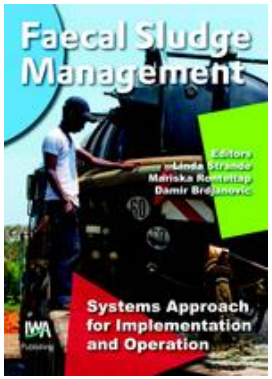
FSM3 3rd International Faecal Sludge Management Conference

IWA the international water association

Faecal sludge management in Japan: night-soil treatment plants



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Introduction: Sanitary improvement in Japan around 1960-1970

- Japan suffering from water-born diseases after World War 2nd
- However, the sanitary conditions rapidly improved around 1960-1970, when the sewerage did not cover its most population.

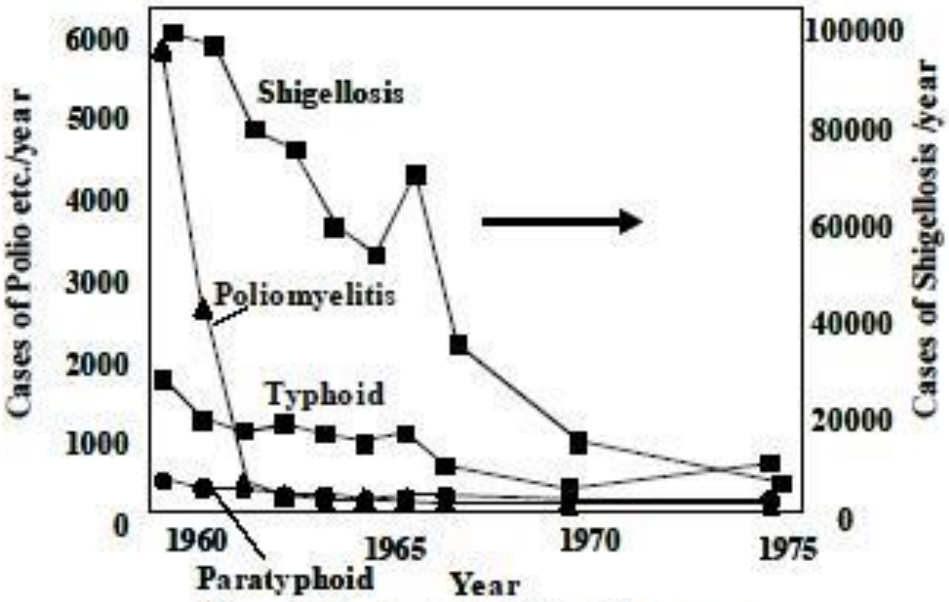


Figure Trend of infectious diseases

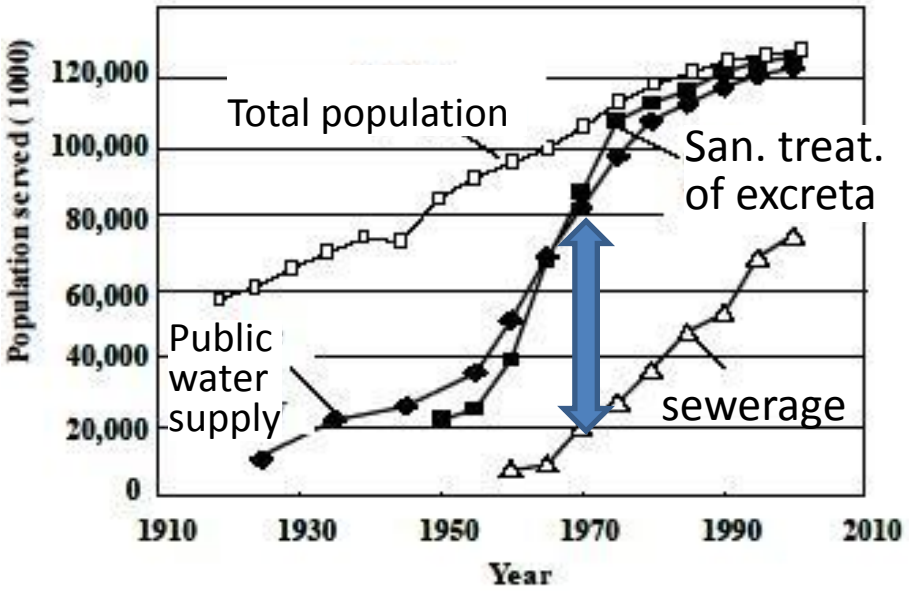


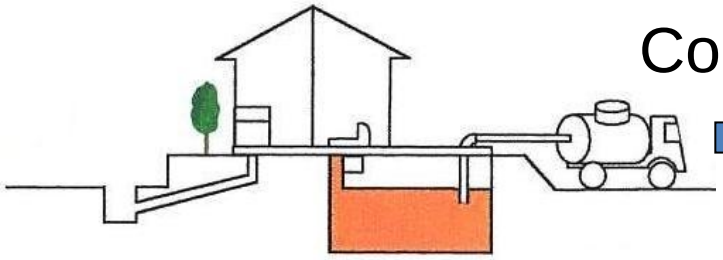
Figure Development of water supply and sanitary treatment

Source: Magara (2003) In the Prc. of Jokasho session of the 3rd World Water Forum

Night-soil collection and treatment system

- Uniquely developed FSM originally based on the tradition of pit latrines with excreta use for agriculture

To review the unique development of Japanese faecal sludge management in Japan and its current change from treatment and resource recovery



Collection → Night-soil treatment plant

Effluent → Water bodies

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Present sanitation facilities and FS flow in JP

Sewerage
70.6 %

Sewer

Blackwater＋greywater

Effluent

Johkaso (packaged treatment unit)
21.7 %

Greywater

Blackwater+Greywater

Johkaso

Sludge

Effluent

Effluent

Night-soil collection& treatment system
7.4 %

Greywater

Black water

Fecal tank

Others
0.3 %

Data source: Waste management in Japan (MOE, 2013)

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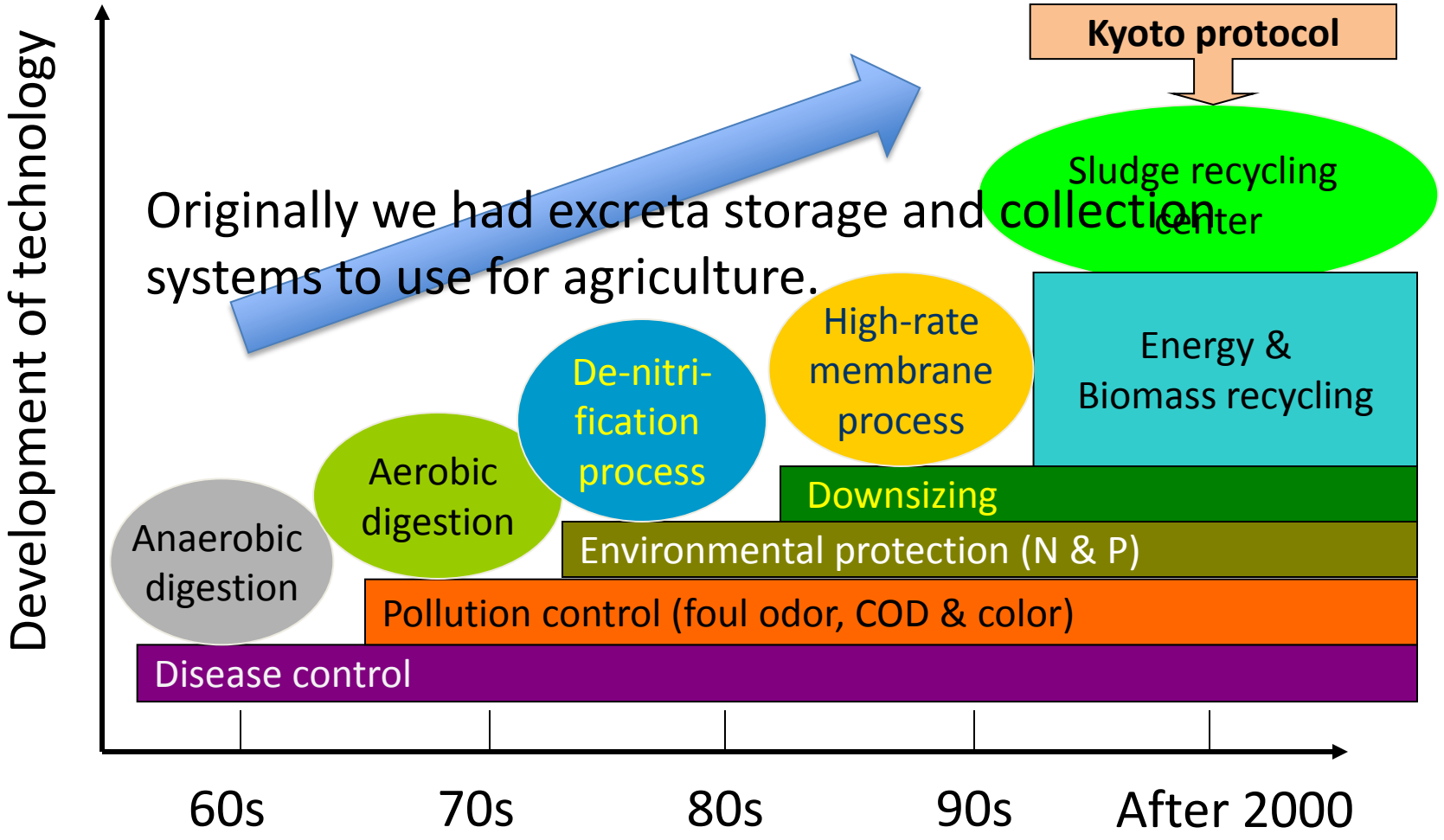
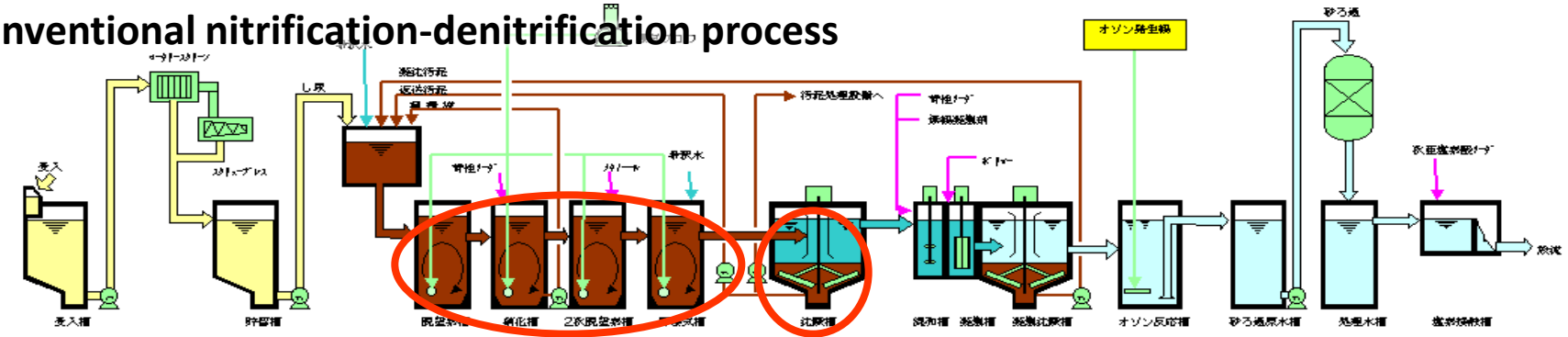
Upgrading of NS treatment process



Original figure from M. Tachibana

Concentrating of activated sludge

Conventional nitrification-denitrification process

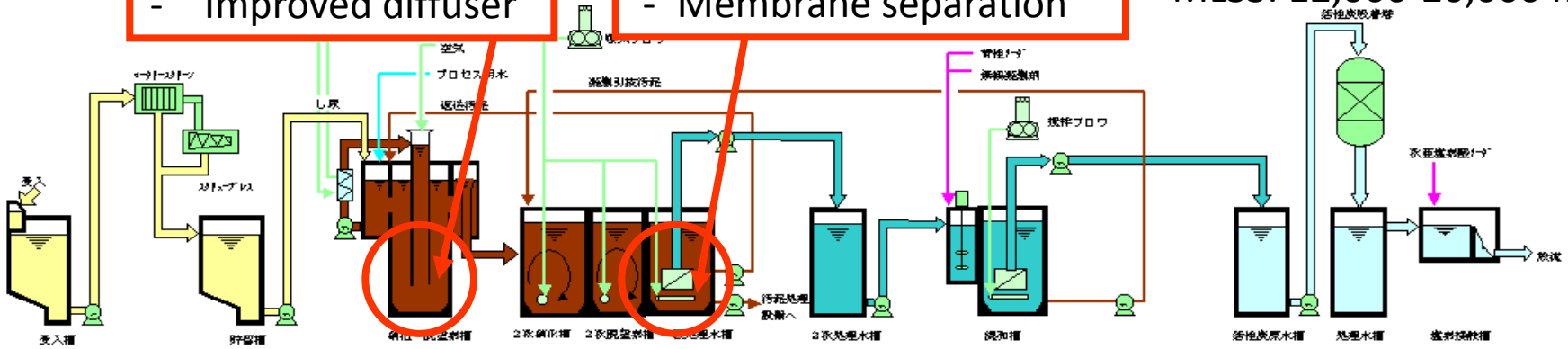


Improved aeration:
- Pressured reactor
- Deep-shaft reactor
- Improved diffuser

Improved sedimentation:
- Pressure floatation
- Mechanical separation
- Membrane separation

MLSS: 6,000 mg/L

MLSS: 12,000-20,000 mg/L



High-loading nitrification-denitrification process

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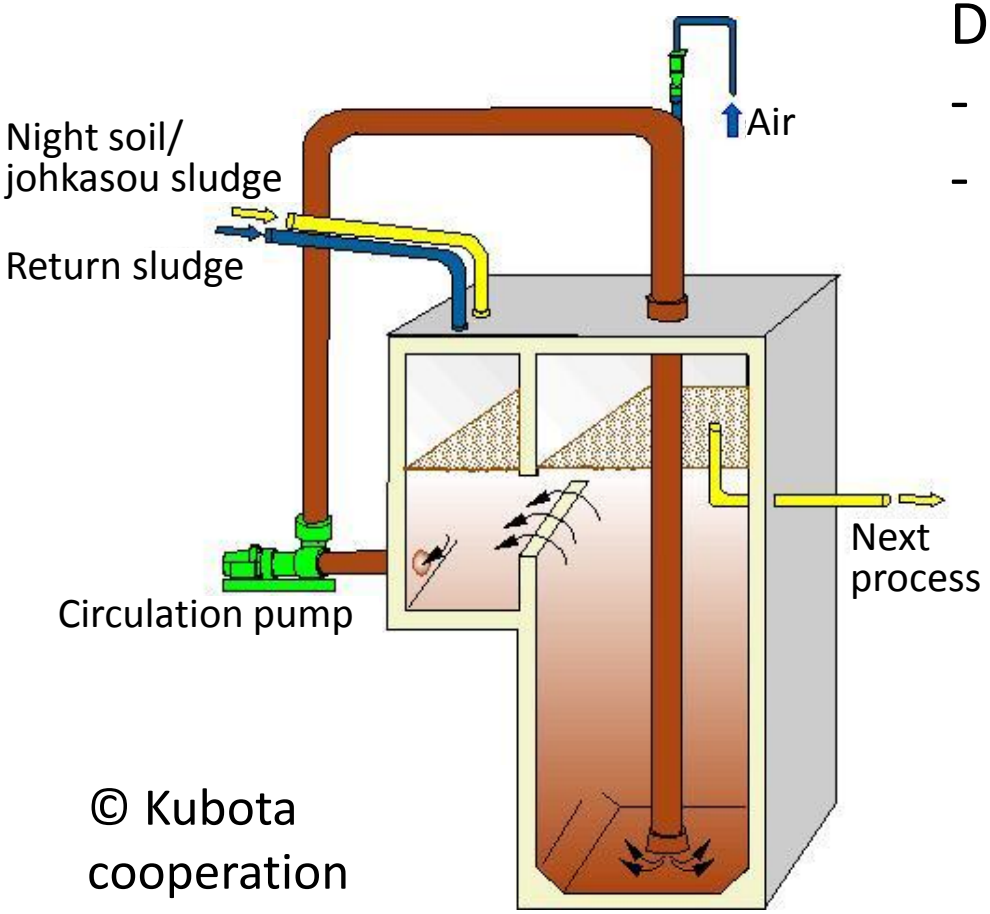
Example of improved aeration



© Kubota cooperation

Fig. Nitrification-and-denitrification tank

Deep shaft type reactor

- 10-meter depth reactor
- High pressure at bottom and effective dissolution of oxygen

From treatment to resource recovery (2000~)

Digested sludge typically dewatered and landfilled/incinerated before

- Reconstruction timing, 40 years after the first NST plant (1953)
- Public concern on the environment & resource recycling, and dioxin (60-70% incinerated)
- Needs of technology adaptation of changing influent composition

Change of subsidies system of NST plant (re)construction in 1997

- From night-soil treatment plant -> Sludge recycling center

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Change of the influent (1): Less concentrated night soil


Traditional pit latrine

Source: Japan toilet association

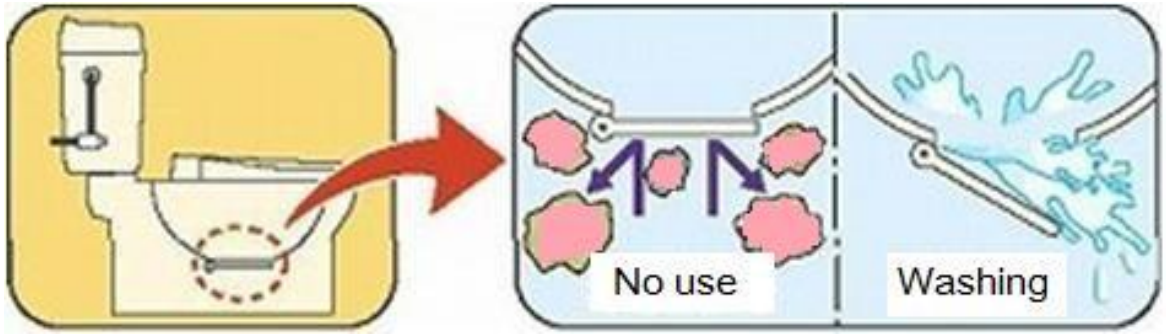

Micro-flush toilet

200-500 ml/flush with a flap valve

Table Composition of collected night soil

	1992	1996	1999	2001
pH	8.0	7.9	7.8	7.6
SS	13000	10000	9900	9400
BOD	10500	11000	10400	9500
COD_{Mn}	5840	5400	5600	5200
TN	3940	3300	3100	2700

Source: JSC (1992, 1996, 1999, 2001)



Source: www.kbk-net.com/whats.html

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Change of the influent (2): Lower concentration due to decrease of NS

Table Composition of night-soil & johkasou sludge

Item	Night soil (stored excreta)	Johkasou sludge
pH	7.8	6.8
SS	9900	7300
BOD	10400	3300
COD_{Mn}	5600	3200
TN	3100	300

Source: Koga et al. (1999)

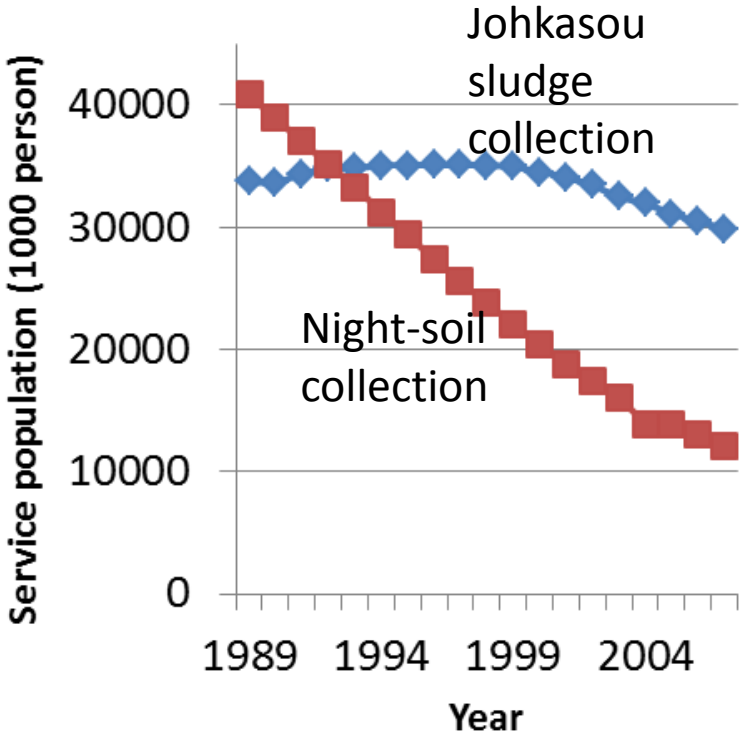

Fig. collected population of night-soil and johkasou sludge

Source: MOE (2001, 2008, 2014)

National support of R&D for biogas

Almost disappear of 1960's anaerobic digestion process of NS treatment plans

- Odor, strong H_2S and corrosion, large plant, low concern on energy recovery

National financial support of R&D
for the re-invention of anaerobic digestion (1995-)

- Mebius system (7 companies)
  - ✓ Single thermophilic digestion [TS: 10-15%, RT: 16 days]
- REM system (5 companies)
  - ✓ Single mesophilic digestion [TS: 10%, RT: 20 days]
- Rinessa system (7 companies)
  - ✓ 2 step (meso+thermo) digestion [TS: 10%, RT: 7 days x 2 steps]

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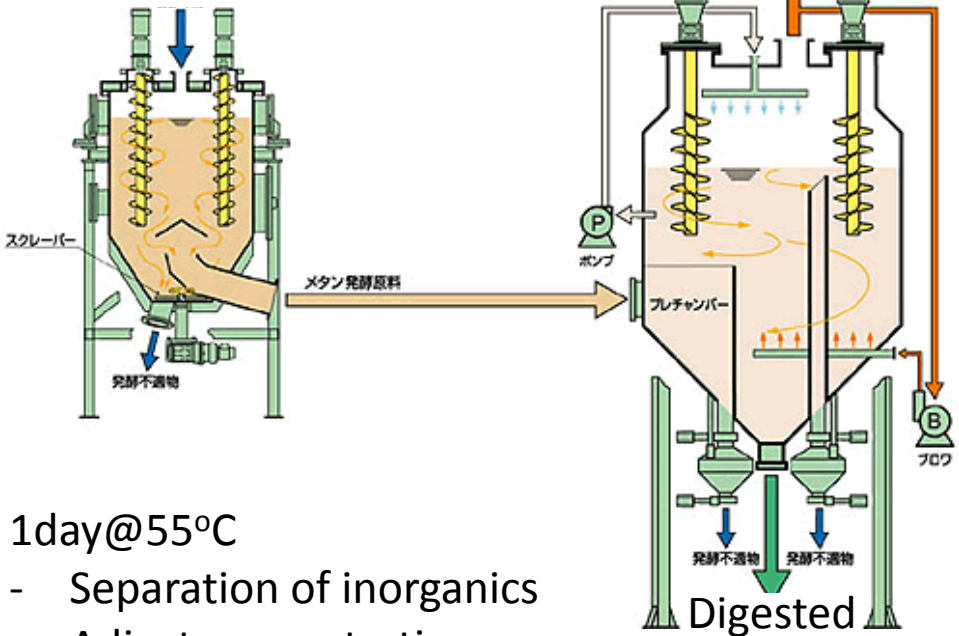
Eg. Mebius system

Mix separator

NS & food wastes



1day@55°C
- Separation of inorganics
- Adjust concentration
- Acidogenic phase

Twin reactor

16 day@55°C
- Methanogenic phase
- 2.3 m3/kL-NS
- 110 m3/ton-food wastes

http://www.hitachizosen.co.jp/products/business/plant/resource/index.html

Maihira clean center
- 149 kL/day of night-soil & johkasou sludge
- 1.8 ton/day of food garbage
- Biogas used for boilers
- Digested sludge composted, and freely distributed

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Sludge treatment facilities of NST plants

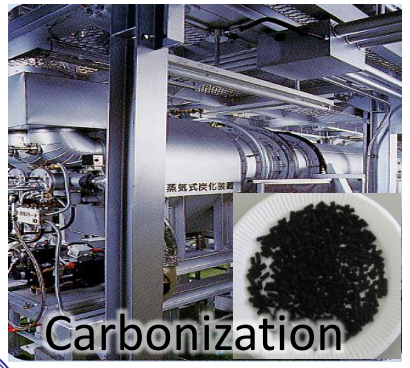
Table Sludge treatment facility of NST plant in 2012

Type of sludge treatment	No. of plant
Incineration of dewatered sludge	586
Composting	243
Direct landfill of dewatered sludge	31
Fuel	20
Biogas recovery + composting	18
Biogas recovery	15
Carbonization	12
Phosphorus recovery	4

Data from MOE, 2014


Biogas recovery


Composting


Carbonization

Pictures from Mr. Mineo Tachibana

Challenges

- Difficulties of dewatering at water treatment process due to increase amount of johkasou sludge
  - Solid separation with coagulant at beginning of the process
- Low concentration of biodegradable matter in recent FS
- Separated collection of food wastes not ready
- Limited (excess) demand of compost from FS
  - Concerns on compost quality
- Population decrease in small towns, resulting in remaining plant capacity
  - FSM unions managed by multiple municipalities (433 out of 1009 plants)
  - Cooperation with sewerage (105 out of 1009 plants)
  - Closure of old plants

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Summary

- Water treatment process of FS has been advanced, while digested sludge recycling is still at a challanging stage.
- NS treatment technology needs to be adapted to the change of the influent quality & quantity, and of the concern of a society in each period.
- Even though technologies are developed, social contexts need to be ready to accept them (e.g. food waste separation).
- Co-management with other organic wastes is essential, especially for resource recovery and for the condition of Japan where sludge generation is declining.

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