Azadi Ka Amrit Mahotsav

SSS NIBE

G20 भारत 2023 INDIA

Quarterly Newsletter

BIO-ऊर्जा

Sardar Swaran Singh National Institute of Bio Energy, Kapurthala

(An Autonomous Institution of Ministry of New and Renewable Energy)

October 2023

Issue - 4

Word from Director General, SSS-NIBE

The fourth issue of our quarterly newsletter is scheduled for release as we complete the second quarter of the new financial year 2023–24. This quarter witnessed discussions with several industries about the piloting of in-house bioenergy technologies developed at the institute. The technologies pertain to the production of biogas and 2G ethanol from agricultural residues such as paddy straw and Napier grass. A non-disclosure agreement has been signed with a few industries, and the pilot plants are expected to be installed in the next financial year. Similarly, preparations have reached a crescendo with respect to hosting an international conference (ICRBAR) in October 2023. All staff and students are looking forward to this event. As it goes without saying, we appreciate your thoughts and recommendations to improve communication in the upcoming newsletter.

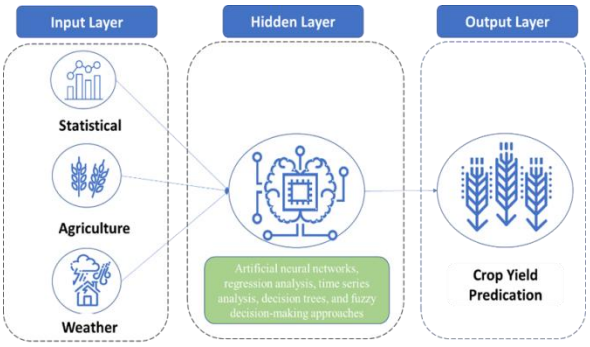
Dr. G. Sridhar
(Director General)
SSS-NIBE

Research and Innovation

Crop Biomass Forecasting

The rise in world population and level of life is predicted to cause a large-scale increase in the demand for food grains, particularly in the middle of the twenty-first century. On the other hand, climate change is also threatening food harvests, putting farmers and their livelihoods at risk. Therefore, it became essential to have long-term crop forecasting using artificial intelligence and machine learning systems that can reliably analyze crop conditions, crop type, and yield. Crop yield patterns are time-dependent and non-linear in nature as a result of the confluence of a vast number of interconnected elements impacted by non-mediation and external characteristics. In the past, farmers made crucial agricultural decisions using crop production predictions based on their prior experiences and reliable historical data. In particular, statistical methods use multiple regression models to connect historical crop yields to historical weather data, which can be used to forecast crop yields under various weather conditions, including drought, temperature, precipitation, and availability of water resources. The accessibility of the swell and the improved quality of the observed historical data have a significant impact on the accuracy of statistical approaches.

Furthermore, remote sensing—specifically, geographical processing system, satellite images, photography, and video—allows for precise crop management through the development of precise and accurate crop maps. In addition, artificial and machine learning (ML) algorithms offer more significant promise for examining weather-yield correlations than statistical methods. Machine learning (ML) methods for crop forecasting include artificial neural networks, regression analysis, time series analysis, decision trees, and fuzzy decision-making approaches.



Crop Biomass Forecasting

The application of these machine learning techniques in crop production has a significant benefit due to the availability of many data sources from which to retrieve hidden information. In addition, the crop yield prediction systems enable better planning and decision-making to increase crop production. In future, the accuracy in the crop yield prediction will ultimately indicate the total and the surplus agro-residue biomass

availability for bioenergy generation, its potential under different scenarios as well as the production of value-added bi-products from biomass.

Conversion of plastic Waste into useful product

Scientists and researchers are searching for novel and sustainable ways to reuse and recycle the plastic waste in order to lessen its harmful effects on the environment as a result of exponential rise in plastic production and the ensuing spike in plastic waste generation. Waste plastic has been accumulating in the environment for decades as a result of the linear approach to resource utilization. Unfortunately, there have always been bottlenecks that have led to quality decline and inefficient value recovery in both conventional mechanical recycling and thermochemical waste treatment. The development of new and sustainable recycling methods is essential owing to the amount of pressure on the current infrastructure in place of the disposal of plastic waste. Plastic waste production and consumption is increasing at an alarming rate, with the increase of the human population, rapid economic growth, continuous urbanization, and changes in life style. The global plastic production rate was increased from 300 to 360 million tons per year in last five years and is continuously increasing every year[1]. Plastic waste recycling is carried out in different ways, but in most developing countries, open or landfill disposal is a common practice for plastic waste management. The disposal of plastic waste in landfills provide habitat for insects and rodents that may cause different types of diseases. Furthermore the cost of transportation, labour and maintenance may increase the cost of recycling projects. In addition, due to rapid urbanization, the land available for landfills, especially in cities, is reducing.

In this study, conversion of plastic waste into useful product was carried out via thermal pyrolysis process. Pyrolysis is a common technique used to convert plastic waste into useful products in the form of solid, liquid and gaseous fuels. Pyrolysis is an endothermic process that produces bio-oil and solid char by heating the feedstock to a temperature between 400 and 650 °C in the absence of oxygen[1-3]. The pyrolysis process parameters, such as feedstock particle size, temperature, and heating rate, affect the product yield. Low heating rates are used in slow pyrolysis, which can increase char production. Fast pyrolysis is carried out at a rapid heating rate, with vapour retention times of less than one second. The benefit of fast pyrolysis is that it concentrates energy in the bio-oil and increases the yield of the finished product. Fast pyrolysis is additionally regarded as the most commercially viable method of producing bio-oil. The advantages of low nitrogen and sulphur content, high energy density, and ease of handling are particularly evident in bio-oil

from pyrolysis. However, the generated bio-oil has undesirable qualities such as high water and oxygen content, high viscosity, and corrosiveness, which prevent it from being used as a transportation fuel directly. Furthermore, biomass has a poor hydrogen/effective carbon ratio (H/Ceff), which leads to a low yield of aromatic compounds and a large generation of coke. To make up for the poor H/Ceff of the biomass, hydrogen-rich polymers can be supplied as feedstock. The oxygen content of the bio-oil is reduced and the selectivity to the aromatic molecule is increased by feeding biomass and plastic together.

Many plastic wastes, including polyethylene (PE), polypropylene (PP), and polyethylene terephthalate (PET), are high in hydrogen and low in oxygen, making them potential hydrogen donors during co-pyrolysis with biomass. Pyrolysis oil made from plastic has a calorific value of around 40 MJ/kg, which is higher than that made from biomass (which has a calorific value of around 17 MJ/kg). In the meantime, the high demand for plastics results in a huge annual build-up of waste. More than 60% of the waste plastics generated worldwide are dumped in landfills, endangering human health and causing various environmental issues. Thus, co-pyrolysis of biomass and plastics can be used to create energy that is sustainable and less harmful to the environment.

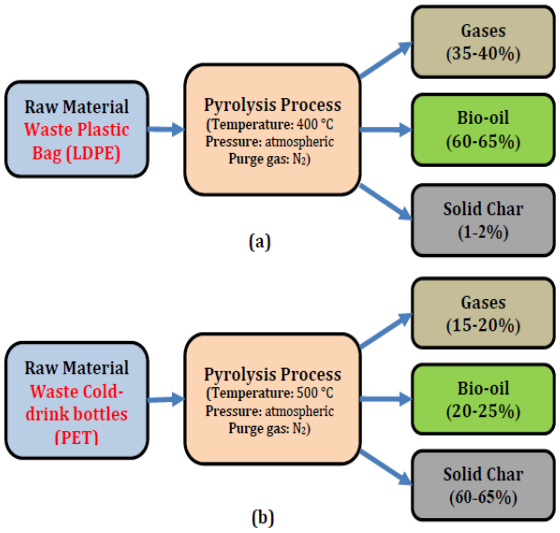


Fig.2: Raw material, reaction conditions, and product obtained from pyrolysis of plastic waste (a) Pyrolysis of Waste plastic bags (LDPE), (b) Pyrolysis of Waste cold drink bottles (PET).

This study is carried out to investigate the effect of temperature, on product quality and yield from pyrolysis of plastic waste. Pyrolysis of different types of plastic wastes plastic (PS, PE, PP, and PET) as single or mixed in different ratios, in the presence of nitrogen and with and without catalyst was carried out in a small pilot scale pyrolysis reactor. The quality, yield, and characterization of pyrolysis products such as liquid oil, gas, and char was also be carried out with different analytic tools such as GC-TCD, GC-FID, GC-MS, etc. Some of results obtained after the pyrolysis of LDPE (waste plastic bags) and PET (waste cold drink bottles) can be found from Fig.2.

1.Rafey, A., Pal, K., Bohre, A., Modak, A., & Pant, K. K. (2023). Catalysts, 13(2), 420.
2.Maqsood, T., Dai, J., Zhang, Y., Guang, M., & Li, B. (2021). Journal of Analytical and Applied Pyrolysis, 159, 105295.
3.Kartik, S., Balsora, H. K., Sharma, M., Saptoro, A., Jain, R. K., Joshi, J. B., & Sharma, A. (2022). Thermal Science and Engineering

News and Events

International Conference on Green Hydrogen

The International Conference on Green Hydrogen (ICGH-2023), a three-day event, was attended by Director General of SSS-NIBE, Dr. A. Senthil (Sci-D), and Dr. Vandit Vijay (Sci-C). This conference took place from the 5th to 7th July, 2023 at Vigyan Bhawan, New Delhi, and was organized by the Government of India. The inauguration of ICGH-2023 was presided by the Union Minister for Power and New and Renewable Energy, Shri R. K. Singh. ICGH-2023 served as a significant platform for cultivating collaborations aimed at realizing our shared vision of a pristine and ecologically sustainable planet with the focus on Hydrogen.

Quarterly Hindi Review Meeting

On the 10th July, 2023, a Hindi review meeting was conducted at the Institute. The meeting, held in the presence of the Director General, was convened in the meeting room to assess the progress of Hindi-related activities at the Institute. Shri V. K. Aggarwal, a Hindi Expert from the Ministry of New and Renewable Energy (MNRE), was invited to partake in this meeting. His invaluable guidance and contributions ensured the successful execution of the meeting.

Visit to NIT Kurukshetra

On 21st July, 2023, Dr. Anil Kumar Sarma visited the National Institute of Technology, Kurukshetra (NIT Kurukshetra). During this visit, he delivered a lecture on the subject of "Technical Aspects and Characterization of Biomass & Pellets Co-firing in Thermal Power Plants (TPPs)." This lecture was an integral part of a one-day training and awareness program organized under the SAMARTH mission.

Visitors from Thapar University

On the 3rd August, 2023, a delegation of professors from Thapar Institute of Engineering and Technology, Patiala, under the leadership of Prof. S.S. Mallick, visited our campus. The primary purpose of their visit was to engage in discussions regarding a collaborative project proposal that had been submitted to the Department of Science and Technology (DST).

Celebration of 77th Independence Day

The 77th Independence Day was celebrated with great enthusiasm at the institute on the 15th August, 2023. The Director General of the Institute had the honor of hoisting the National Flag to mark this significant occasion. Following the flag-hoisting ceremony, Director General NIBE led a tree planting initiative. Additionally, a brief

cultural program was organized, featuring the active participation of researchers, staff, and their families, thereby adding to the festive spirit of the event.

Orientation Program for M.Tech Batch 2023

On August 28, 2023, a collective orientation program was organized for the recently admitted 11 M.Tech (Renewable Energy) students at SSS-NIBE. During the event, the Director General of NIBE extended a warm welcome to the incoming M.Tech students. The new students, in turn, introduced themselves, after which a brief interactive session ensued, allowing them to engage with faculty members from NITJ and all scientific staff of SSS-NIBE.

Meeting with CPRI Team of Subgroup-I, SAMARTH Mission

A comprehensive project review meeting took place on the 27th of September with the team from Central Power Research Institute (CPRI), belonging to Subgroup-I of the SAMARTH Mission. The meeting was presided over by Shri B.A. Sewale, DG, CPRI. The primary objective of this meeting was to assess the progress of the three projects that had been sanctioned to SSS-NIBE by CPRI. DG, SSS-NIBE extended a warm welcome to the members of the CPRI team. During the meeting, the respective project team from NIBE presented the advancements and developments pertaining to each of the three projects. Subsequently, the team led by Shri Sewale had the opportunity to visit the Research and Development Labs, where they observed the operation of equipment and ongoing experimental work, further enhancing their understanding of the projects status.

International Conference on Recent Advances in Bioenergy Research

Online call for abstract/paper submission announced for the 4rd International Conference on Recent Advances in Bioenergy Research (ICRABR), to be held at SSS-NIBE, Kapurthala between October 9 and 12th, 2023. Full-length manuscripts are invited related to the conference themes mentioned below. All submitted manuscripts will undergo a peer review process for selection. Selected papers from the conference will be published in Scopus Indexed Proceedings and Journals after peer review. More details are available on: https://www.icrabr.com/.

Broad themes/Tracks of ICRABR 2023:

- **Biomass Resource Management**
- **Biomass/waste conversion to energy**
- **Biomass Valorisation/ Waste to value added materials/ Products**
- **Modelling of Bio-energy system**
- **Biorefinery and Biohydrogen**

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