

# Development of Large Scale System and Establishment of Control Organization for Solubilization and Resource Conversion of Biowaste

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# 1996 Fiscal Year Final Research Report Summary

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## Development of Large Scale System and Establishment of Control Organization for Solubilization and Resource Conversion of Biowaste

Research Project

### Project/Area Number

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07680600

### Research Category

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Grant-in-Aid for Scientific Research (C)

### Allocation Type

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Single-year Grants

### Section

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一般

### Research Field

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環境保全

### Research Institution

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Kanazawa University

### Principal Investigator

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### Co-Investigator(Kenkyū-buntansha)

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### Project Period (FY)

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1995 – 1996

### Keywords

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biowaste / steam explosion / enzymatic saccharification / alcohol fermentation / epoxy resin

## Research Abstract

Effective systems of steam explosion, enzymatic hydrolysis, alcohol fermentation, and resinification were developed for solubilization and resource conversion of biowaste. Rice straw as a biowaste was exploded under various operational conditions such as steam pressure of 2.55-4.02 MPa and steaming time of 0.5-10 min. The exploded rice straw was separated into water soluble material, methanol soluble lignin, Klason lignin, and mixture of cellulose and low molecular substance. The effects of steam explosion on the characteristics of the exploded rice straw were studied from the point of view of pH, pore size distribution, amounts of extractive components, and enzymatic saccharification. The enzymatic saccharification was expressed as a function of steam pressure and steaming time. It was estimated from the equation that maximum saccharification was obtained at a steam pressure of 3.3-3.8 MPa and a steaming time of 1.8-2.2 min. Glucose and xylose in the enzymatic hydrolyzate were converted into ethanol rapidly and efficiently. The amount of ethanol produced reached the maximum value at a flow rate of 0.2 vvm. A bioreactor coupled with pervaporation using a polytetrafluoroethylene membrane was developed for the production of a higher ethanol concentration from the enzymatic hydrolyzate. The methanol soluble lignin in the rice straw exploded at a steam pressure of 3.53 MPa and a steaming time of 2 min was converted into an excellent thermosetting resin by the epoxy reaction.

## Research Products (12 results)

All Other

All Publications (12 results)

- [Publications] Sawada, T., Y. Nakamura, F. Kobayashi and M. Kuwahara: "Effects of Fungal Pretreatment and Steam Explosion Pretreatment on Enzymatic Saccharification of Plant Biomass" *Biotechnology and Bioengineering*. 48. 719-724 (1995) 
- [Publications] Nakamura, Y., T. Sawada, F. Kobayashi and M. Suzuki: "Stability Analysis of Continuous Culture in Diauxic Growth" *Journal of Fermentation and Bioengineering*. 81. 429-436 (1996) 
- [Publications] Nakamura, Y., T. Sawada, F. Kobayashi and M. Ohnaga: "Microbial Degradation of Phenol Wastewater Containing Heavy Metals by Immobilized Cells" *5th World Congress of Chemical Engineering*. 2. 402-406 (1996) 
- [Publications] Nakamura, Y., F. Kobayashi, M. Ohnaga and T. Sawada: "Alcohol Fermentation of Starch by a Genetic Recombinant Yeast Having Glucoamylase Activity" *Biotechnology and Bioengineering*. 53. 21-25 (1997) 
- [Publications] Nakamura, Y., T. Sawada, M. Godliving and M. Kuwahara: "Lignin Peroxidase Production by *Phanerochaete chrysosporium* Immobilized on Polyurethane Foam" *Journal of Chemical Engineering of Japan*. 30. 1-6 (1997) 
- [Publications] Nakamura, Y., T. Sawada, F. Kobayashi and M. Godliving: "Microbial Treatment of Kraft Pulp Wastewater Pretreated with Ozone" *Water Science and Technology*. 35. 277-282 (1997) 
- [Publications] Sawada, T., Y. Nakamura, F. Kobayashi and M. Kuwahara: "Effects of Fungal Pretreatment and Steam Explosion Pretreatment on Enzymatic Saccharification of Plant Biomass" *Biotechnology and Bioengineering*. 48. 719-724 (1995) 
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