Johkasou Desludging in Japan

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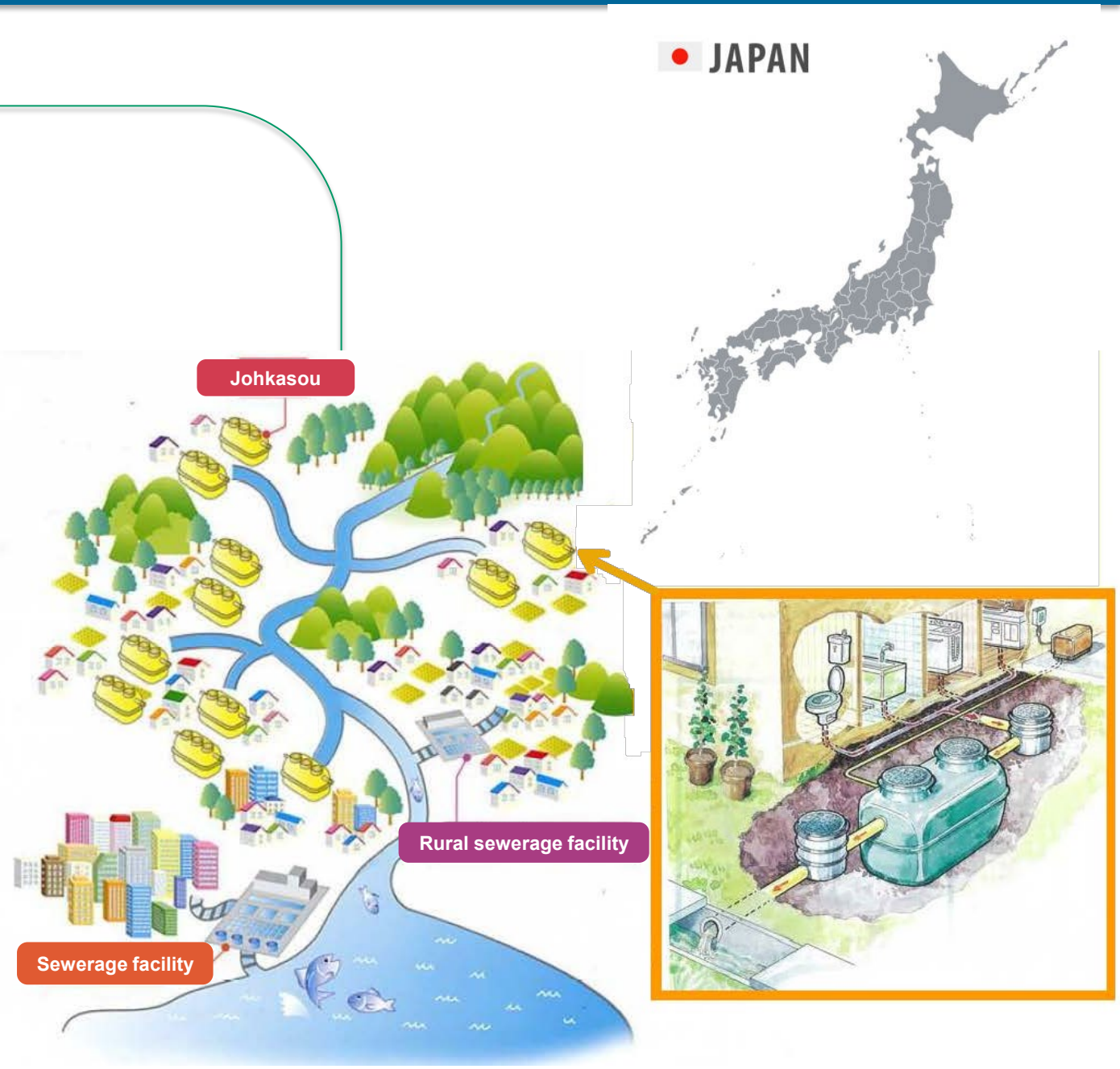
1. Country Profile

Population by type of wastewater treatment

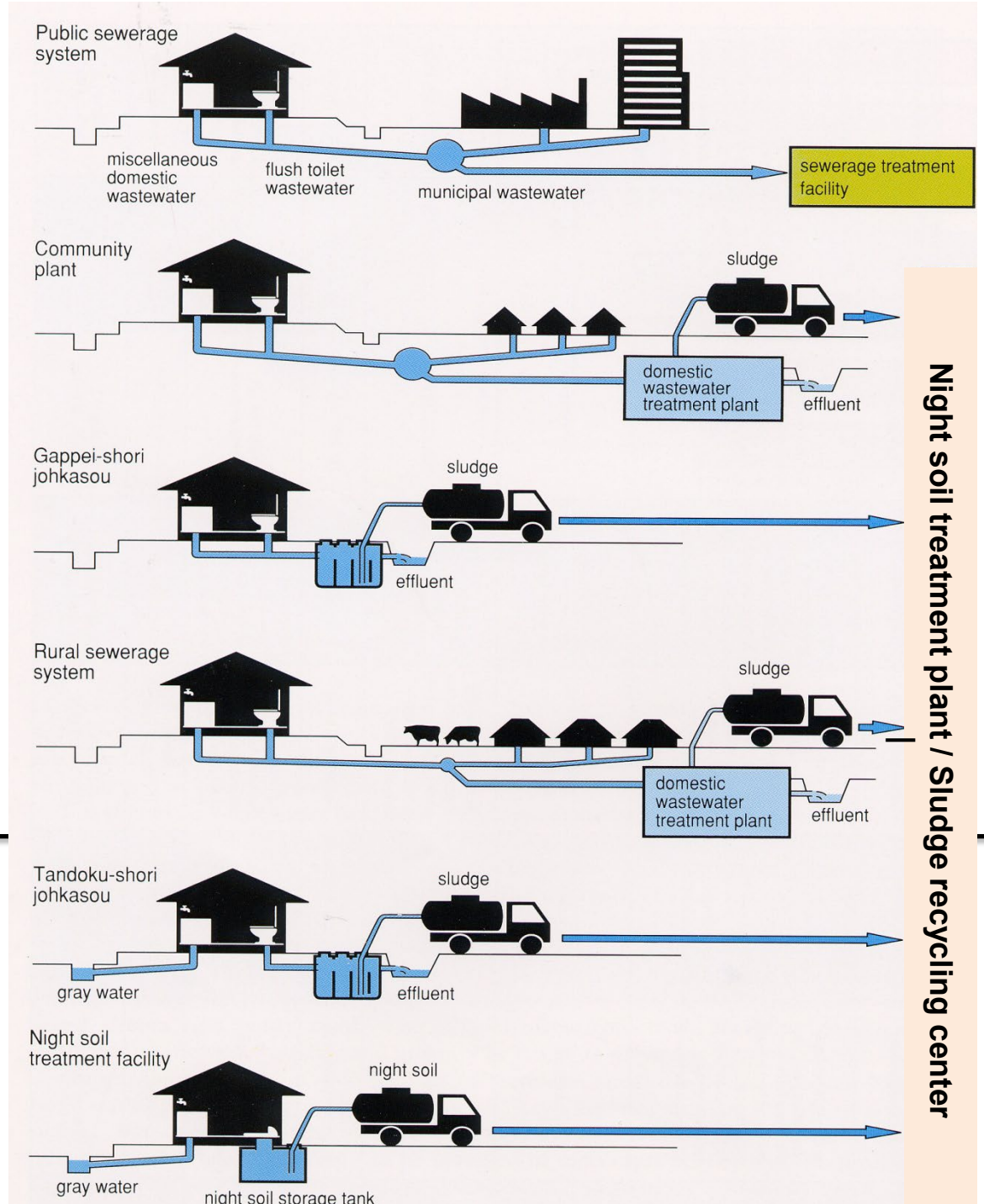
Total population	123.44 million	
Sewerage	101.41 million	(82.2%)
Johkasou	11.71 million	(9.5%)
Rural sewerage, etc.	2.76 million	(2.2%)
Community plants	0.14 million	(0.1%)
Served (total)	116.02 million	(94.0%)
Not yet served	7.41 million	(6.0%)



2. Wastewater Treatment Systems

Black water + gray water

Black water only



Public sewerage

Community plant

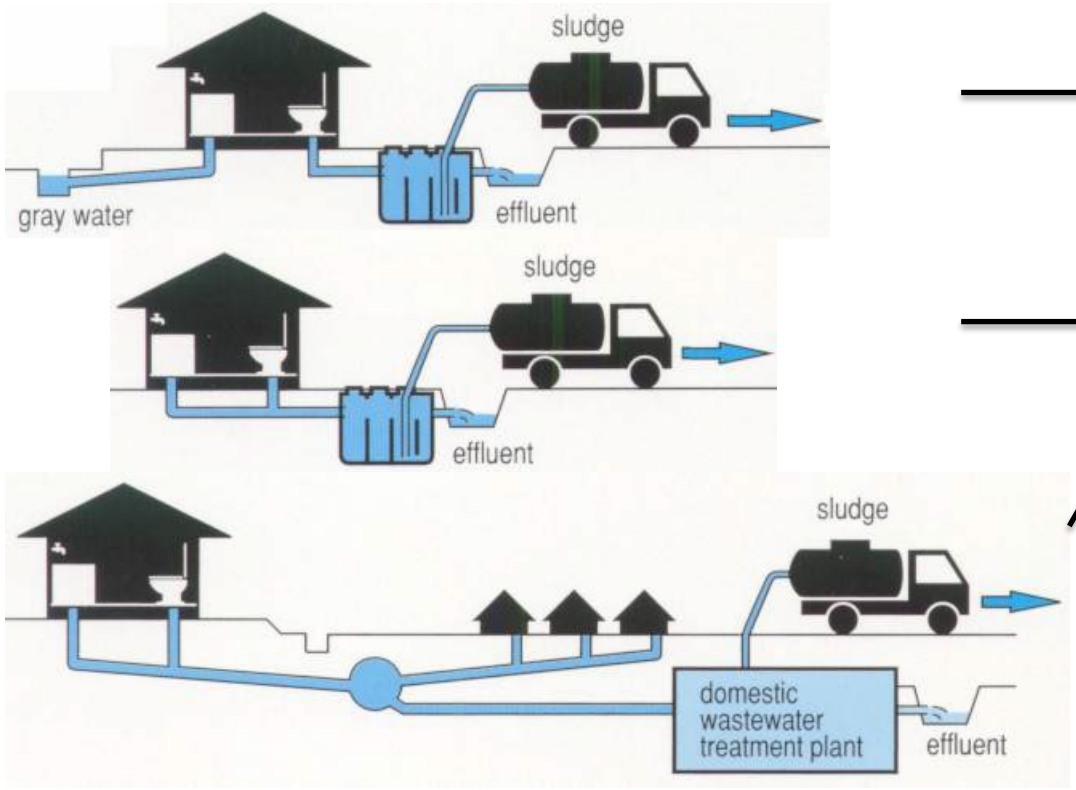
Johkasou (black + gray water)

Rural sewerage

Old-type Johkasou (black water only)

Vault toilet

3. Number of Johkasou Installed

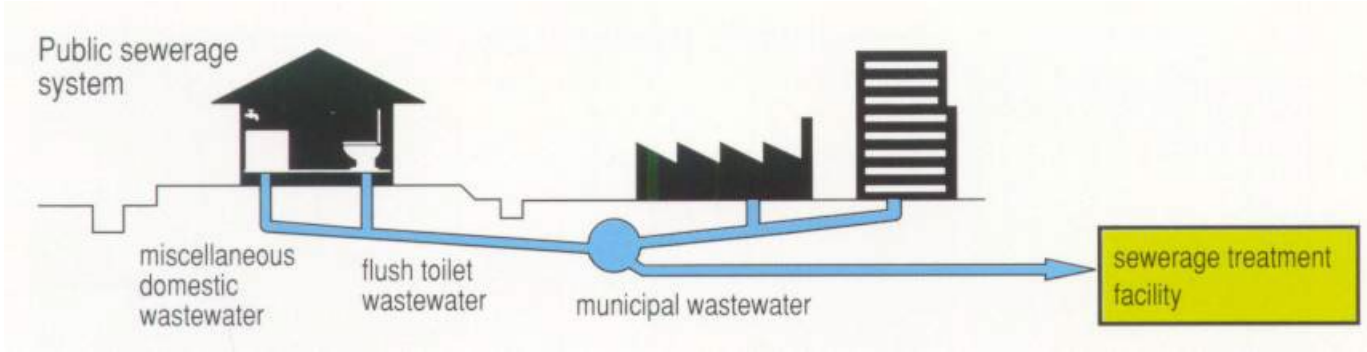


Old-type Johkasou (black water only)

3.290 million units

Johkasou 4.143 million units

Total 7.434 million units

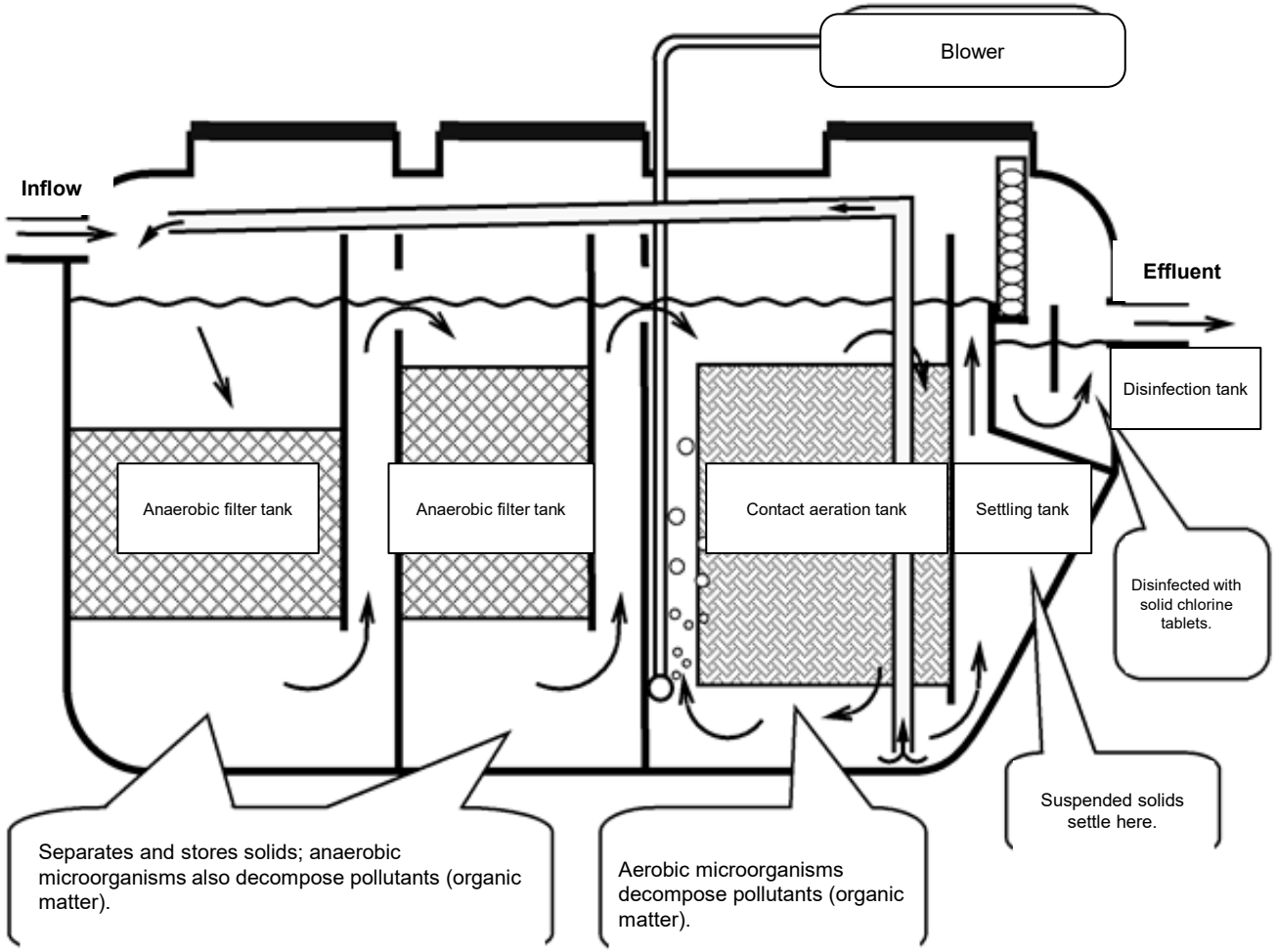


Sewerage

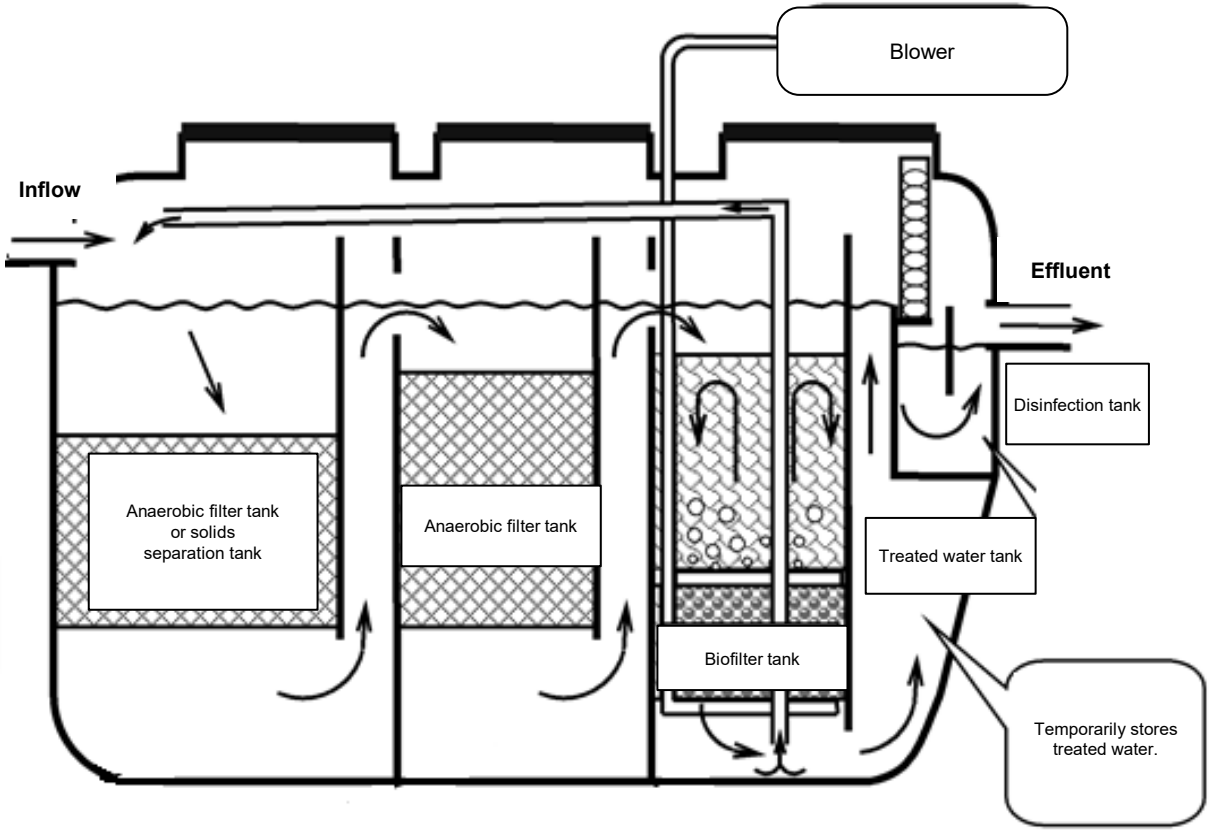
Approx. 2,100 facilities

4. Treatment Processes Used in Small-scale Johkasou

Anaerobic filter + contact aeration



Anaerobic filter + moving-bed carrier + biofiltration



5. Mechanism of Sludge Generation in Johkasou

1. Sludge from removal of solids in domestic wastewater

(settled sludge, scum and filter-bed sludge in the primary treatment unit)

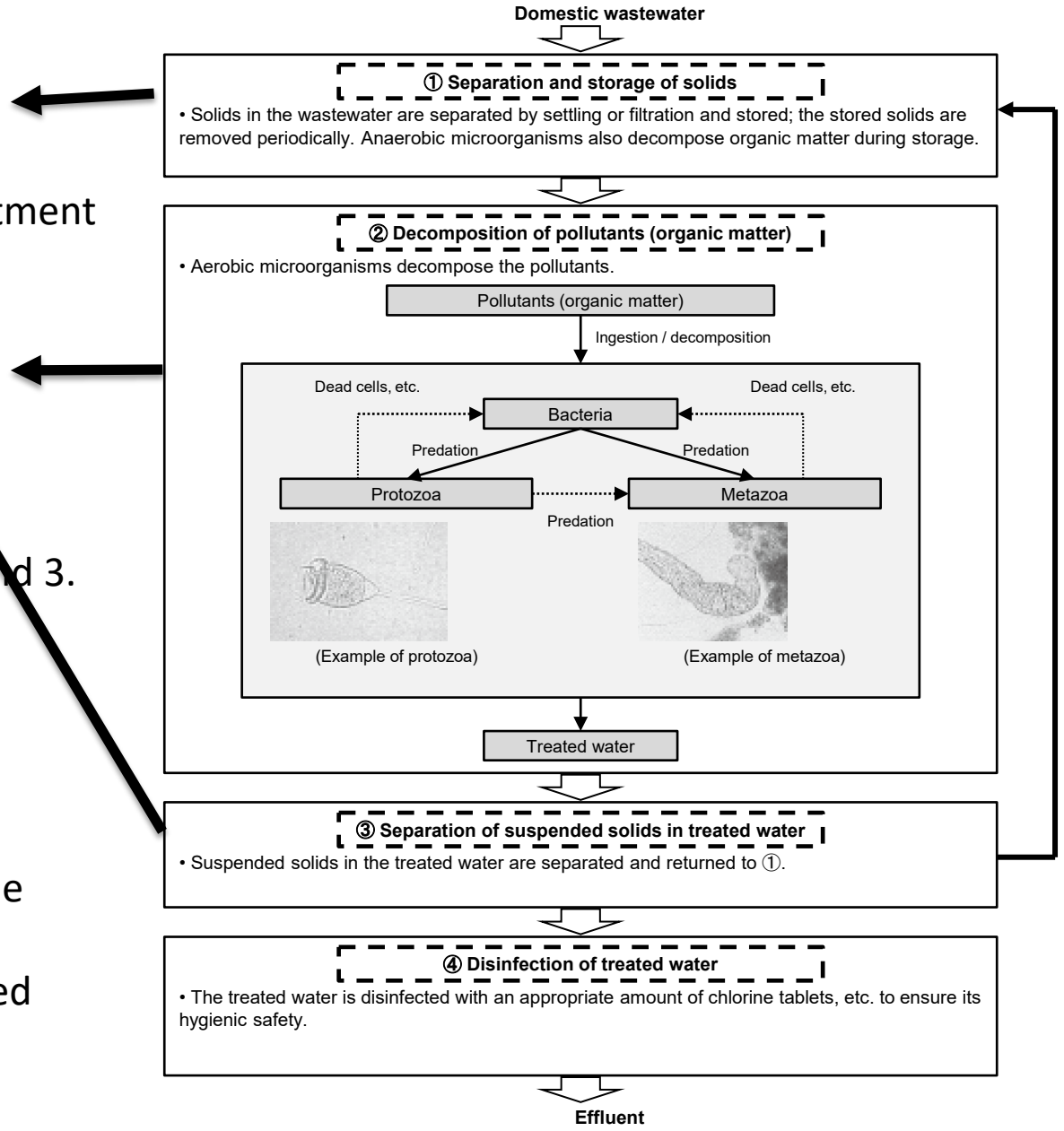
2. Sludge from microbial treatment of fine SS and organic matter

3. Sludge from settling of microbial aggregates produced in 2.

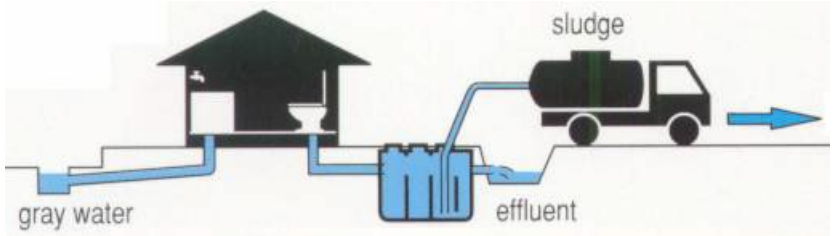
4. Sludge accumulation from transfer of sludge generated in 2. and 3. to the primary treatment unit

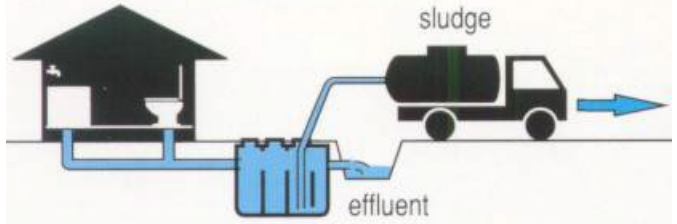
Sludge accumulation:

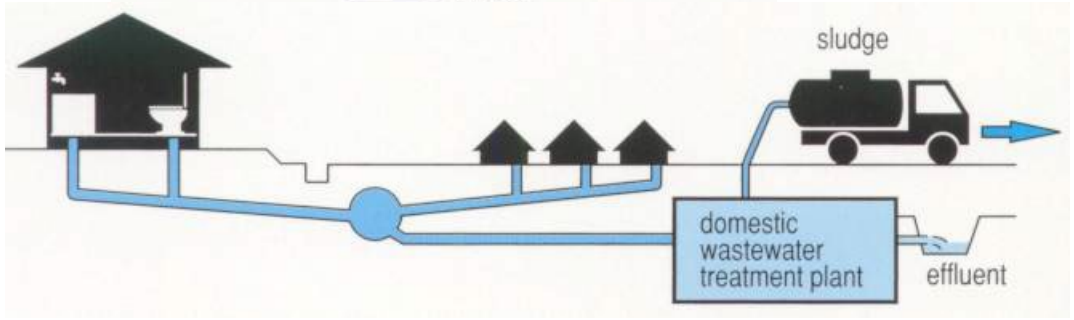
- Affected by the inflow load (wastewater volume, number of users)
- Changes the flow velocity in the tank, which in turn affects the accumulated sludge itself
- Affected by anaerobic/aerobic degradation of the accumulated sludge
- Affects effluent quality through flotation (gasification) and washout of fragmented sludge, etc.



6. Maintenance and Desludging Frequency of Johkasou







Johkasou Maintenance frequency

Depends on size & process

Once every 3-4 months

Once a month

Once every 2 weeks

Once a week

Daily

etc.

Johkasou Desludging frequency

(removed by vacuum truck)

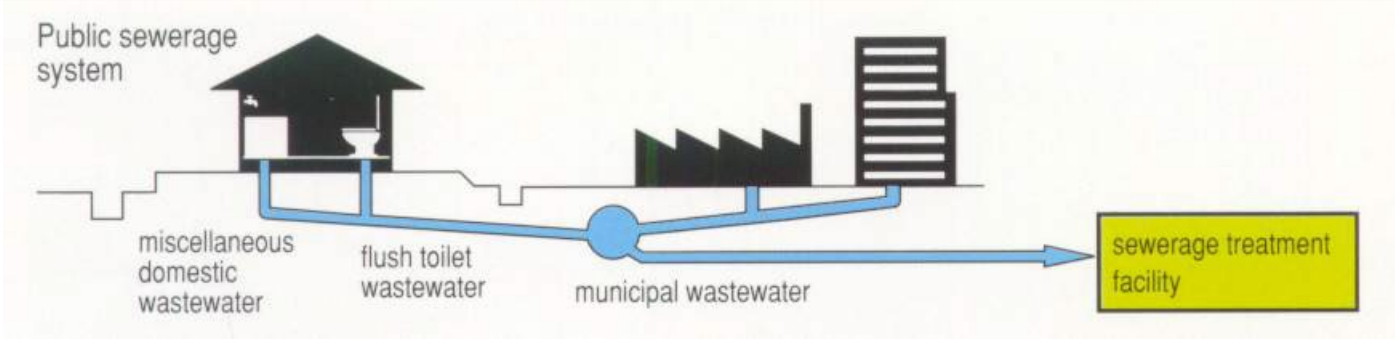
Small-scale Johkasou

Once a year

Medium-scale Johkasou

Once every 1-2 months

(based on accumulation)



Sewerage

Daily operation

Dewatering 2-3 times a week

(drying/incineration at some plants)

7. Desludging Interval vs. Effluent SS and Desludged Sludge Volume

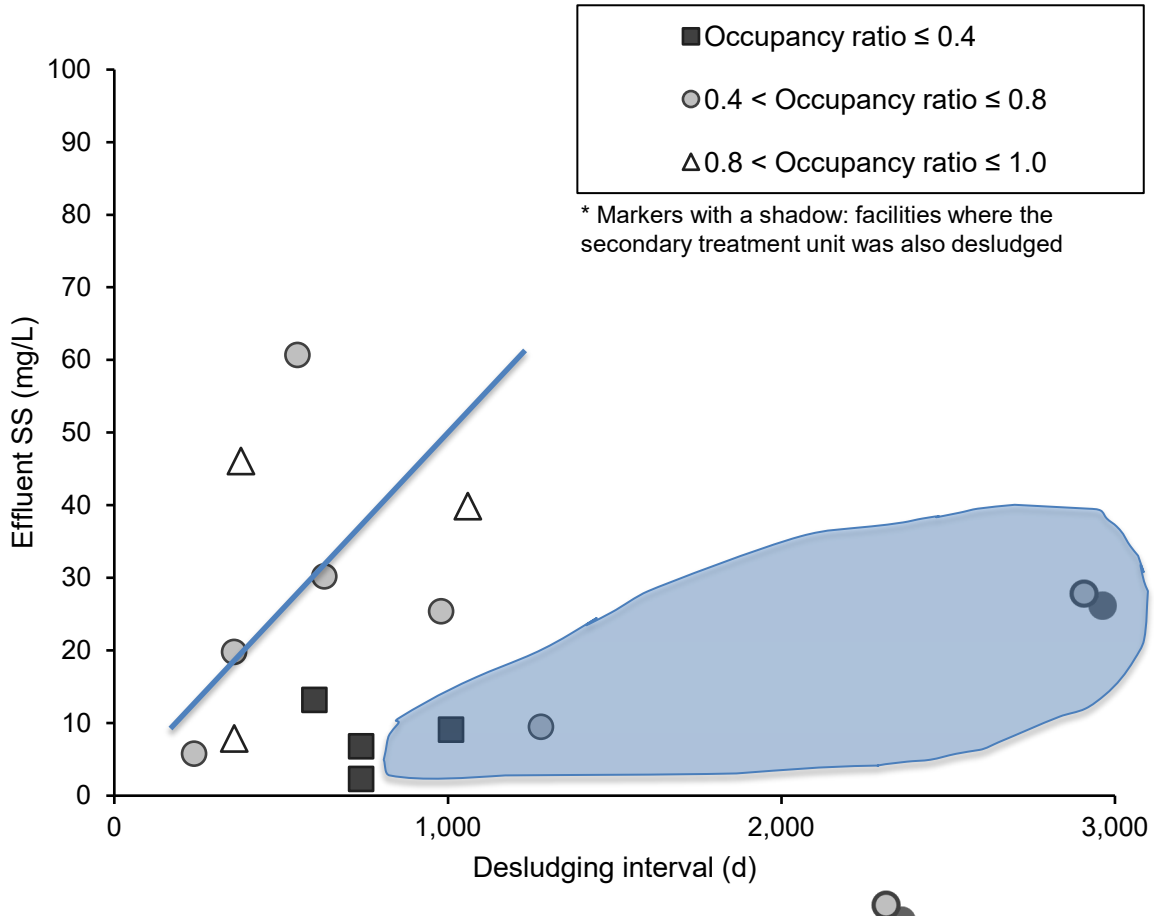


Fig. Desludging interval vs. effluent SS

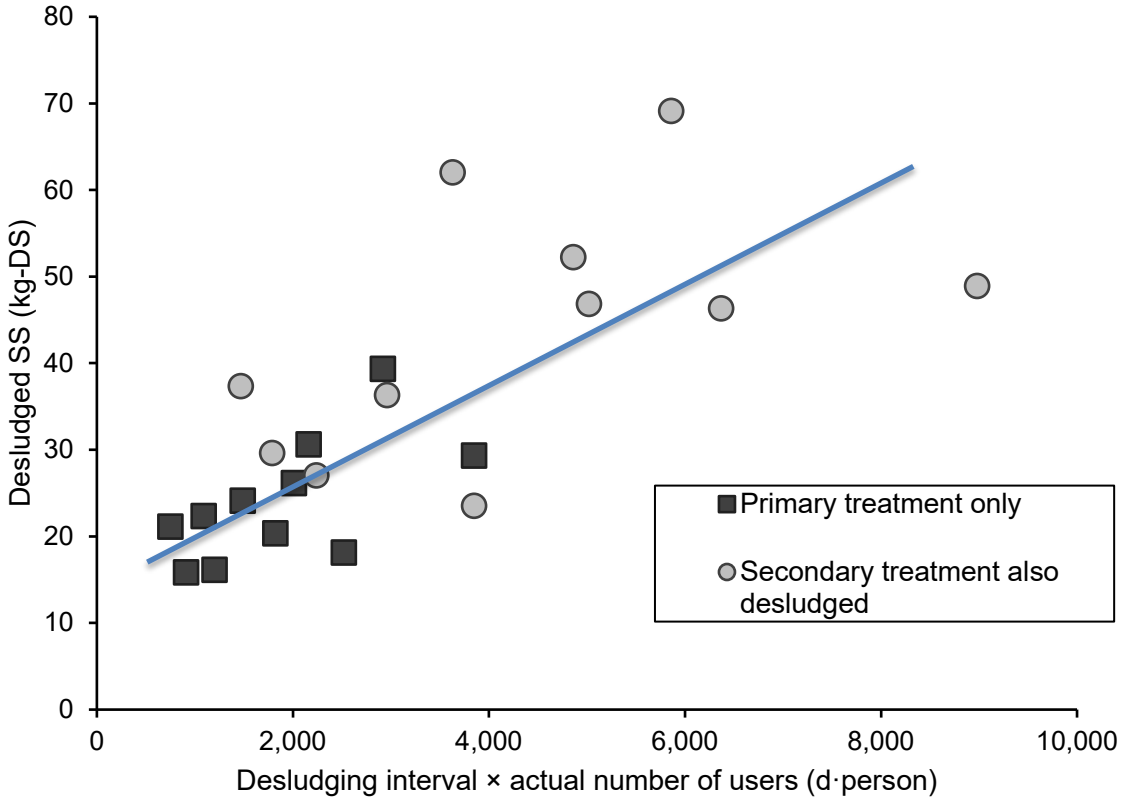


Fig. Desludging interval × actual number of users vs. desludged sludge volume (SS)

8. Desludging Interval vs. Sludge Properties (VSS Ratio)

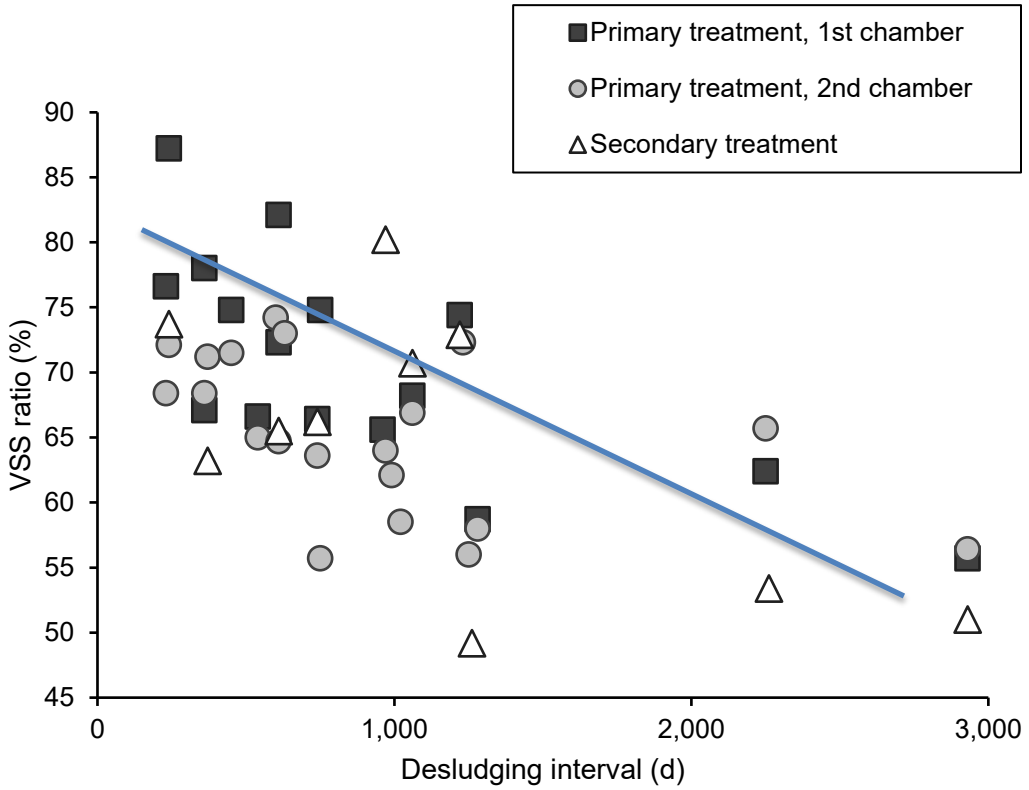


Fig. Desludging interval vs. VSS ratio by chamber

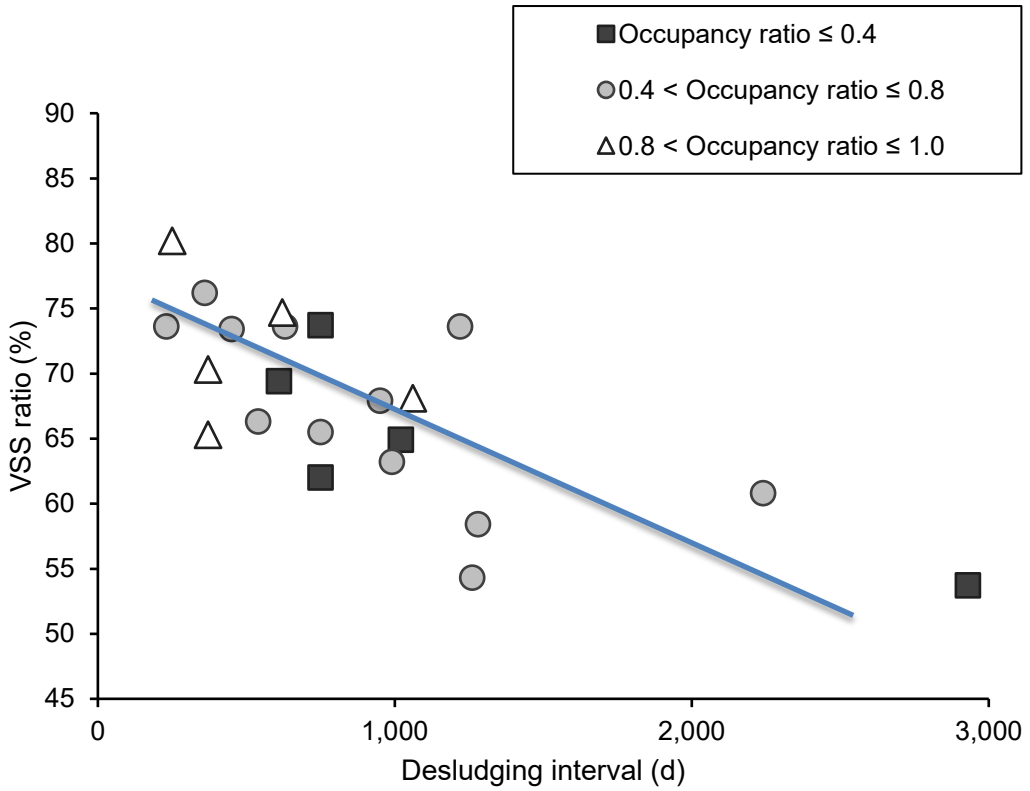
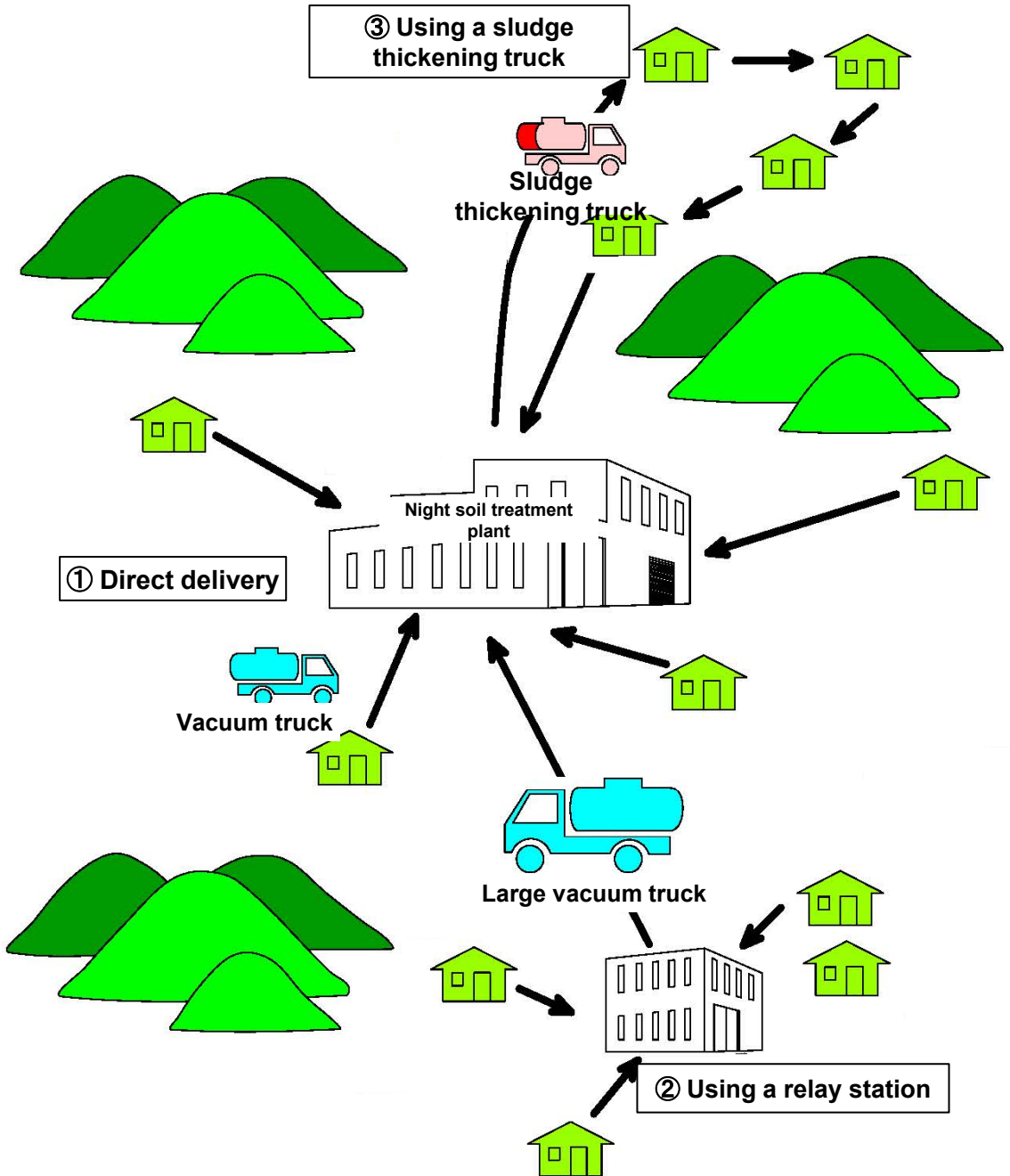


Fig. Desludging interval vs. VSS ratio by occupancy ratio

9. Desludging Service Flow, Legal & Institutional Framework



- Sludge removed from Johkasou by vacuum truck is delivered to and treated at night soil treatment plants
- Johkasou sludge is classified as general (municipal) waste, so municipalities are responsible for its treatment
- In the past, municipalities often did desludging directly; today it is mostly done by licensed private companies
- The Johkasou Act requires desludging, in principle once a year
- Desludging companies work on request from Johkasou managers (owners), so whether desludging is actually carried out is uncertain

10. Desludging Implementation Rate of Johkasou

1. Questionnaire to desludging associations and statistical analysis by JECES (2004)

According to “Waste Management in Japan”:

Fiscal year	1992	1996	2000	2004
(Heisei era)	4	8	12	16
Night soil	1.70	1.94	2.16	2.23
Johkasou sludge	0.99	1.10	1.19	1.28

Per-capita Johkasou sludge by prefecture (L/person/day) (FY2000)

Fukuoka	2.03	Toyama	1.03
Gifu	1.55	Chiba	0.96
Nagasaki	1.33	Kagawa	0.57
Iwate	1.19	Okinawa	0.38

Varied widely by prefecture

Causes analyzed by multiple regression of Johkasou population and sludge volume (single/combined) over several years

Average per-capita sludge volume: combined-treatment Johkasou 2.61, single-treatment Johkasou 1.11 (L/person/day)

Using FY2000 population shares of combined/single treatment and these unit values, the desludging rate was estimated at about 75%

2. Desludging implementation rate surveyed by the Ministry of the Environment (FY2025)

Combined treatment 68.3%　Single treatment 62.9%　Overall 65.9%

Possible reasons for the low implementation rate:

Early stage: sludge was often refused due to the limited capacity of night soil treatment plants

Recently: more Johkasou managers (owners) are refusing desludging

11. Situation in the Early Stage of Johkasou Installation

① Frequent problems at the construction stage (poor installation)

- Inlet and outlet reversed • Not level • Leakage • No blower, etc.

② Inadequate operation and maintenance

- Lack of user awareness • No regular maintenance • No desludging, etc.
- Even when desludging was done, there were no facilities to treat the sludge

③ Insufficient legal framework

- Building Standards Act, Waste Management Act, Water Pollution Control Act, etc.
- However, none of these laws was designed for the proper spread of Johkasou

⇒ As a result, poor installation, improper or no management and unreported installations were widespread, causing “Johkasou pollution”. Many Johkasou were smelly, dirty and discharged untreated wastewater.

12. Importance of Legislation Recognized: Enactment of the Johkasou Act

1. Provisions for those who install and use Johkasou
2. Provisions for Johkasou manufacturers
3. Provisions for Johkasou installation contractors
4. Provisions for Johkasou maintenance providers
5. Provisions for Johkasou desludging providers
6. Provisions for periodic inspection of Johkasou

Regarding desludging:

- The Johkasou Act sets periodic desludging and its technical standards
- The Waste Management Act governs collection, transport and treatment of the removed sludge

13. Challenges and Responses in Johkasou Desludging

Challenges

1. Diverse new treatment processes: desludging methods must be widely communicated
2. Timing of desludging for low-occupancy Johkasou (population decline, smaller households)
3. Longer transport distances due to regional consolidation of night soil treatment plants
4. Subsidies to cope with rising desludging fees
5. Support for low-income households

Responses

To 1. Training for desludging engineers and practitioners

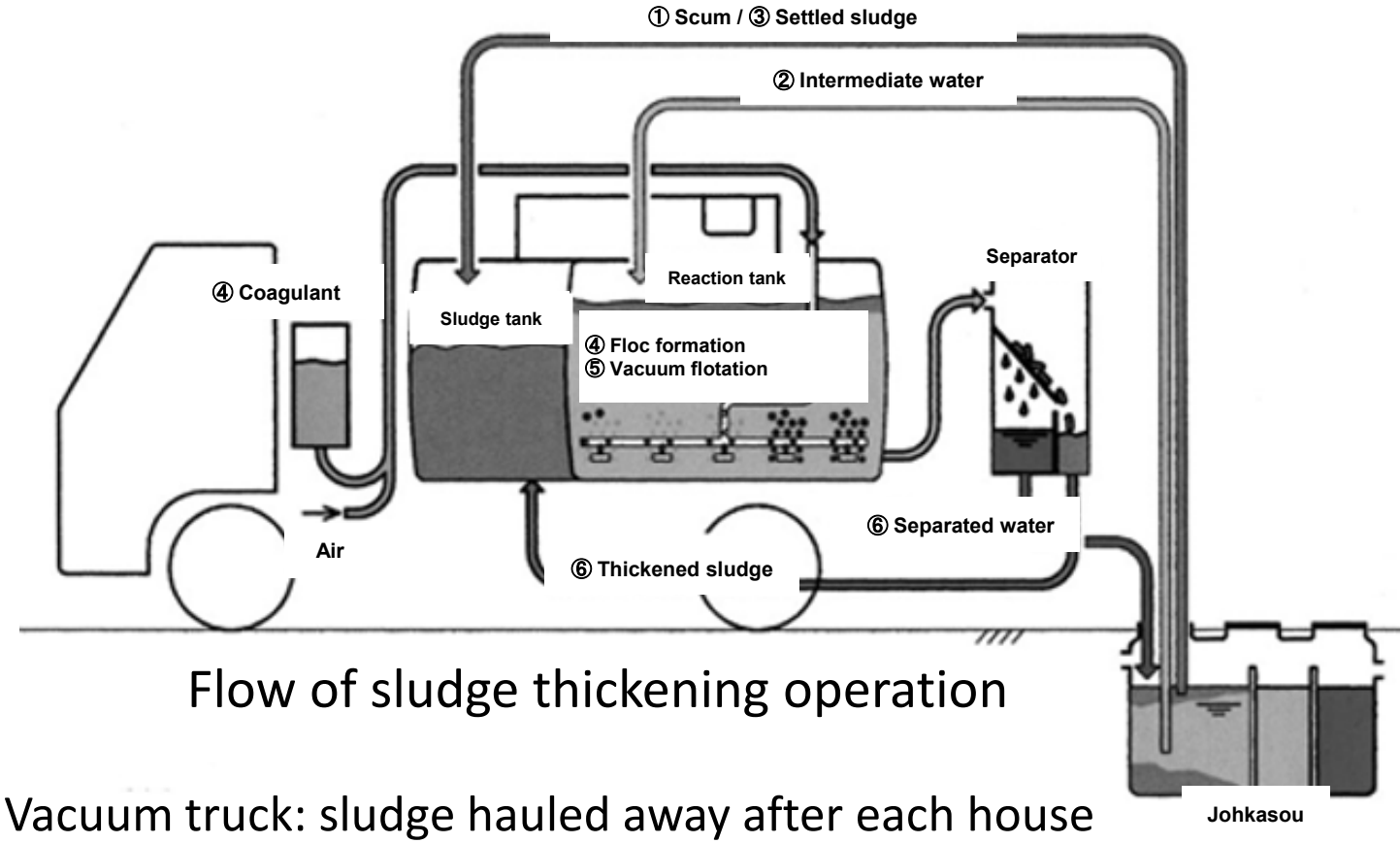
To 2. Uniform desludging has maintained performance, but it is time to consider exceptions; thickening dilute sludge before removal should also be considered

To 3. Better transport efficiency with sludge thickening trucks (also good for the SDGs)

To 4. & 5. Desludging frequency per 2., volume reduction per 3., and municipal financial support are needed

14. Efficient Sludge Collection and Transport with Johkasou Sludge

Photo: Johkasou sludge thickening truck



Flow of sludge thickening operation

Vacuum truck sludge: SS approx. 1%

Thickening truck sludge: SS > 3%

Separated (refill) water: transparency > 50 cm

Vacuum truck: sludge hauled away after each house

Thickening truck: hauled away after several nearby houses

Fuel per house: thickening truck uses half of a vacuum truck

i.e., CO_2 emissions cut by about 50%

Large utility savings at night soil treatment plants as well