



नवीन और  
नवीकरणीय ऊर्जा मंत्रालय  
MINISTRY OF  
NEW AND  
RENEWABLE ENERGY

# SARDAR SWARAN SINGH NATIONAL INSTITUTE OF BIO-ENERGY

(An autonomous institute of Ministry of New and Renewable Energy, GoI)



Quarterly Newsletter

# Bio-ऊर्जा

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Issue 9

## **Word from the Director General, SSS-NIBE**



*The Ninth issue of SSS-NIBE's quarterly newsletter is scheduled for release as we complete the third quarter of the financial year 2024–25.*

*The third quarter was a period of consolidation of the R&D efforts at the institute, particularly with respect to design and optimization of biomass torrefaction technology. Two of the R&D labs underwent review for NABL accreditation by external assessors. The outcome of the review process is awaited.*

*I had the opportunity to participate in the Chintan Shivir 2024, organized by MNRE in Bhubaneswar, and provided valuable insights and suggestions with respect to National Biogas Program: Emerging Role of Biogas in Indian Energy Basket. Also, continuation of our support to co-firing of biomass in thermal power plants, a team of scientists and researchers visited NTPC Jhajjar and NTPC Dadri in order to understand biomass handling and co-firing related issues at these plants, specifically looking for solutions to operational challenges that have emerged with biomass utilization in thermal power plants.*

*This quarter witnessed conducting a 5-day National Hands-on Training Programme on Biogas Technology. There were pan India participation which included researchers, start-ups and consultants.*

*Dr. G. Sridhar  
(Director General)  
SSS-NIBE*

## Research and Innovation

### **Rice straw biomass conversion into phenolic rich bio-oil through hydrothermal liquefaction process**

Ms. Mridusmita Dutta & Dr. Bijoy Biswas

Energy is the driving force behind the development of the global economy. Fossil fuels such as coal, petroleum, and natural gas currently meet a significant portion of the world's energy demands. However, the combustion of fossil fuels releases substantial amounts of CO<sub>2</sub>, CO, and other greenhouse gases, contributing to environmental challenges such as the greenhouse effect, global warming, and climate change.

Rapid industrialization and population growth have led to a dramatic increase in energy consumption, resulting in the depletion of fossil fuel reserves and an urgent search for alternative energy sources. Among these, biofuels have emerged as a promising solution to reduce greenhouse gas emissions and mitigate the adverse effects of particulate matter in energy generation.

Initially, the production of first-generation biofuels relied heavily on consumable crops such as maize, sugarcane, sorghum, soybean, beans, and palm. This approach raised

concerns over the potential conflict between food security and fuel production. As a result, attention has shifted towards second and third-generation biomasses, which include non-food resources such as rice straw, rice husk, tamarind seeds, corn cobs, algae, water hyacinth, wood, sawdust, and other lignocellulosic materials.

Rice straw is among the most abundant lignocellulosic agricultural residues worldwide and offers substantial potential as a renewable resource due to its composition, which includes lignin, cellulose, hemicellulose, and ash. Biomass like rice straw can be converted into various value-added products using thermo-chemical and biochemical processes. Thermo-chemical conversion methods such as combustion, pyrolysis, gasification, and hydrothermal liquefaction are particularly effective in transforming biomass into quality bio-oil, fuels and other valuable materials.

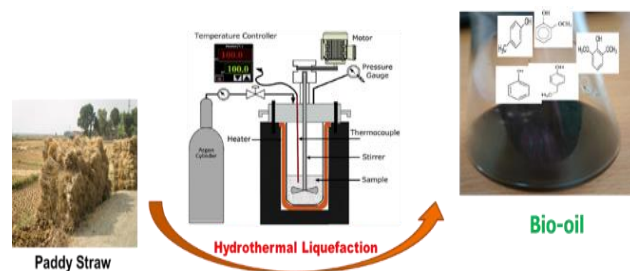
Hydrothermal liquefaction (HTL) is a highly promising thermochemical technique for converting biomass in the presence of various solvents into valuable chemicals and fuels. This method is effective for the producing the

lower oxygen containing bio-oil compared to the pyrolysis. HTL is typically carried out in water/other solvents at temperatures between 250 and 374 °C and pressures ranging from 4 to 22 MPa. The hydrothermal process is characterized by two distinct reaction environments: subcritical and supercritical, defined by the critical point of water/other solvents. These environments offer unique benefits. For example, while biomass components like cellulose and lignin are insoluble in ambient water, they become soluble in supercritical or high-temperature water. Under sub/supercritical conditions, biomass macromolecules are broken down into their basic components and producing higher bio-oil yield.

Bio-oil, the primary product derived from the hydrothermal liquefaction of biomass, contains a variety of compounds, including phenolics, carbonyls, esters, acids, and nitrogen-containing compounds. To enhance the production of phenolic compounds, it is essential to optimize reaction process parameters and employ suitable catalysts.

Phenolic-rich bio-oil has versatile applications. It can be used to produce biochemicals such as phenolics and ketones, which serve as solvents

and resins. Additionally, it can be converted into aromatic hydrocarbons, widely utilized as solvents and fuels in industrial applications. Phenolic-rich bio-oil is also a potential substitute for petroleum-derived phenol in phenolic resins, offering a sustainable alternative.



Another notable application of phenolic-rich bio-oil is in treating oxidized asphalt binder used in roads, roofs, airports, and bridge decks. The bio-oil can restore the binder's physical properties, improving its resistance to cracking.

Catalysts play a crucial role in converting biomass macromolecules into monomeric compounds and other desirable products. Non-noble metals such as Fe, Ni, Co, and V, supported on materials like ZSM-5, Al<sub>2</sub>O<sub>3</sub>, CeO<sub>2</sub>, ZrO<sub>2</sub>, as well as biomass-derived biochar used as metal-supported catalysts, have garnered significant attention for the production of higher yields and phenolic-rich bio-oil. Developing efficient and cost-effective

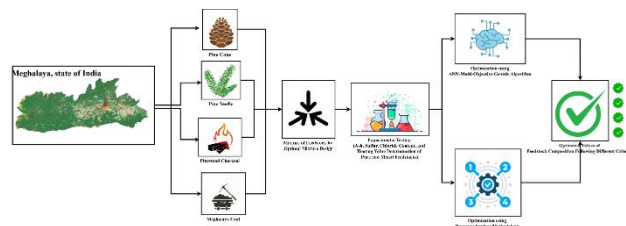
catalysts is essential for maximizing biomass conversion and enhancing the production of phenolic-rich bio-oil.

## Unique AI-driven approach for optimizing Biomass-Coal cofiring in Meghalaya region

Dr. Anil Kumar Sarma, Dr. Tapas Patra & Team<sup>a</sup>

The underutilization of forest biomass in India, particularly in the state of Meghalaya, has been a growing concern due to challenges like limited infrastructure and competing land uses. The study titled “A comprehensive analysis and optimization of coal-biomass mixed fuel for sustainable power generation using the design of experiments and artificial neural network” addresses the issue by exploring the feasibility of co-combusting Meghalayan coal with forest biomass—namely pinewood charcoal, pine cones, and pine needles—to enhance energy output while minimizing environmental pollutants such as sulfur, chloride, and ash content. Meghalaya, a state with abundant forest cover, has vast potential for leveraging forest residues like pine cones and needles, which are often left to waste or contribute to forest fires. This study is significant as it aims to provide a solution to both the energy deficit

in Meghalaya and the environmental issues arising from coal combustion.



This research is unique in its approach, as it integrates a multi-objective optimization technique combining artificial neural networks (ANNs) with a genetic algorithm to develop the optimal composition of coal-biomass mixtures for energy generation. By using response surface methodology and regression analysis, the study optimized the mixture to maximize heating value while reducing harmful emissions. The study identified an optimal blend of 50% coal, 10% pinewood charcoal, 23.49% pine cone, and 16.52% pine needle that yielded a heating value of 3873.70 kcal/kg while keeping sulfur, chloride, and ash content within acceptable limits. In the study, various other cases were also analyzed to optimize the coal-biomass mixture for different performance goals. These included combinations to achieve the lowest chloride, sulfur, and dry ash content, as well as those designed to maximize the heating value (HHV).

Additionally, specific cases were studied to minimize pinewood charcoal usage while maximizing pine cone and pine needle content, balancing both environmental, fuel efficiency and powerplant guideline considerations. This innovative research offers a promising solution for sustainable power

generation in Meghalaya by utilizing underexploited forest biomass. It sets the groundwork for replicating such initiatives in other forest-rich regions, helping address both energy and environmental challenges in a sustainable manner.

## News and Events

### **Researcher Receives Young Scientist Award**

Dr. Bijoy Biswas (PDF, Chemical Conversion Division, SSS-NIBE) was honored with the Young Scientist Award by the Biotech Research Society of India (BRSI) for 2023, recognizing his groundbreaking research in utilizing biomass and food waste for high-value chemicals and fuels. The award was presented at the International Conference on Advances in Biotechnology and Bioinformatics (ICABB-2024) in Pune, November 26–29, 2024.

### **Training session on Central Secretariat Manual of Office Procedure**

On October 17<sup>th</sup>, 2024, Sh. Kailash Chand, Deputy Secretary, MNRE, and Sh. Arun Singh Gurjar, ASO, MNRE, led a training session on the provisions of the Central Secretariat Manual of Office Procedure (CSMoP) related to Record Management (Chapter 10). This session was part of Special Campaign 4.0 and was conducted at the SSS-NIBE Committee Room. The focus was on key elements of Record Management in accordance with the CSMoP guidelines, aimed at ensuring efficient and systematic record handling within the department. In addition to CSMoP provisions, the session also addressed relevant practices under the General Financial Rules (GFR), the Public Records Act, and Record Retention



Dr. Bijoy Biswas Receiving the Young Scientist Award

Schedules, ensuring that participants gained a comprehensive understanding of the applicable legal and regulatory frameworks. The training was designed to improve adherence to best practices in record management, supporting transparency and accountability within the organization.

### **National Hands-on Training Programme on biogas**

SSS-NIBE, in collaboration with the Indian Biogas Association (IBA), jointly organized a National Hands-on Training Programme on Biogas Technology and its Implementation from 21st to 25th October 2024. The event was officially inaugurated by Dr. G. Sridhar, Director General (DG), SSS-NIBE. The inaugural session was graced by the Chief Guest, Shri. Adarsh Pal Vig, Chairman of the Punjab Pollution Control Board, along with Shri. Gaurav Kedia, Chairman of the Indian Biogas Association. The training program aimed to provide participants with practical knowledge and skills in biogas technology and its effective implementation, fostering advancements in sustainable energy solutions.

This five-day event aimed to provide

participants with comprehensive knowledge and practical skills in biogas production, utilization, and its role in promoting sustainable energy solutions.



National Hands-on Training Programme on biogas

### **Vigilance awareness week**

SSS-NIBE actively observed "Vigilance Awareness Week-2024" from 28<sup>th</sup> October to 3<sup>rd</sup> November 2024, in line with the national initiative to promote transparency, integrity, and accountability across all levels of governance. The observance began with the enthusiastic participation of officers, staff, research scholars, and other members of the institute in taking the "Integrity Pledge" on 28<sup>th</sup> October 2024, reaffirming their commitment to ethical practices and combating corruption in all its forms.

To foster awareness and engage participants, a series of interactive activities were organized, including a quiz and debate competition on

29<sup>th</sup> October 2024. These events, held in the Dr. A.P.J. Abdul Kalam Auditorium, SSS-NIBE witnessed vibrant participation and lively discussions that underscored the importance of integrity and vigilance in professional and personal conduct.



Vigilance awareness week

The week-long observance aimed to reinforce the institute's dedication to promoting a culture of honesty and fairness, while inspiring individuals to become proactive champions of anti-corruption initiatives. Such programs not only create awareness but also strengthen the moral fabric of the institution, contributing to a more transparent and accountable environment.

### **CII Bioenergy Summit**

CII organized the 12th CII Bioenergy Summit on the theme "Fueling the Future - Securing India's Green Growth Goals" on 14 October 2024 in New Delhi. DG, SSS-NIBE, Dr. G Sridhar participated as an esteemed panelist in the

session on "Navigating Supply Chain Complexities: Strategies for a Sustainable Future" during the summit.

The summit was further graced by the presence of Hon'ble Ministers Shri Nitin Gadkari (Ministry of Road Transport and Highways) and Shri Hardeep Singh Puri (Ministry of Petroleum and Natural Gas), who delivered inspiring keynote talks. Their addresses highlighted the government's commitment to fostering bioenergy initiatives and aligning them with India's green growth ambitions, particularly in achieving energy security and reducing carbon emissions.

The event provided an excellent opportunity for collaboration and knowledge sharing among stakeholders, reinforcing the importance of bioenergy in achieving India's sustainable development goals.

### **Exhibition in REI Expo**

The Renewable Energy India Expo (REI Expo) was held at the India Expo Centre and Mart, Greater Noida, Uttar Pradesh, from 3rd to 5th October 2024. The event showcased innovative advancements in renewable energy and provided a platform for industry leaders, researchers, and policymakers to discuss and explore sustainable energy solutions.



As part of the event, the Bioenergy Pavilion featured a dedicated booth managed by SSS-NIBE on behalf of the Ministry of New and Renewable Energy (MNRE). The stall highlighted NIBE's significant contributions to bioenergy research and development through an array of posters, displays, and interactive materials showcasing the institute's work and ongoing projects.

Dr. Sachin Kumar and Dr. Vandit Vijay, along with research scholars from SSS-NIBE, actively represented the institute at the pavilion, engaging with visitors and stakeholders to share insights into the cutting-edge bioenergy technologies being developed at the institute. Dr. Sachin Kumar also delivered an insightful talk at the international conference held during the expo on 5th October 2024, where he presented recent advancements in bioenergy and their potential to drive India's green energy transition.

### **Constitution Day Celebration**

On November 26, 2024, the institute celebrated Constitution Day, emphasizing the importance of reflecting on our rights and responsibilities as individuals dedicated to the progress and unity of the nation. During the event, a pledge was taken by all attendees to

be responsible citizens and uphold the values enshrined in the Constitution. The celebration brought together staff, students, and faculty members, who collectively pledged to support the ideals of justice, equality, and liberty as envisioned by the framers of the Constitution. This occasion served as a reminder of our commitment to the democratic principles that guide our nation.



Constitution Day Celebration

### **Hindi Workshop**

In compliance with the official language rules, a workshop was organized in the institute on 26<sup>th</sup> November, in the Dr. A.P.J. Abdul Kalam Auditorium. The session featured an engaging talk by Mr. Manoj Bhat, Deputy Director (Official Language), Lok Sabha, who provided in-depth insights into the Rajbhasha Acts, along with practical guidance on official noting and drafting in Hindi. The workshop aimed to promote the use of Hindi in official communication and enhance participants'

understanding of its implementation as part of administrative processes.

### Visit to Hyderabad

Dr. Sanjeev Mishra visited Jawaharlal Nehru Technical University, Hyderabad to participate

and deliver a talk at 2nd International Symposium on Advance in Algal Research (AAR 2024 during 17-18 Dec. Additionally, on 16<sup>th</sup> December, 2024, Dr. Mishra visited M/s Kaashyap Energy Infrastructure Pvt. Ltd, a wastewater treatment and biofuel plant.



#### Published by:

Director General,  
Sardar Swaran Singh National Institute of Bio-Energy,  
Kapurthala, Punjab,  
Pincode-144603

**Publication Team:** Editor: Dr. Sandeep Kumar Assistance: Mr. Hitesh Sharma

Website: <http://nibe.res.in>

Email: [sss.nibe@nibe.res.in](mailto:sss.nibe@nibe.res.in)

Twitter@SssNibe

Telephone: (+91)1822507406

Facebook: <https://www.facebook.com/SSS.NIBE>

\*\*\*\*\*For suggestion please contact at [sss.nibe@nibe.res.in](mailto:sss.nibe@nibe.res.in)\*\*\*\*\*