(IB-6)

Comparison of bio-drying MBT with other energy recovery system in terms of energy balance and life cycle CO_2 emission

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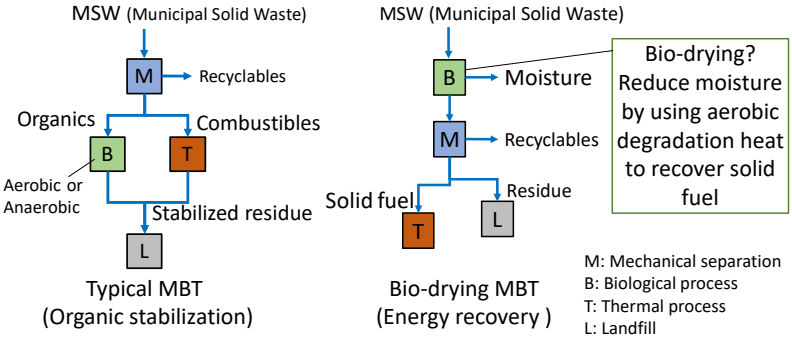
Introduction

❑ MBT (Mechanical-Biological Treatment) system



Objective

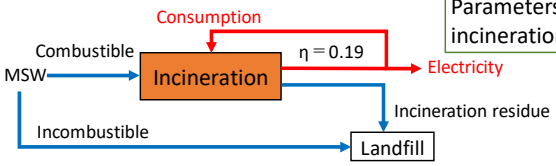
Evaluate whether bio-drying MBT can treat MSW better than other energy recovery systems in terms of **energy** and **life cycle CO_2 emission**

Methodology

❑ Compared systems

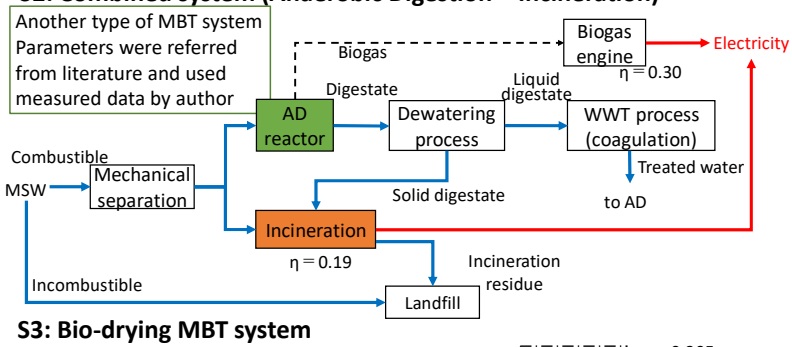
S1: Incineration with energy recovery

The most prevailed technology for energy recovery
Parameters from domestic incineration facility survey

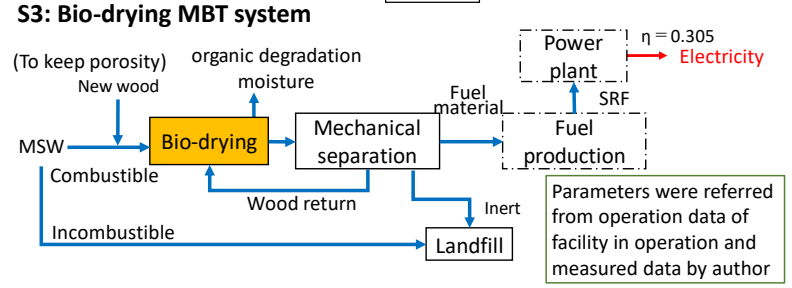


S2: Combined system (Anaerobic Digestion + Incineration)

Another type of MBT system
Parameters were referred from literature and used measured data by author

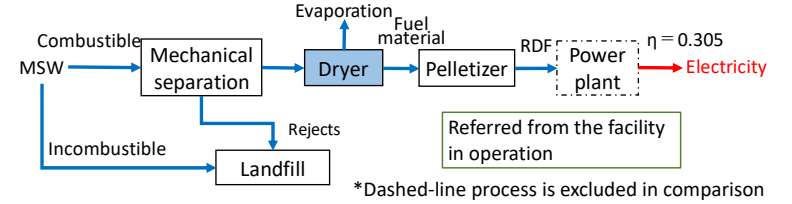


S3: Bio-drying MBT system



Parameters were referred from operation data of facility in operation and measured data by author

S4: RDF (refuse-derived fuel) production system



Referred from the facility in operation

*Dashed-line process is excluded in comparison

❑ Target area: Asahikawa city

Waste generation in 2017

Unit: t/y

Source	Combustibles	Incombustibles
Household	43143	9747
Business	33283	2572
Present:	Incineration	Landfill

→ Compared systems are considered as possible management option for "combustible waste" in the city

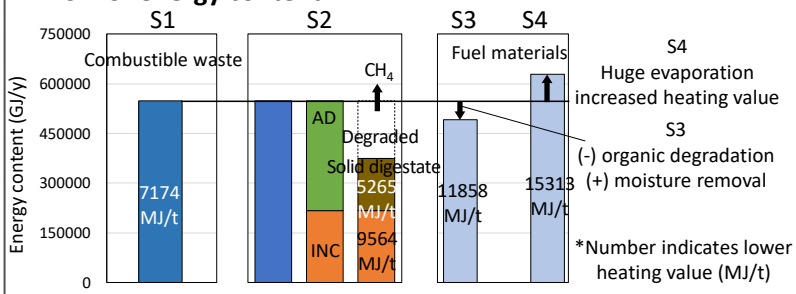
❑ Evaluation index

Net energy balance (MJ/y)
= Energy recovery (power generation)
– Energy consumption for utility (electricity, fuel, chemicals)

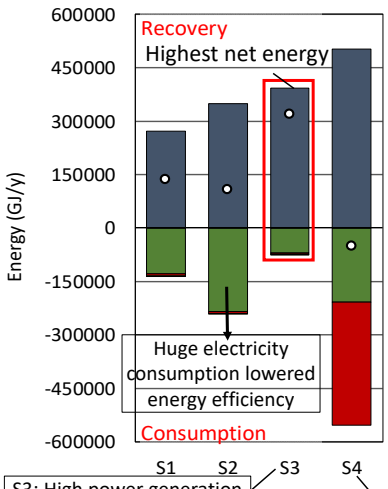
Life cycle CO_2 emission
= CO_2 emission – Avoided CO_2 emission

Results and discussion

❑ Flow of energy content



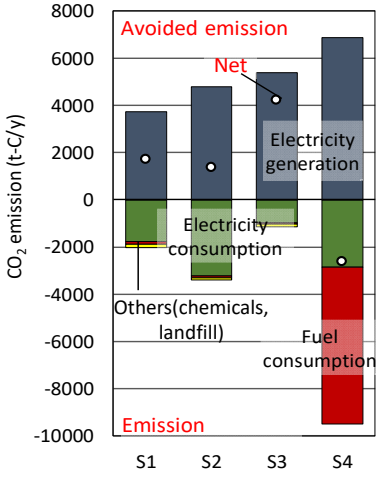
❑ Energy balance



S3: High power generation efficiency of power plant With low electricity and fuel consumption

S4: Highest energy recovery but huge fuel consumption for drying

❑ Life cycle CO_2 emission



Electricity and fuel are major source of CO_2 emission

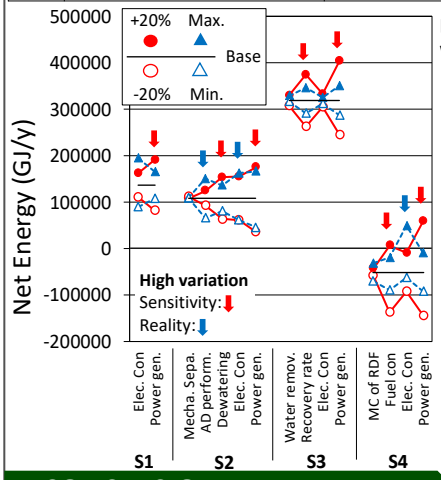
❑ Sensitivity analysis

Selected parameters for change

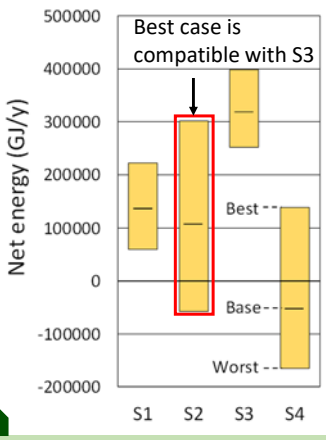
	Parameters	Positive impact on 'Net'
S1-4 (all)	Electricity consumption Power gen. efficiency	Low electricity consumption High power gen. efficiency
S2	Mechanical separation rate to AD	More organic AD, Combustible to Incineration
	AD performance	Organic degradation↑ ⇒ biogas↑
	Dewatering performance	Low moisture in solid digestate
S3	Moisture removal rate	Heating value of solid fuel ↑
	Fuel material recovery rate	Fuel material recovery ↑
S4	Moisture content of RDF	Heating value of solid fuel ↑
	Fuel consumption for drying	Fuel oil consumption ↓

Variation

- Sensitivity: ±20% of set values
- Reality: "Max." & "Min." of literature values



Best: Improve all parameters to "Max."
Worst: Deprove all parameters "Min."



CONCLUSION

- Bio-drying MBT system showed the highest net energy recovery
- RDF production system recovers the highest energy but huge fuel consumption lowered net energy recovery
- Combined system showed low energy efficiency but can be improved as compatible with the bio-drying MBT system under ideal condition