(IB-6)

Business

Incineration

→ Compared systems are considered

as possible management option for "combustible waste" in the city

2572

Life cycle CO₂ emission

= CO₂ emission – Avoided CO₂ emission

Comparison of bio-drying MBT with other energy recovery system in terms NO UN of energy balance and life cycle CO2 emission

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Introduction **Results and discussion** ☐ Flow of energy content ☐ MBT (Mechanical-Biological Treatment) system **S1** MSW (Municipal Solid Waste) MSW (Municipal Solid Waste) Fuel materials Combustible waste Bio-drying? Huge evaporation 600000 M Recyclables Moisture Reduce moisture increased heating value by using aerobic Organics [450000 1 Combustibles egraded Recyclables degradation heat (-) organic degradation В to recover solid 300000 (+) moisture removal 7174 1858 Aerobic ór Residue fuel MJ/t MI/i Anaerobio Stabilized residue 150000 Number indicates lower heating value (MJ/t) M: Mechanical separation **B:** Biological process Typical MBT **Bio-drying MBT** ☐ Life cycle CO₂ emission □ Energy balance T: Thermal process (Organic stabilization) (Energy recovery) L: Landfill 600000 Avoided emission Objective Highest net energy 6000 450000 Evaluate whether bio-drying MBT can treat MSW better than other energy recovery systems in terms of energy and life cycle CO2 emission 4000 300000 emission (t-C/y) **Flectricity** 2000 Methodology generation 150000 (GJ/y) □ Compared systems The most prevailed technology Energy Electricit S1: Incineration with energy recovery for energy recovery -2000 nsumption Parameters from domestic Consumption -150000 incineration facility survey -4000 $\eta = 0.19$ Combustible Others(chemicals, MSW -300000 landfill) Fuel -6000 Huge electricity consumptio Incineration residue insumption lowered -450000 energy efficiency -8000 Landfill **Emission** -600000 -10000 S2: Combined system (Anaerobic Digestion + Incineration) Another type of MBT system S3: High power generation Electricity S4: Highest energy Electricity and fuel are Parameters were referred Biogas efficiency of power plant engine $\eta = 0.30$ recovery but huge fuel major source of CO₂ from literature and used With low electricity and fuel Liquid emission consumption for drying measured data by author consumption AD Dewatering WWT process Sensitivity analysis (coagulation) Combustible Mechanical Treated water Selected parameters for change Variation Solid digestate Parameters Positive impact on 'Net' separation to AD Sensitivity: Low electricity consumption Incineration Electricity consumption ±20% of set values (all) Power gen. efficiency High power gen. efficiency $\eta = 0.19$ Incineration More organic AD, Combustible to Incineration Mechanical separation rate to Reality: Incombustible residue Landfill "Max." & "Min." of Organic degradation↑ ⇒ S3: Bio-drying MBT system AD performance literature values biogas ↑ $\eta = 0.305$ Power Dewatering performance Low moisture in solid digestate organic degradation (To keep porosity) plant Moisture removal rate Heating value of solid fuel 个 moisture New wood Fuel material recovery rate Fuel material recovery ↑ Mechanical Heating value of solid fuel ↑ Moisture content of RDF **Bio-drying** MSW Fuel consumption for drying Fuel oil consumption ↓ separation production Combustible 500000 Parameters were referred Best: Improve all parameters to "Max." Wood return from operation data of Worst: Deprove all parameters "Min." 400000 Incombustible Landfill facility in operation and 500000 -20% Min Best case is measured data by author 300000 compatible with S3 S4: RDF (refuse-derived fuel) production system 400000 200000 Evaporation Fuel material Net energy (GJ/y) Combustible Energy (300000 100000 Mechanical Power MSW Dryer Pelletizer separation plant 200000 Referred from the facility **High variation** Rejects Best -100000 100000 Incombustible in operation Sensitivity: Landfill Reality: *Dashed-line process is excluded in comparison -200000 ☐ Target area: Asahikawa city ■ Evaluation index Base -100000 Waste generation in 2017 Net energy balance (MJ/y) Unit: t/v Worst = Energy recovery (power generation) Source Combustibles Incombustibles -200000 - Energy consumption for utility Household CONCLUSION (electricity, fuel, chemicals) 33283

· Bio-drying MBT system showed the highest net energy recovery

lowered net energy recovery

RDF production system recovers the highest energy but huge fuel consumption

Combined system showed low energy efficiency but can be improved as

compatible with the bio-drying MBT system under ideal condition