

Laboratory of Sustainable Material Cycle Systems

Kazuei Ishii

Professor, Laboratory of Sustainable
Material Cycle Systems
Faculty of Engineering,
Director, Hokkaido University
Research and Education Center for
Robust Agriculture, Forestry and
Fisheries Industry,
Hokkaido University, Japan



Staff

Laboratory of Sustainable Material Cycle Systems

Prof.	Kazuei Ishii
Associate Prof.	Shiho Ishikawa
Assist. Prof.	Geun-Yong Ham
PD	Jumana Ali Falah Al-mallahi

Students

Graduate	13 persons (Dr:2, M2:4, M1:7)
Undergraduate	6 persons

Laboratory of Biomass Community Planning

Prof.	Toru Furuichi
Assist. Prof.	Satoru Ochiai



Self-introduction



Name: Kazuei Ishii
 Birth: Sapporo city
 on 22/04/1970
 Age: 54

- Soil and groundwater pollution remediation
- Waste management system planning
- Biomass utilization system development
- Town development based on utilization of regional resources

1993 Bachelor of Sanitary Engineering,
 Hokkaido University
 1995 Master of Sanitary Engineering, Hokkaido
 University
 1997 Research associate at Faculty of
 Engineering, Hokkaido Univ. through
 doctoral course
 2004 Ph.D
 2010 Associate Professor, Hokkaido Univ.
 2018 Professor, Hokkaido Univ.

Laboratory of Sustainable Material Cycle Systems



<https://smcs.eng.hokudai.ac.jp/>

Self-introduction

Geun-Yong HAM (ハム・グンヨン)

Seoul, Republic of Korea

Assistant Professor at Laboratory of Sustainable Material Cycle Systems, Hokkaido University



<ACADEMIC QUALIFICATION>

2017-2020: Ph.D. in Environmental Engineering at Hokkaido University

2013-2015: MSc in Energy and Environmental System Engineering at University of Seoul

2009-2013: BSc in Environmental Engineering at University of Seoul, Republic of Korea

<WORK EXPERIENCE>

2020-2022: Research Associate at National Institute for Environmental Studies, Japan

2015-2017: Researcher at Eco-energies research center, University of Seoul

<RESEARCH>

- Bio-drying MBT (Ph.D. thesis and up to date)
- Assessment of bioplastics' biodegradability under various environment
- Anaerobic digestion for food wastes
- N & P recovery from the organic wastes (food waste, livestock manure, sewage sludge)

Purpose of our research

To manage material flow and conversion adequately in our society, it is very important to reduce wastes, to promote recycling, and to make plans reasonably to construct proper treatment and disposal facilities, based on public involvement.

Our goal of research is to develop reasonable and sustainable material cycle, including waste, biomass, and energy, from the practical and technical viewpoints by using system approaches and socio-economic methods.



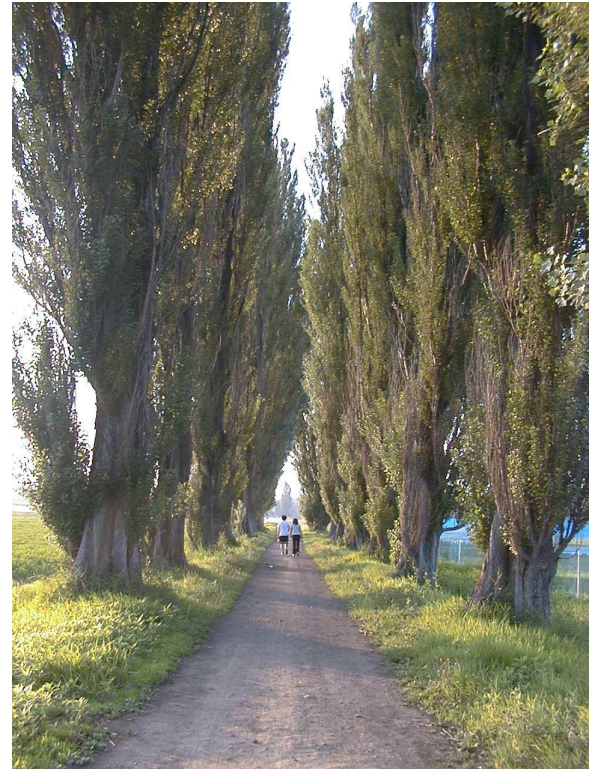
Our approach for solutions

1. Systems Approach

- Macroscopic thinking
- Integration of social and technical aspects

2. Practical Approach

- Practical solutions to waste management problems
- Community-based planning for sustainable society



1. System planning for solid waste management

- 1) Study on location of waste incineration facilities for new integration of municipalities in Hokkaido (2021, B)
- 2) Development of Waste Management Strategies based on Recycling and Energy Recovery in Indonesia (2021, D)
- 3) Study on Estimation of the Ratio of Greenhouse Gas Emission and Absorption and the Effects of Introducing Renewable Energy in Each Municipality, Hokkaido (2021, M)
- 4) Study on an Estimation Method of Energy Consumption in Each Sector for Verifying the Effectiveness of Local Decarbonization Policies: A Case Study in Akaigawa Village (2022, M)
- 5) Estimation of Greenhouse Gas Emissions by Mitigation Measures in Hokkaido Prefecture and Each Municipality (2022, B)
- 6) A New Approach for Promoting Resource Recycling and Residual Waste Reduction in Malaysia (2021, D)
- 7) Study on Visualization of the Change in the Regional Industrial Structure by introducing Biogas Plants (2022, M)
- 8) Study on optimal placement of waste incineration and transfer station facilities for rearrangement of wide-area waste management in Hokkaido as of 2050 (2023, M)
- 9) Analysis of regional resource circulation structure in a small-scale local municipality using a regional resource circulation map (2023, B)
- 10) Study on regional similarity of decarbonization measures among municipalities in Hokkaido (2023, B)



2. Environmental conservation and risk management

- 1) A study to improve feeding and working environment for stable milk production in dairy farms (2021, B)
- 2) Study on kinetic of ammonia dissolution in packed beds of glass forming material (2021, B)
- 3) Study on Numerical Modeling of Ammonia Deodorization by a Glass Foaming Material (2022, M)
- 4) Study on development and application of a Landfill Leachate prediction model considering ventilation pipes for climate change adaptation (2021, M)
- 5) Prediction of Leachate Generation from Landfill Sites by Long Short-Term Memory Model: Case Study at the Landfill Site in Fukuoka City (2022, B)
- 6) Applicability of Vital-data collected from a Non-contact Sensor for Estimating an Individual Cow's Methane Emission with a Laser Methane Detector (2022, M)
- 7) Study on quantification of physical work loads to reduce fatigue in waste hand-sorting processes (2023, M)
- 8) Heat balance analysis of greenhouse bio-drying MBT under southeast Asian Environment (2023, B)



3. Material flow management

- 1) Evaluation of biogas transportation systems from dairy cow manure regarding greenhouse gas and input-output energy (2021,B)
- 2) Study on Advanced Heat Utilization in Biogas Plant for Dairy Cow Manure - Simulation model of biogas heat utilization – (2021, M)
- 3) Study on Selection of Cow Manure-derived Biogas Utilization Methods Considering Regional Conditions for Decarbonized Society (2022, M)
- 4) Study on Bio-drying for production of bedding material from digestate of cow manure (2021,B)
- 5) Fundamental Study of Inhibition Factors in Anaerobic Digestion at a Biogas Plant for Food Waste (2022, M)
- 6) Development of a diffusion-driven nutrient supply system for native microalgae cultivation using nitrogen in cow manure digestate (2021, M)
- 7) Study on Feasibility of Microalgae Cultivation and Harvesting by Using Dialysis bags (2022, B)
- 8) Study on the Possibility of Nitrogen & Phosphorus Recovery and GHG Emissions from Biomass Waste Management Systems in Japan (2022, M)
- 9) Study on the stability of compost quality based on analysis of N and P in the anaerobic digestion facility for food waste (2022, B)
- 10) Ergonomic approach on optimization of work environment for waste hand-sorting processes (2022, B)
- 11) Performance of microalgae cultivation in the raceway reactor with membrane separation using cow manure digestate as nutrients considering different membrane pore sizes (2023, M)
- 12) The current situation of liquid-bio fertilizer utilization and the ammonia volatilization during its application to farms (2023, M)

Subject of research (Title of thesis from 2021 to 2023)

3. Material flow management

- 13) Development of a microalgae cultivation reactor for native microalgae cultivation using nitrogen in cow manure digestate and carbon dioxide in power generation exhaust gas from cow manure biogas plants: pH control and carbon source supply by a vapor-liquid equilibrium carbon dioxide supply method (2023, M)
- 14) Comparison between mixotrophic and heterotrophic conditions for native microalgae cultivation using digestate of cow manure methane fermentation (2023, B)
- 15) Data analysis and consideration for high organic-load and stable operation in a food waste biogas plant (2023, B)



- Kazuei Ishii, Motoki Yamanaka, Satoru Ochiai, Masahiro Sato: Multicriteria Evaluation of Biogas Plants Receiving Food Waste from a Brod Area Considering Diferent Spatial System Boundaries and Stakeholders, Journal of Solid Waste Technology and Management, Vol. 50, Issue 2, pp.512-526, 2024, <http://doi.org/10.5276/jswtm/iswmaw/502/2024.512>
- Jumana Al-Mallahi, Takumi Nakashima, Kazuei Ishii, Satoru Ochiai, Shiho Ishikawa: Applying membrane separation technology for integrating high strength cow manure digestate treatment and microalgae cultivation in an open reactor system, Journal of Material Cycles and Waste Management, 2023, <https://doi.org/10.1007/s10163-023-01769-7>
- Samuel Kinari SAGA, Shiho ISHIKAWA, Tomohiro MITANI, Shigeru MORITA, Ryoichi HARA, Takayuki TANAKA, Michio KOMIYA, Kazuei ISHII, Satoru OCHIAI, Geun-Yong HAM: Applicability of vital data collected from a non-contact sensor for estimating an individual cow's methane emission with a laser methane detector, Journal of JSCE, Vol.11, No.2, 23-26006, 2023.
- Kim, W.-K.; Park, H.; Ishii, K.; Ham, G.-Y. Investigation on Microplastics in Soil near Landfills in the Republic of Korea. Sustainability 2023, 15, 12057. <https://doi.org/10.3390/su151512057>
- Jumana Al-Mallahi, Kazuei Ishii, Masahiro Sato and Satoru Ochiai: Static Supply of Different Simulated Flue Gases for Native Microalgae Cultivation in Diluted Cow Manure Digestate, Journal of Environmental Management, 335, 1, 2023 <https://doi.org/10.1016/j.jenvman.2023.117557>
- Jumana Al-Mallahi, Kazuei Ishii: Attempts to alleviate inhibitory factors of anaerobic digestate for enhanced microalgae cultivation and nutrients removal: A review, Journal of Enviromnetal Management, 304, 114266, 2022



- Kazuei Ishii, Masahiro Sato, and Satoru Ochiai: Prediction of Leachate Quantity and Quality from a Landfill Site by the Long Short-Term Memory Model, *Journal of Environmental Management*, 310, 114733, 2022
- Afif Faiq Muhamad, Kazuei Ishii, Masahiro Sato, Satoru Ochiai; Strategy of landfilled waste reduction by a distributed materials recovery facility system in Surabaya, Indonesia, *Waste Management & Research*, 38, 10, 2020
- Faisal Bin Arifin, Kazuei Ishii, Masahiro Sato, Satoru Ochiai: The Effectiveness of E-money Incentive Mechanism in Promoting Separation of Recyclables at Source in Malaysia, *Journal of Material Cycles and Waste Management*, 23, 371-385, 2021
- Ryosuke Kizuka, Kazuei Ishii, Satoru Ochiai, Masahiro Sato, Atsushi Yamada, Kouei Nishimiya; Improvement of Biomass Fuel Properties for Rice Straw Pellets Using Torrefaction and Mixing with Wood Chips, *Waste and Biomass Valorization*, 12, 3417-2429, 2021.
- Ryosuke Kizuka, Kazuei Ishii, Masahiro Sato, Atsushi Fujiyama: Characteristics of wood pelletss mixed with torrefied rice straw as a biomass fuel, *International Journal of Energy and Environmental Engineering*, 10, 357-365, 2019
- Kazuei Ishii, Atsushi Fujiyama, Masahiro Sato, Toru Furuichi: A three-dimensional simulation of 1,4-dioxane contamination in an aquifer with a complex hydrogeological setting – application of a coupled estimation method, *Journal of solid waste technology and management*, 45-1, 84-101, 2019
- Kazuei Ishii, Toru Furuichi, Atsushi Fujiyama, Shintaro Watanabe: Logistics Cost Analysis of Rice Straw Pellets for Feasible Production Capacity and Spatial Scale in Heat Utilization Systems: A Case Study in Nanporo Town, Hokkaido, Japan, *Biomass and Bioenergy*, Vol. 94, pp.155-166, 2016

Deep learning method to predict the quantity and quality of leachate at landfill sites



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Journal of Environmental Management

Volume 310, 15 May 2022, 114733



Prediction of leachate quantity and quality from a landfill site by the long short-term memory model

Kazuei Ishii, Masahiro Sato, Satoru Ochiai

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<https://doi.org/10.1016/j.jenvman.2022.114733>

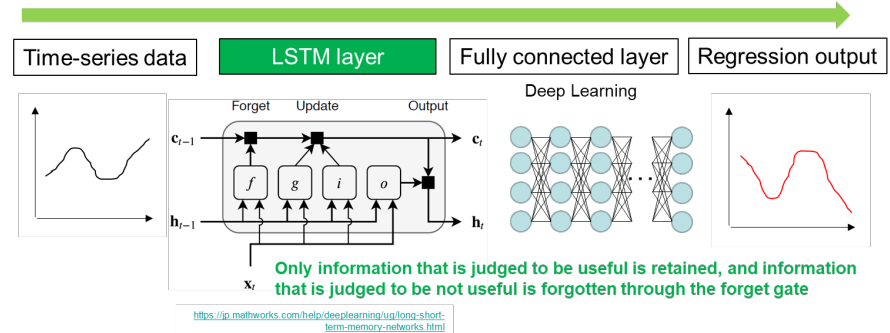
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Highlights

- The long short-term memory was useful to predict leachate quantity and quality.
- Daily average temperature contributed to predict leachate quantity in the spring thaw.
- The prediction was acceptable for the operation of treatment facility.

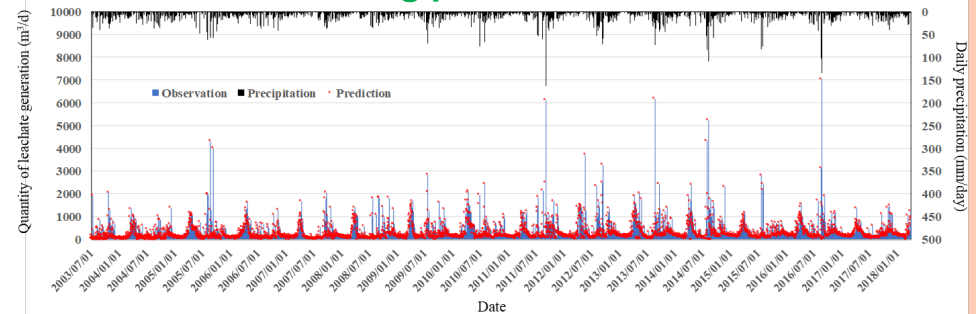
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Long short-term memory (LSTM) model

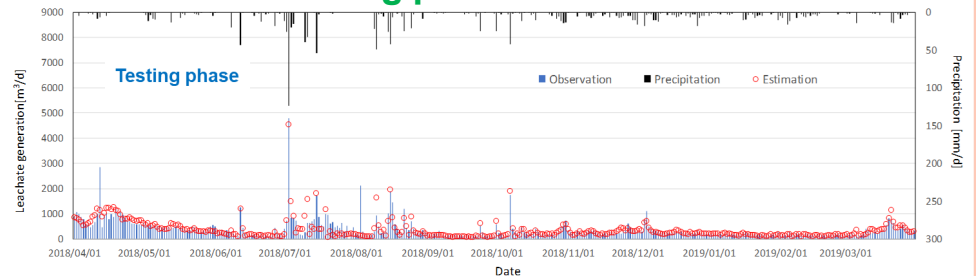


Results in the learning phase

R²=0.99995



Results in the testing phase





Multicriteria Evaluation of Biogas Plants Receiving Food Waste From a Broad Area Considering Different Spatial System Boundaries and Stakeholders

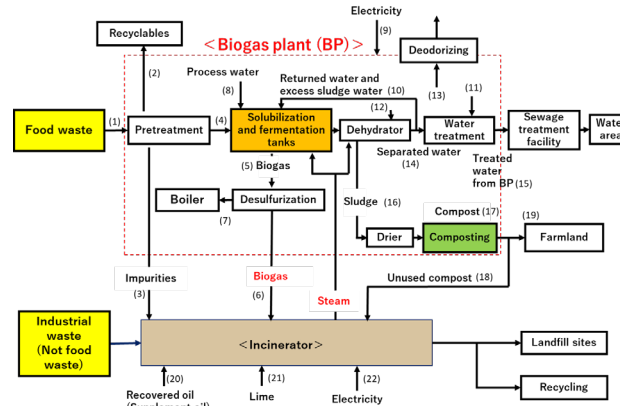
Authors: Ishii, Kazuei; Yamanaka, Motoki; Ochiai, Satoru; Sato, Masahiro
Source: The Journal of Solid Waste Technology and Management, Volume 50, Number 2, July 2024, pp. 512-526(15)
Publisher: International Society of Waste Management, Air and Water (ISWMAW)
DOI: <https://doi.org/10.5276/jswtm/iswmaw/502/2024.512>

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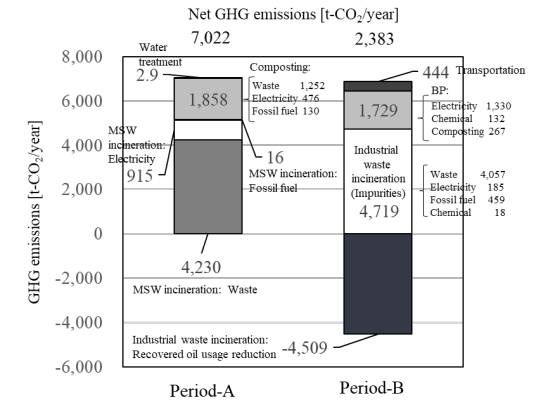
Abstract | References | Citations | Supplementary Data | Suggestions

Food waste biogas plants have multiple effects on the regional

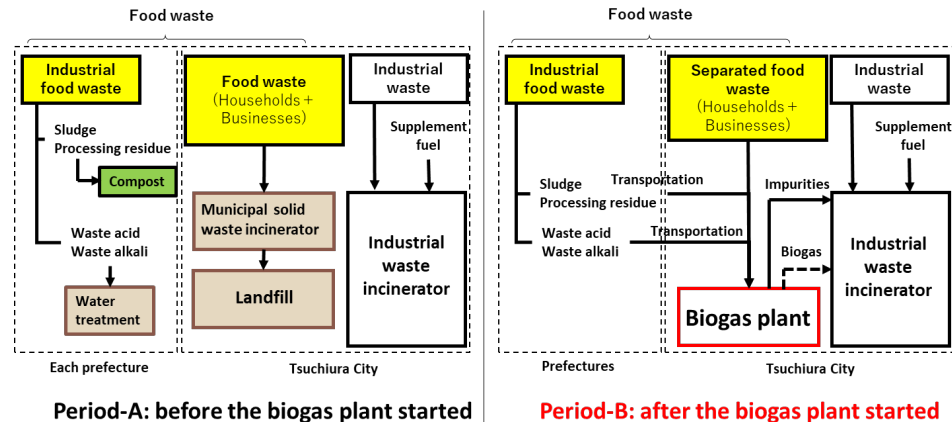
Process flow in the biogas plant



Estimation of GHGs reduction



Scenario analysis to compare GHG emissions



Period-A: before the biogas plant started

Period-B: after the biogas plant started

Diffusion-driven nutrient extraction systems with no energy

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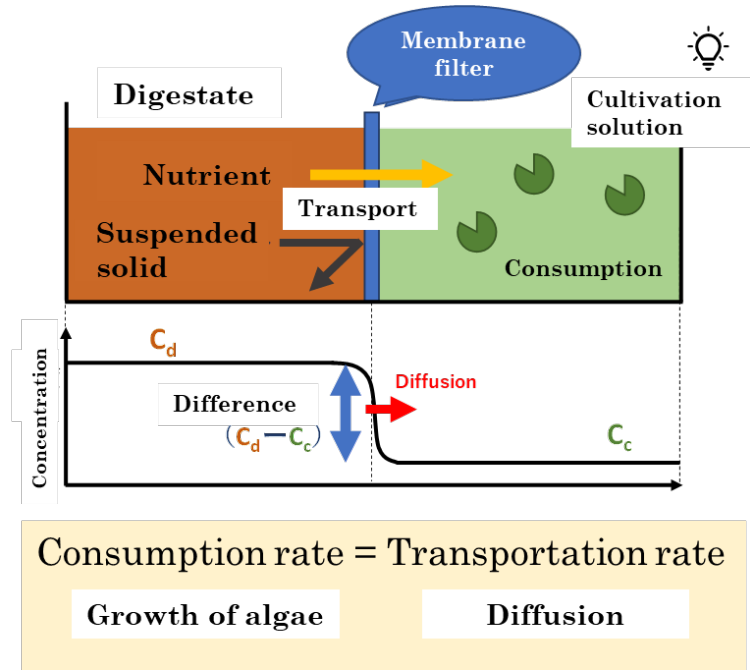
Applying membrane separation technology for integrating high strength cow manure digestate treatment and microalgae cultivation in an open reactor system

ORIGINAL ARTICLE | Published: 09 August 2023
Volume 25, pages 3451–3461, (2023) [Cite this article](#)

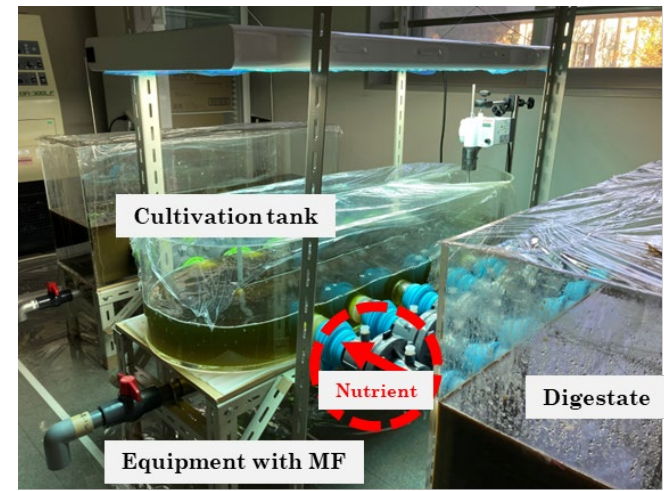
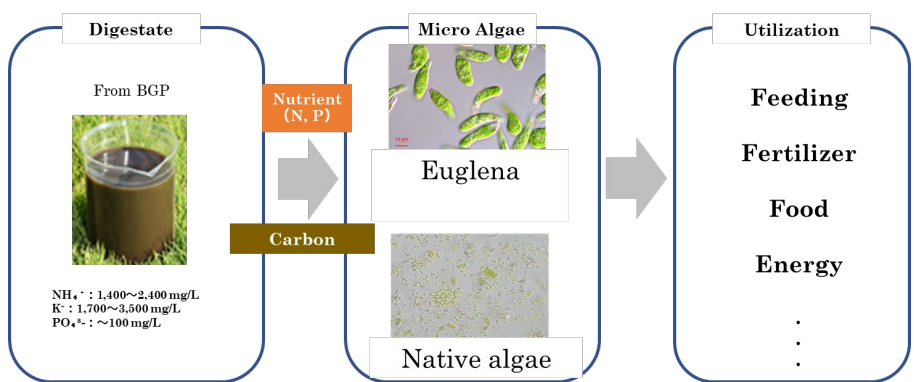


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Digestate utilization for algae cultivation



Raceway reactor (50L)

Torrefaction of rice straw

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Improvement of Biomass Fuel Properties for Rice Straw Pellets Using Torrefaction and Mixing with Wood Chips

Original Paper | Published: 10 September 2020
Volume 12, pages 3417–3429, (2021) [Cite this article](#)

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Ryosuke Kizuka, Kazuei Ishii , Satoru Ochiai, Masahiro Sato, Atsushi Yamada & Kouei Nishimiya

Torrefied rice straw

190°C
(1 hour)



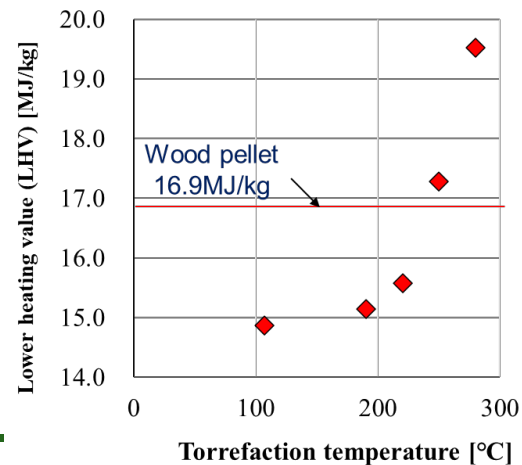
220°C
(1 hour)



250°C
(1 hour)

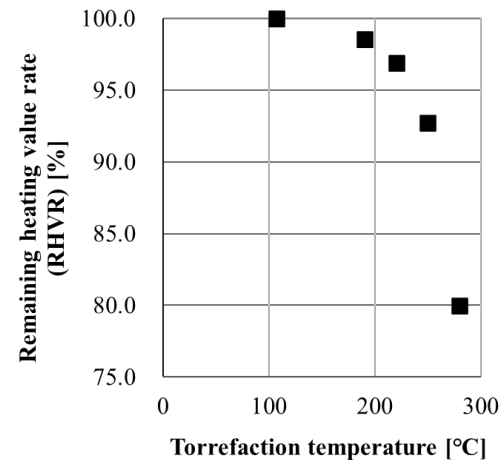


Lower heating value (LHV)



Relationships between the torrefaction temperature and lower heating value

Remaining Heating value rate (Energy yield)



The relationships between the torrefaction temperature and remaining heating value rate (RHVR)





Waste Management

Volume 34, Issue 12, December 2014, Pages 2621-2626



Influence of moisture content, particle size and forming temperature on productivity and quality of rice straw pellets

Kazuei Ishii , Toru Furuichi

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Highlights

- Optimized conditions were determined for the production of rice straw pellets.
- The moisture content and forming temperature are key factors.
- High quality rice pellets in the lower heating value and higher calorific value were produced.

Get citation



Biomass and Bioenergy

Volume 94, November 2016, Pages 155-166



Research paper

Logistics cost analysis of rice straw pellets for feasible production capacity and spatial scale in heat utilization systems: A case study in Nanporo town, Hokkaido, Japan

Kazuei Ishii , Toru Furuichi , Atsushi Fujiyama, Shintaro Watanabe

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<https://doi.org/10.1016/j.biombioe.2016.08.007>

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Highlights

- This study conducted a case study of logistics cost analysis for rice straw pellets.
- Economically feasible production capacity and spatial scale was clarified.



Journal publication

- Kim, W.-K.; Park, H.; Ishii, K.; Ham, G.-Y. Investigation on Microplastics in Soil near Landfills in the Republic of Korea. *Sustainability* 2023, 15, 12057.
<https://doi.org/10.3390/su151512057> (corresponding author)
- Geun-Yong Ham, Toshihiko Matsuto. Comparison of energy recovery system from municipal solid waste in terms of energy balance and life cycle CO2 emission. *Journal of Material Cycles and Waste Management* (06 June 2021 published in online first).
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