Development of Low Cost Composting Toilet for Developing Countries

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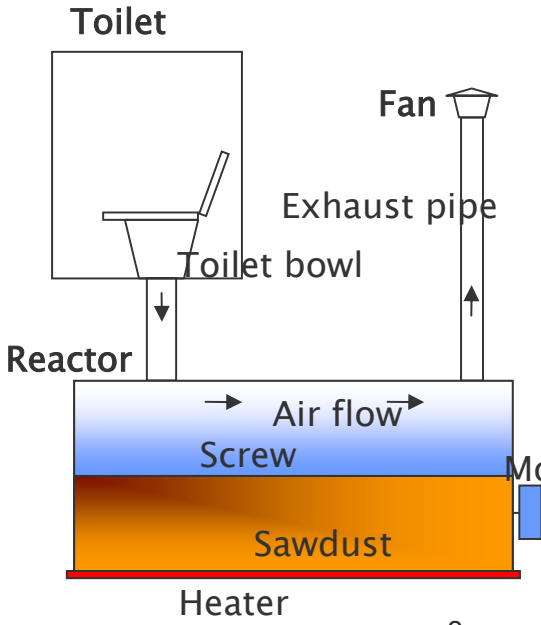
Background

- Dry type of composting toilet
  - One of the most effective solutions to improve sanitation in developing countries
  - Features of our previous composting toilet
    - Using composting matrix
    - Intermittent mixing
    - Heating
- Known problems
  - Cost
    - Initial – 0.7 - 1 M yen for 4 member family
    - Operation – 2,000-3,000 yen for electricity
  - Utilization into farmland



Problems – operation cost

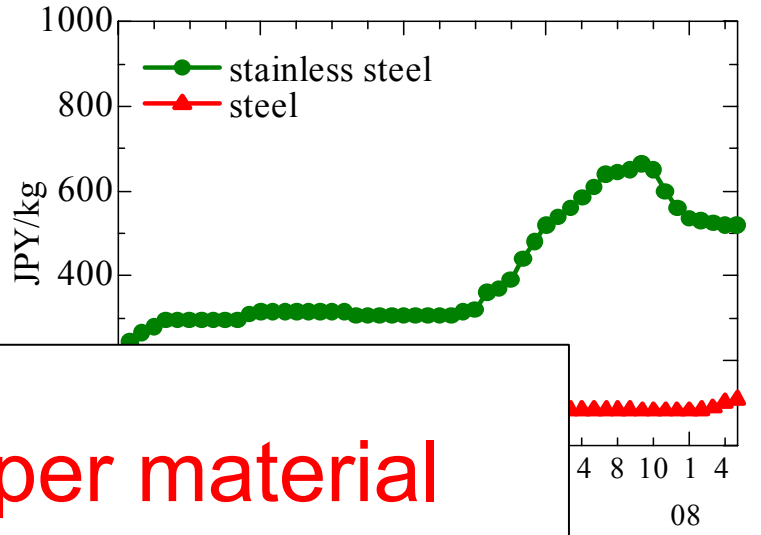
- Important parameters
  - Biodegradation of organic matter in wastes
    - Aerobic biodegradation
  - Inactivation of pathogens
    - Dry condition & high temperature
  - Moisture content
    - **Water input - output**
      -
      -
      - Evaporation – requires energy supply for rapid drying
      - Input energy source – electricity
    - **Energy analysis**
      - 95% is for heating device → high cost
      - Reducing water amount or natural energy - solution

Urine diverting toilet

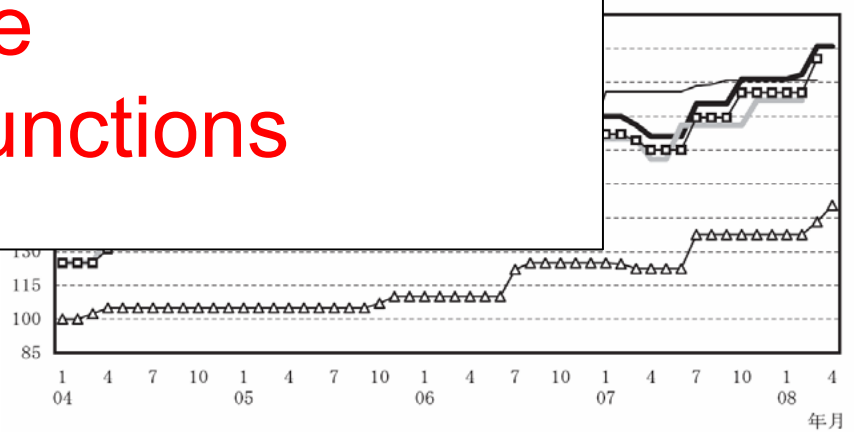
er 90% from urine

Problems – initial cost

- Current composting toilet
  - Made in stainless steel
  - St… wi…
  - He…
  - Hi…



Using cheaper material
Small scale
Avoiding functions



Problems – collection

Objective

- Developing low cost composting toilet
  - Using lower price material
    - plastics
  - Small scale
    - Ownership for each house -> private toilet
    - Quick replacement of compost
  - Limited functions
    - Hand mixing, no heating ->urine diverting toilet
- Performance of low cost composting toilet
  - Biodegradation, pathogens, required force for mixing

Developed toilet

Features

- Wooden interface
- Urine diverting toilet bowl
  - Urine storage tank
- Reactor
  - PVC for container
  - Steel for screw with rotation handle
  - Dustproof bearing
  - Reducer
  - Weight 22kg
  - 60L for composting reactor (6kg of dry sawdust)

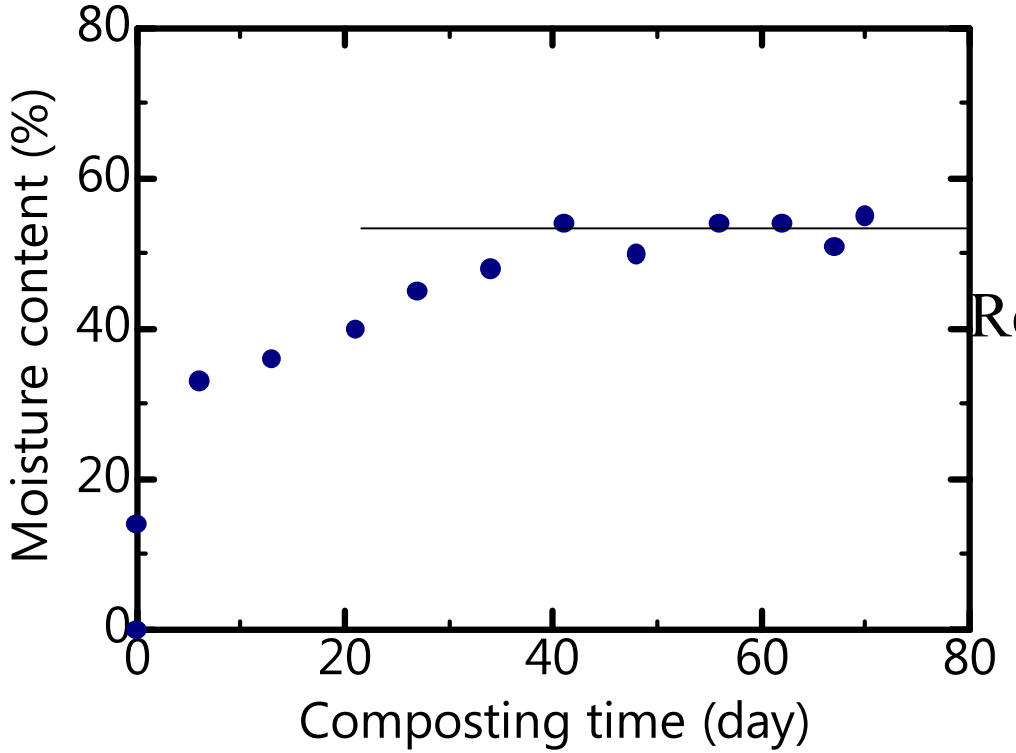
Operation condition

- Feaces load: 600g/day pig manure
- 4 rotations of screw per day
- No temperature control

Measurement

- Weight
  - Total weight, moisture content, decomposition rate
- Temperature
- Organic acids
  - Lactic, formic, acetic, propanoic acid
- Colliform
  - E-coli, coliform
- Required force -
- Cost

Result – moisture content



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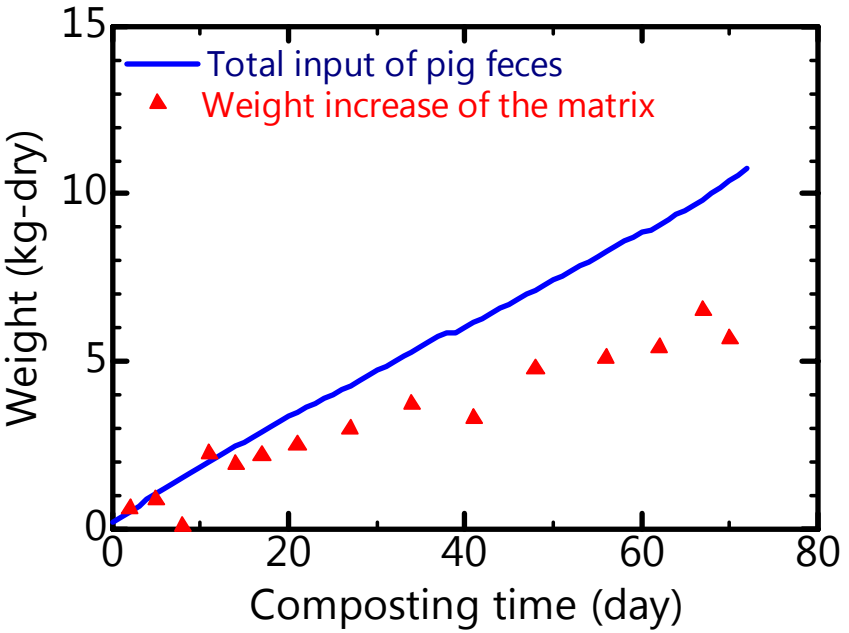
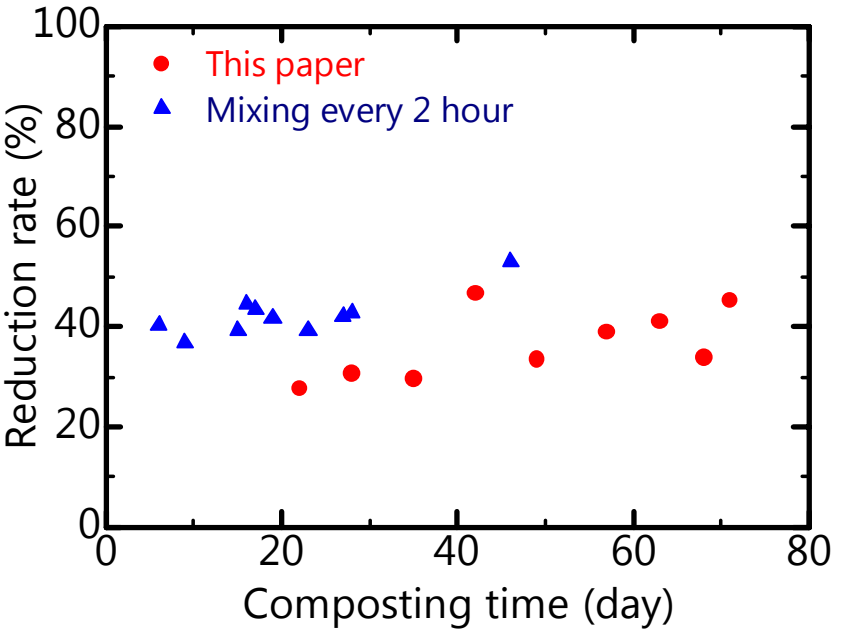
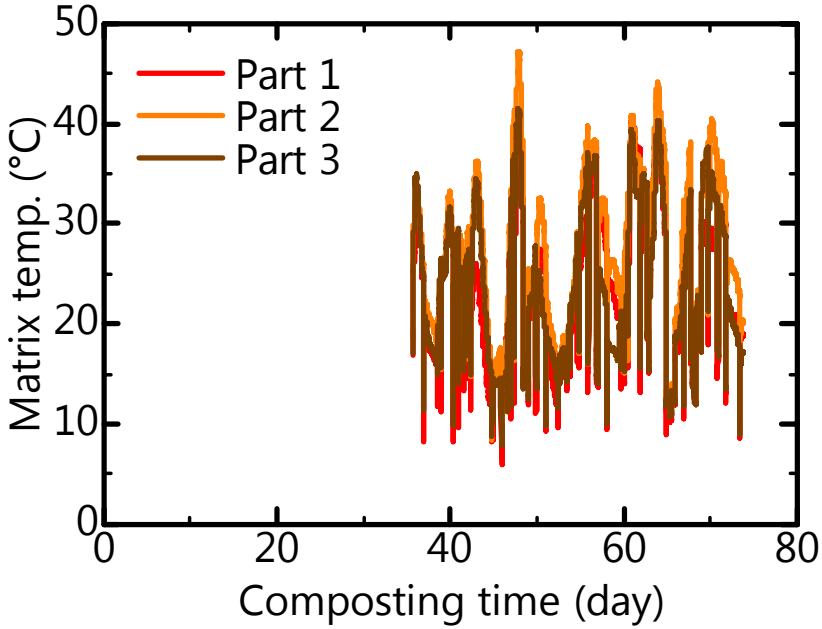
Results – weight variation



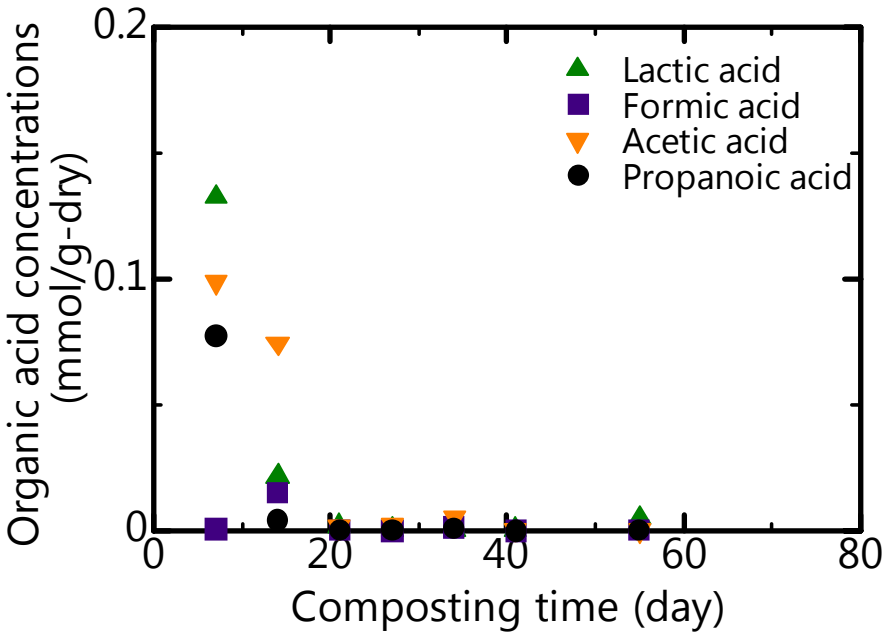


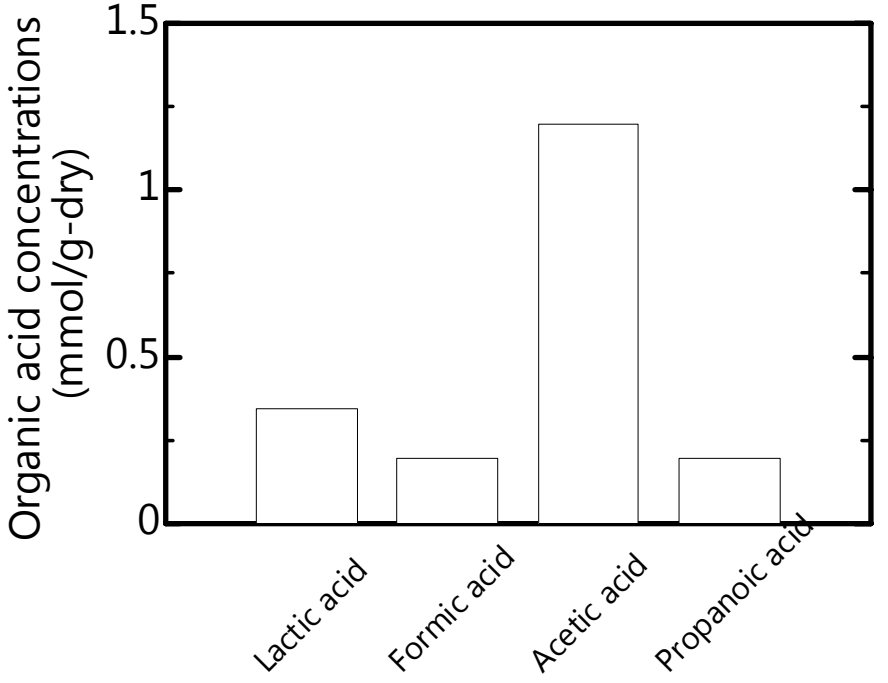
Results – temperature variation



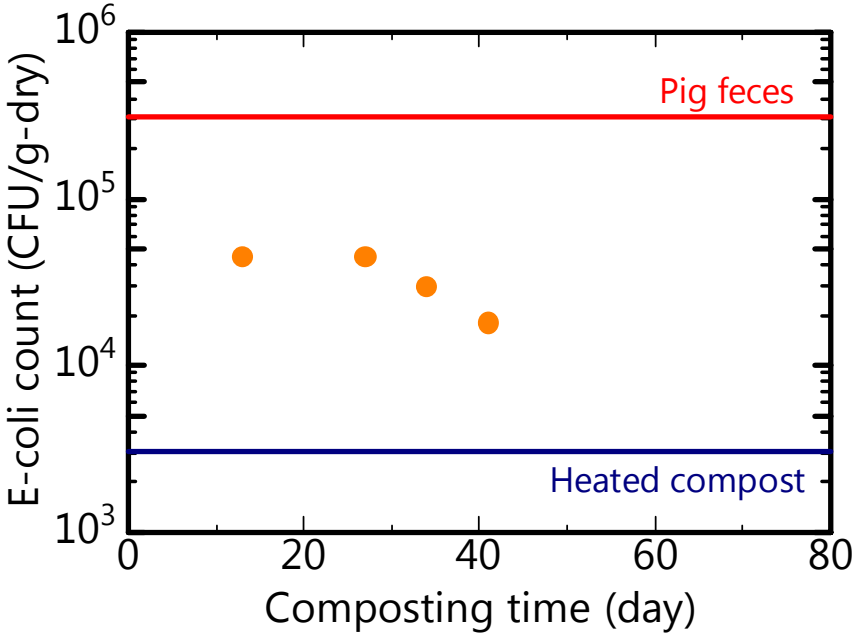
Average temperat
15 deg, C

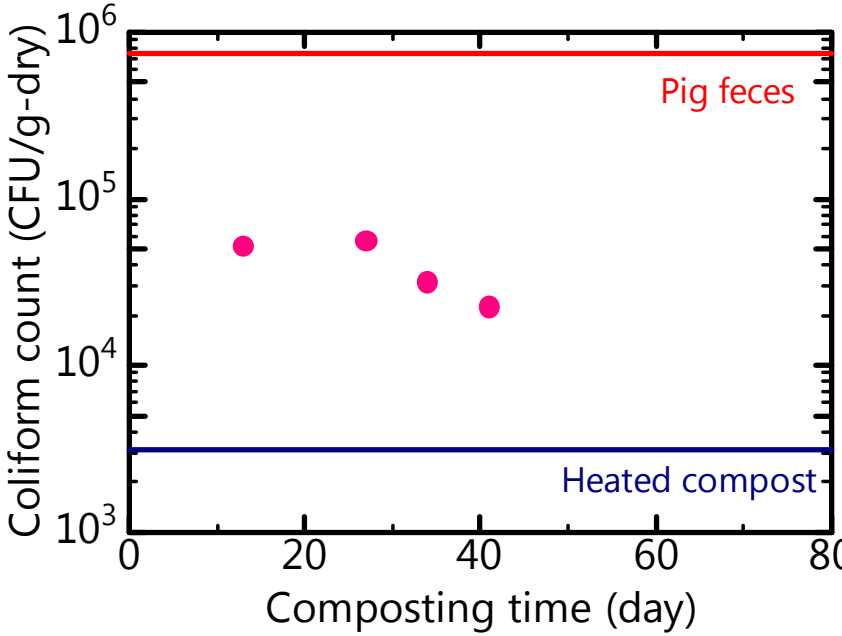
Results – organic acids





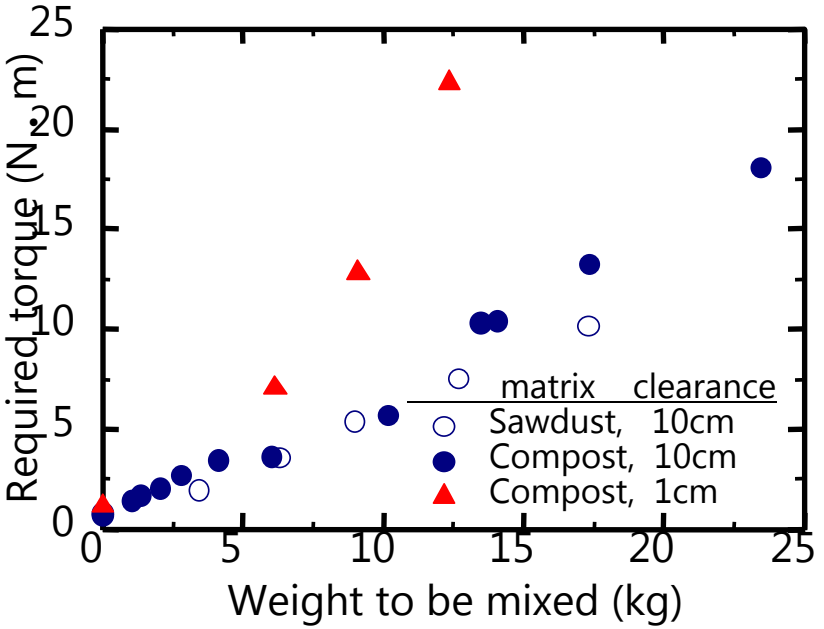
Results - coliform

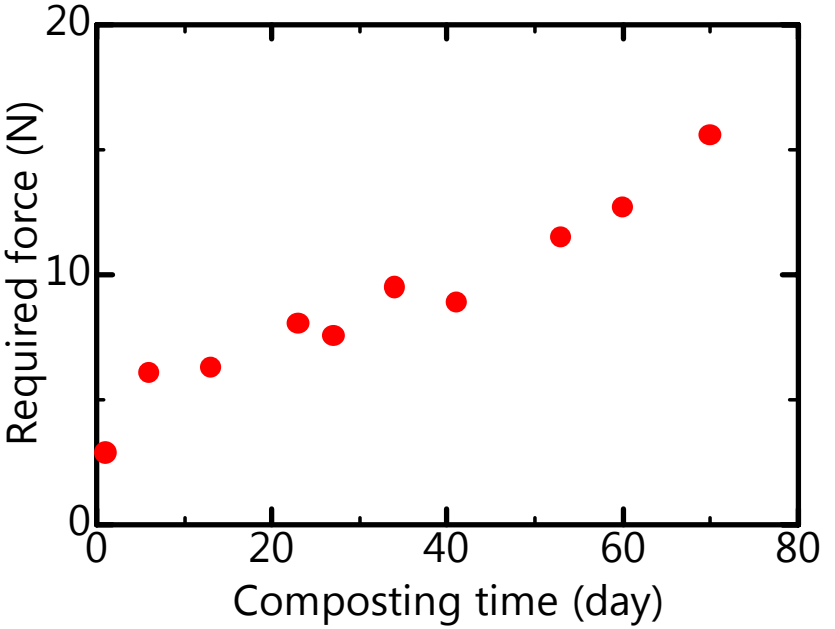




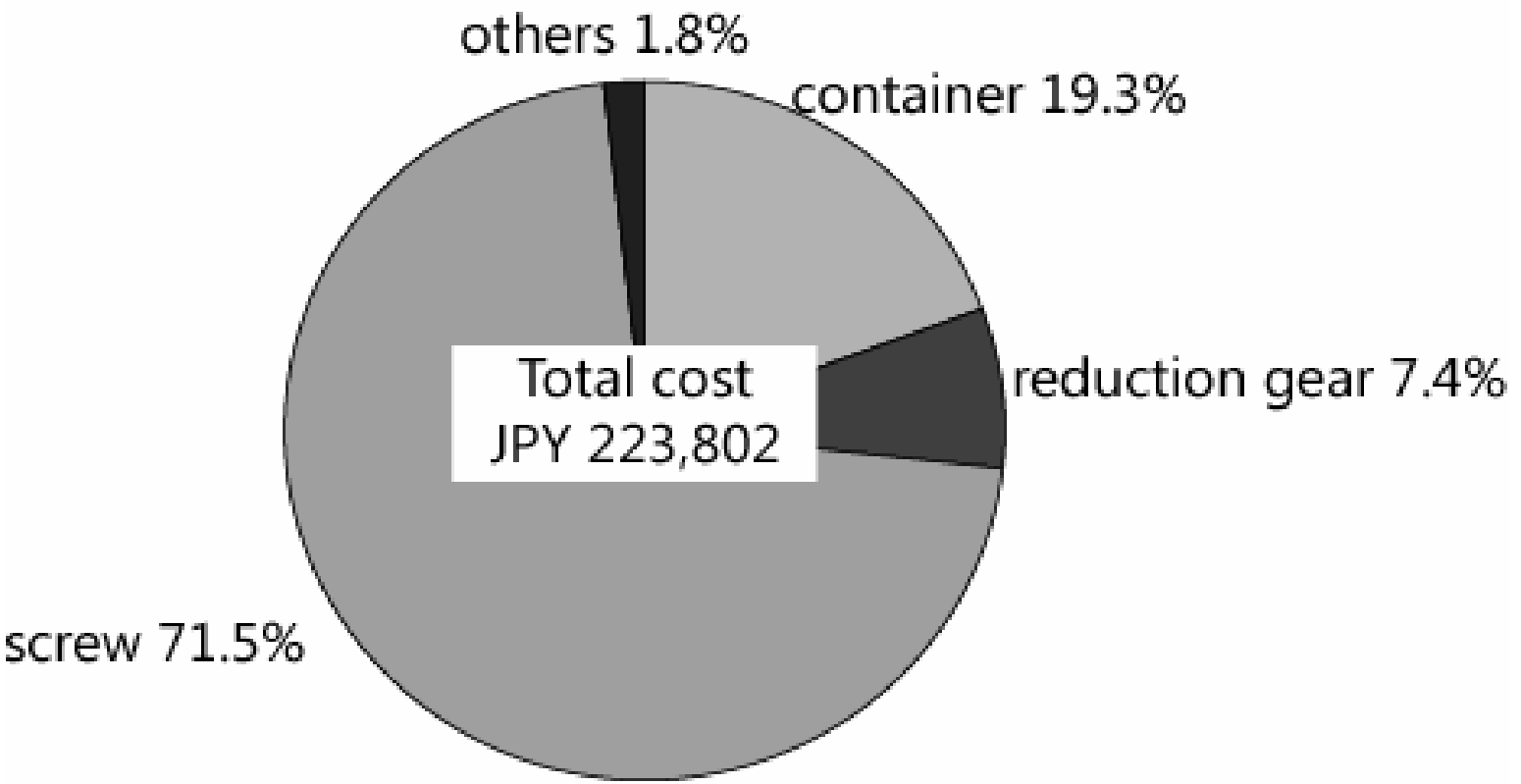
Additional treatment – calcium hydroxide

Results – required force





Results – initial cost



Conclusion

- Low cost composting toilet was successfully developed.
  - Low cost materials
  - Avoiding functions
  - Urine diverting toilet
- The toilet was well worked.
  - Suitable moisture content
  - Aerobic biodegradation
    - 50% of decomposition ratio
    - Heat generation inside the compost
    - Low level of organic acids
  - Still high coliform count
  - Low level of required force for 3 months operation
  - Cost analysis
    - Cheep screw
    - Saving materials for container

Future plan

Thank you for your attention!