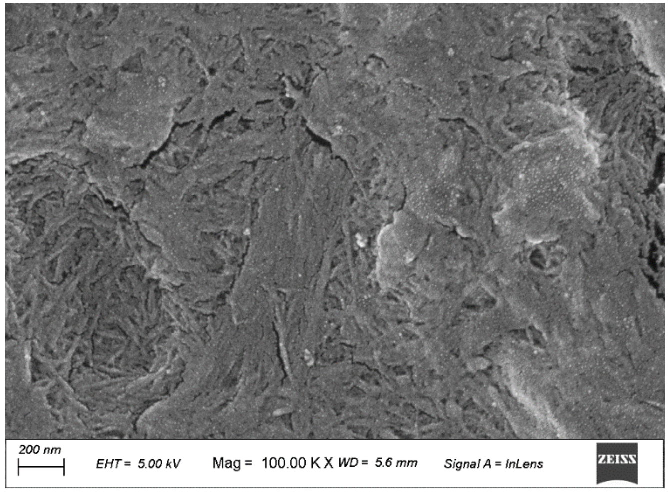


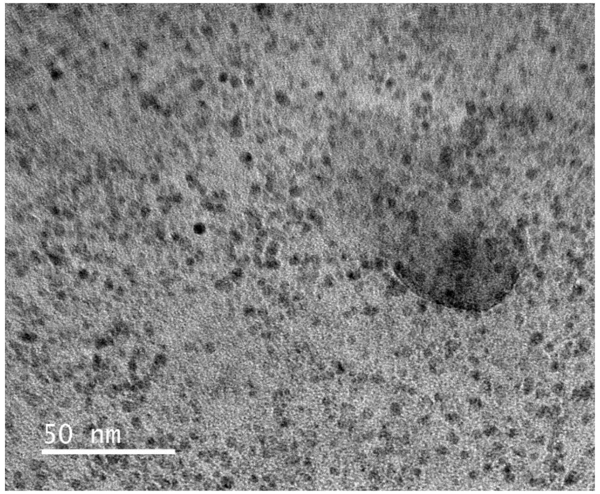
p-XRD



FTIR

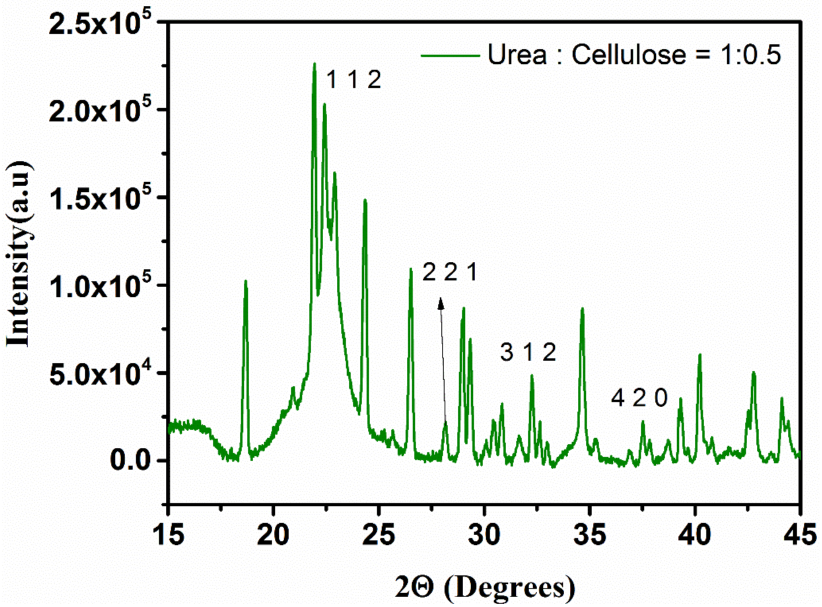
FESEM



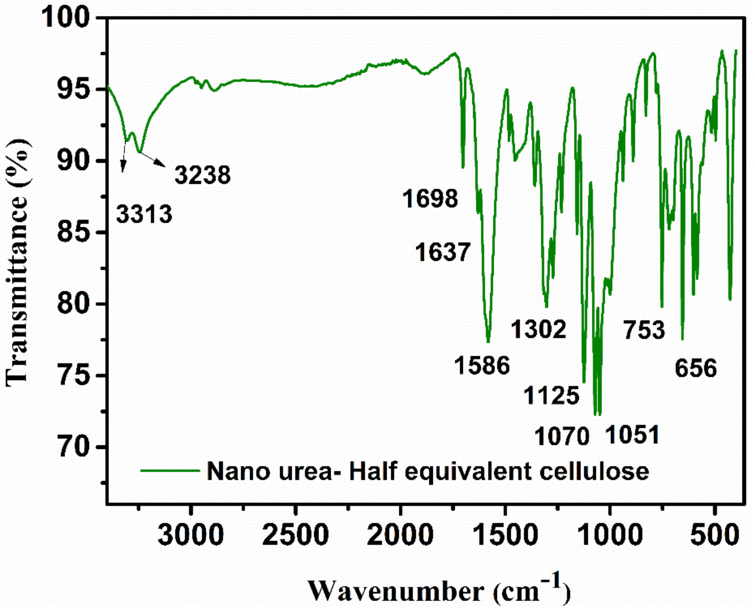


FETEM

Synthesis of Nano-Urea- Nano Urea : Binder (1:0.5)

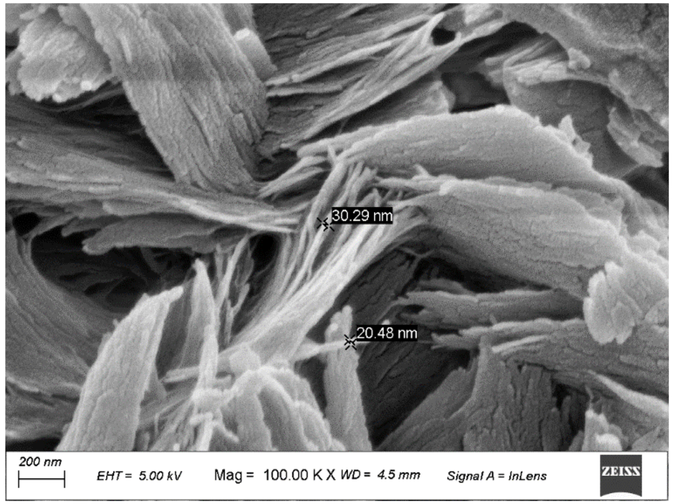


p-XRD

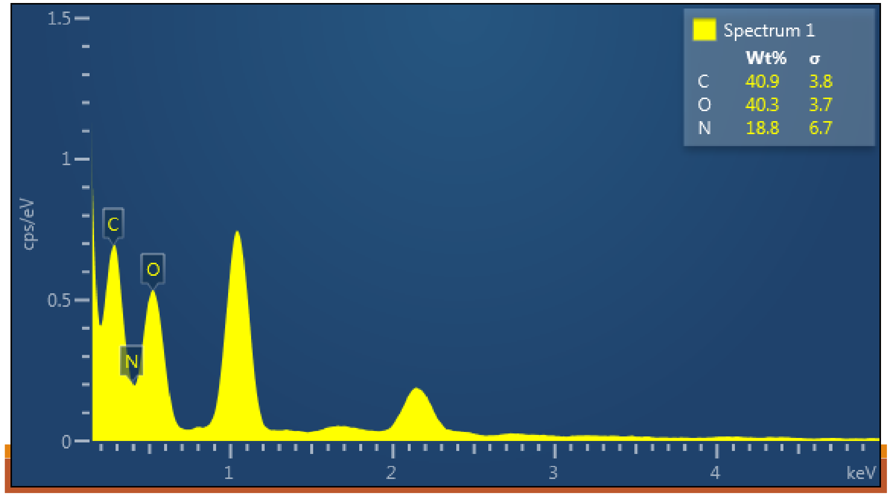


FTIR

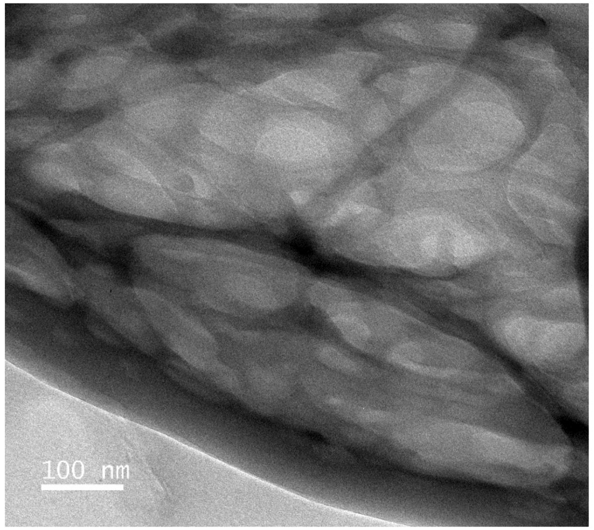
FESEM



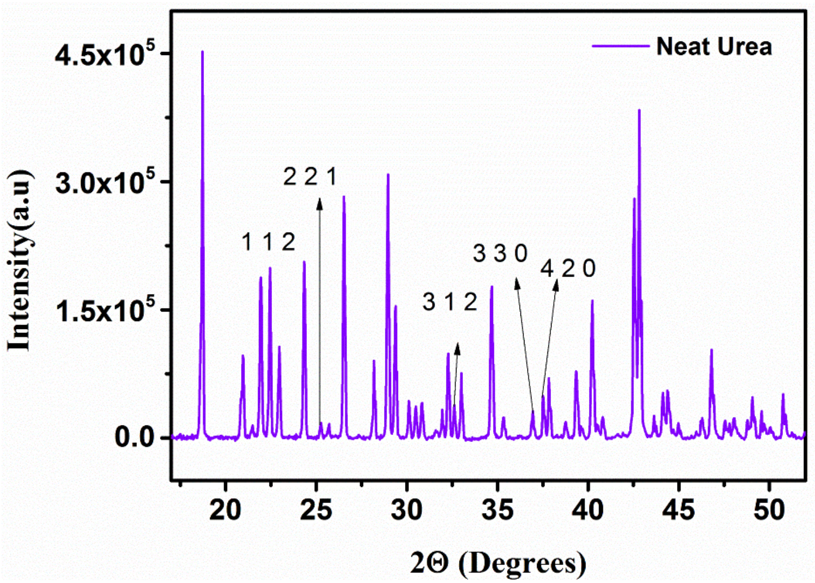
EDS



FETEM

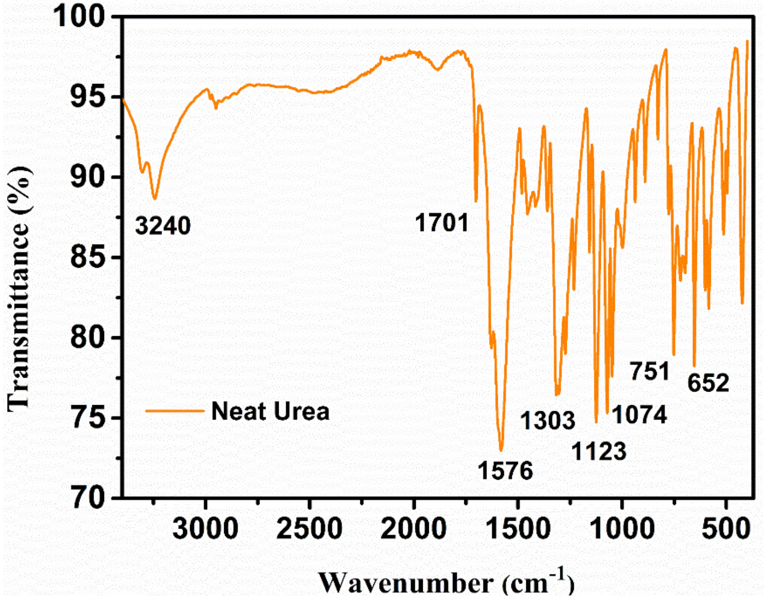


Synthesis of Nano-Urea- Nano Urea (100%)

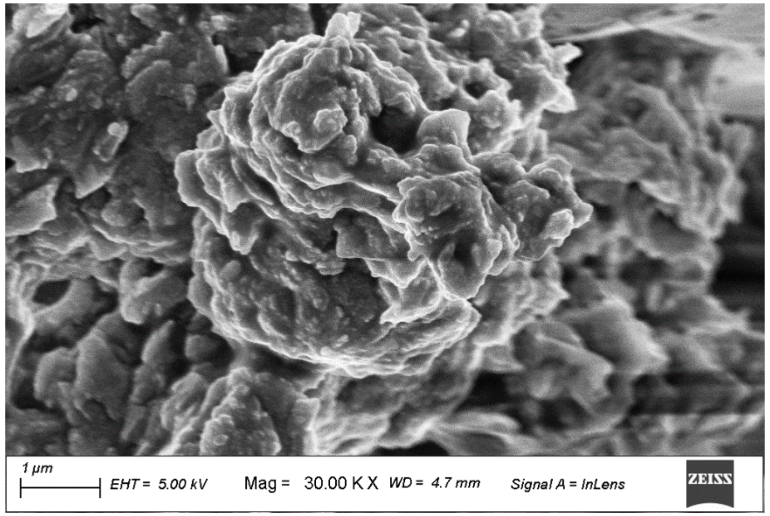


p-XRD

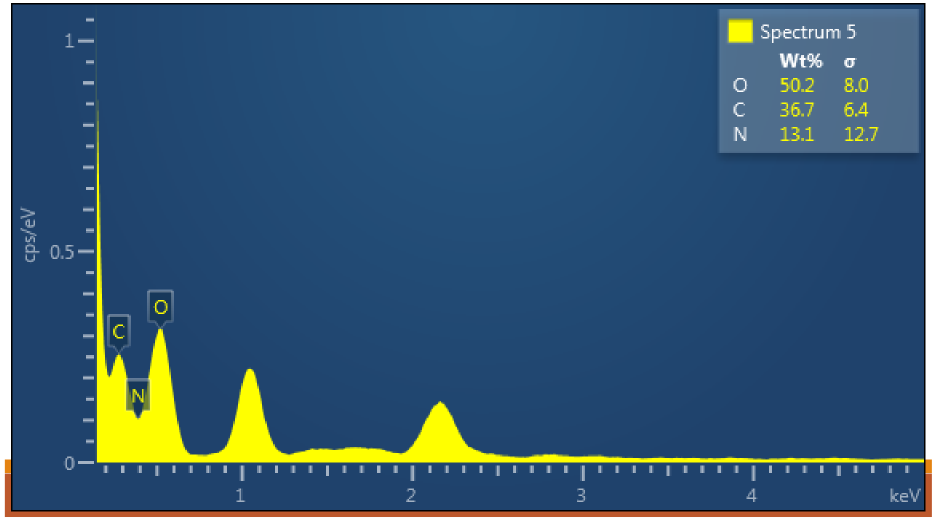
FTIR



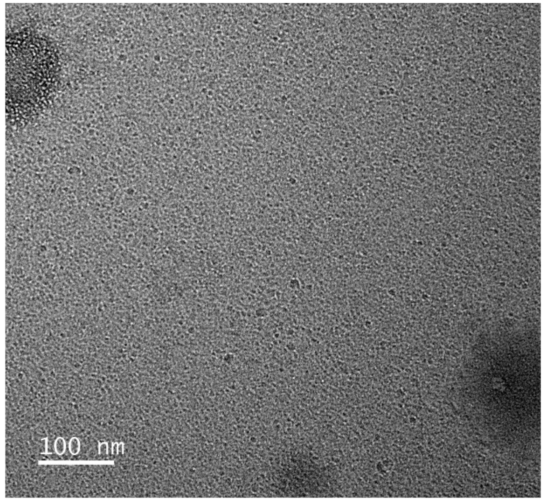
FESEM



EDS



FETEM



Synthesis of Nano-Urea- Characterizations

Sample	*p*-XRD	FESEM	EDS	FETEM	FTIR	NMR		Zeta potential
						^{1}H	^{13}C	
100% Nano Urea	✓	✓	✓	✓	✓	✓	✓	✓
Nano Urea: Slow release Binder 1:0.5 equivalent	✓	✓	✓	✓	✓	✓	✓	✓
Urea: Slow release Binder 1:1 equivalent	✓	✓	✓	✓	✓	✓	✓	✓

Nitrogen Content – 20-23%

Soyabean Crop Trials (MPKV Rahuri)

T1	Control
T2	Recommended dose of Fertilizers
T3	Recommended dose of Biochar (N% =)
T4	20% Less of RDF of Biochar
T5	20% More of RDF Biochar
T6	Recommended Dose of Nanourea (N%=)
T7	20% Less of RDF Nano urea
T8	20% More of RDF Nanourea
T9	Biochar + Nanourea
T10	20% less of BN Content
T11	20% More of BN Content
T12	Rhizobium + Biochar
T13	Azotobactor + Biochar
T14	FVM + Biochar
T15	FVM + Biochar
	Total Nano Urea required (kgs)
	Biochar (Kgs)
Plot Size	3 x 3 m
Design	Randomize Block Design
Total Area Required	125 sqm / replication
Replications	3

CD - Nano Urea : Field Trials

(MPKV Rahuri)

Conventional Urea Vs. Nano Urea

	Conventional Urea	ChemDist Nano Urea Technology
Environmental Pollution	Soil, Water and Air	Nil Pollution
CO2 Footprint	Very High	Almost NIL
Renewable and Green	No	Yes
Nitrogen Convey	30-50 % to plants	More than 80 % to Plant
Sustain Release	No. Due to which more urea wasted in climate	Yes. Due to which no wastage of Nano Urea in climate.
Available Form	Solid	Solid
NOx	NOx formation during use	No NOx emissions
Soil Yield / Fertility	Continuous use decreases soil yield	Increased soil yield and increase in crop production

Media Coverage

BBC coverage on Oxygen Concentrators

Ministry of Education tweets about CD-OXY

PM. Narendra Modi wears our N95 SWASA Mask

Our R&D Network

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Professor, IIT Guwahati
(Clean Energy - Fuel and Solar Cells)

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(Nano Technology)

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Professor, IIT Guwahati
(Bio-inspired Polymer Materials)

Dr. Tapas K. Mandal
Professor, IIT Guwahati
(Micro-Nano Technology for Energy Harvesting)

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INDIA TODAY NE

ChemDistGroup of Companies is the industry collaborator on this project. Speaking on the industrial potential of the research Dr. Sunil Dhole, Director, ChemDist Group of Companies, said, “Commercially speaking, the exciting fact about this work is that an abundantly available and cheaper organic chemical like Methanol can be converted to Hydrogen using a cheaper catalyst, at lower temperatures and without the emission of Carbon Dioxide. This technology has the potential to make significant strides towards achieving carbon neutrality.”

The details of the catalytic system have been published in ACS Catalysis. The paper has been co-authored by Vinay Arora, Eileen Yasmin, Niharika Tanwar, Venkatesha R. Hathwar, Tushar Wagh, Sunil Dhole, and Akshai Kumar A.S.

indiatodayne.in

Media Coverage

Selected in Hydrogen Mission by Govt. of India

IITGu Chemdist News covered by 91 Newspapers all over India

https://www.indiatodayne.in/assam/story/iit-guwahati-researchers-develop-catalyst-to-produce-sustainable-green-hydrogen-fuel-551320-2023-05-01

Selected in Hydrogen Mission by Govt. of India

With Prof. Ajay Sood (Principal Scientific Advisor to the Prime Minister), Dr. Raghunath Mhaselkar (Former DG CSIR)

With Prof. Abhay Karandikar (Secretary Department of Science and Technology, Govt. of India), Dr. Ashish Lele (Director CSIR-NCL)

Dr. Sunil Dhole was nominated for the Padma Shri Award for his contribution in Science and Technology in the year 2023

Thank You

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