

# Water Quality Improvement through Replace Old Type Johkasou by Johkasou

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# Current situation of old type johkasou and johkasou installation

## Revision of the Johkaous Act (Enforeced from April, 2001)

- New installation of old type johkasou is banned
- Promoting replace of old type johkasou by johkasou as a responsibility of the user of old type johkasou

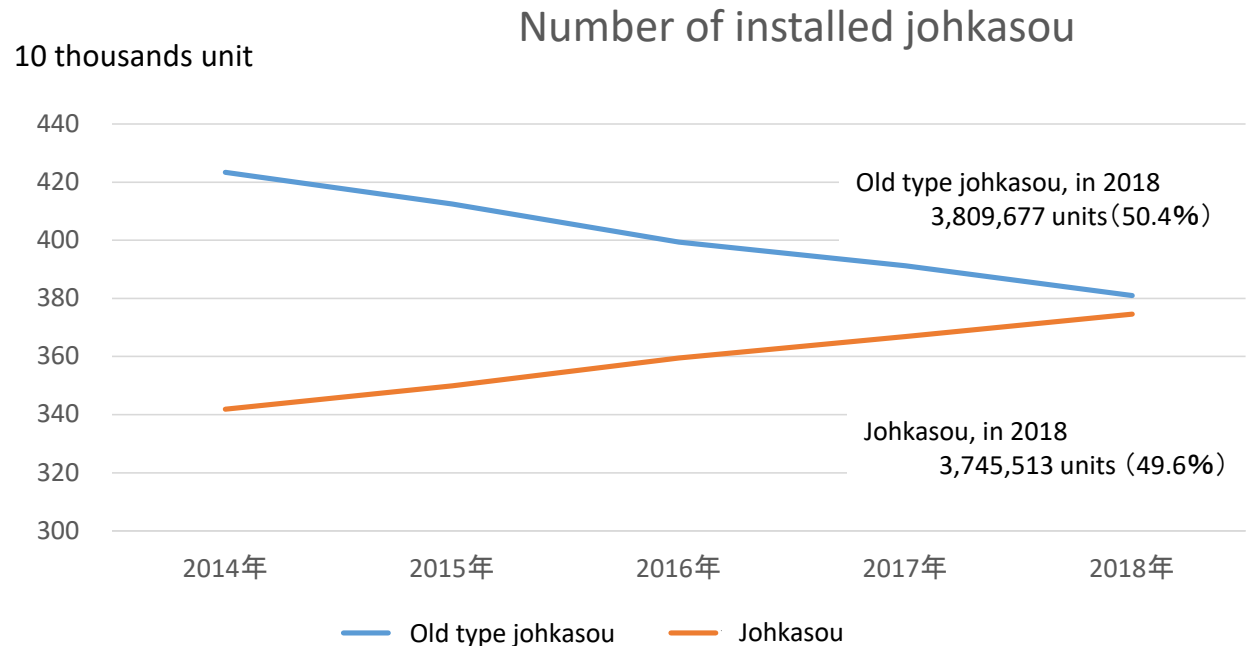


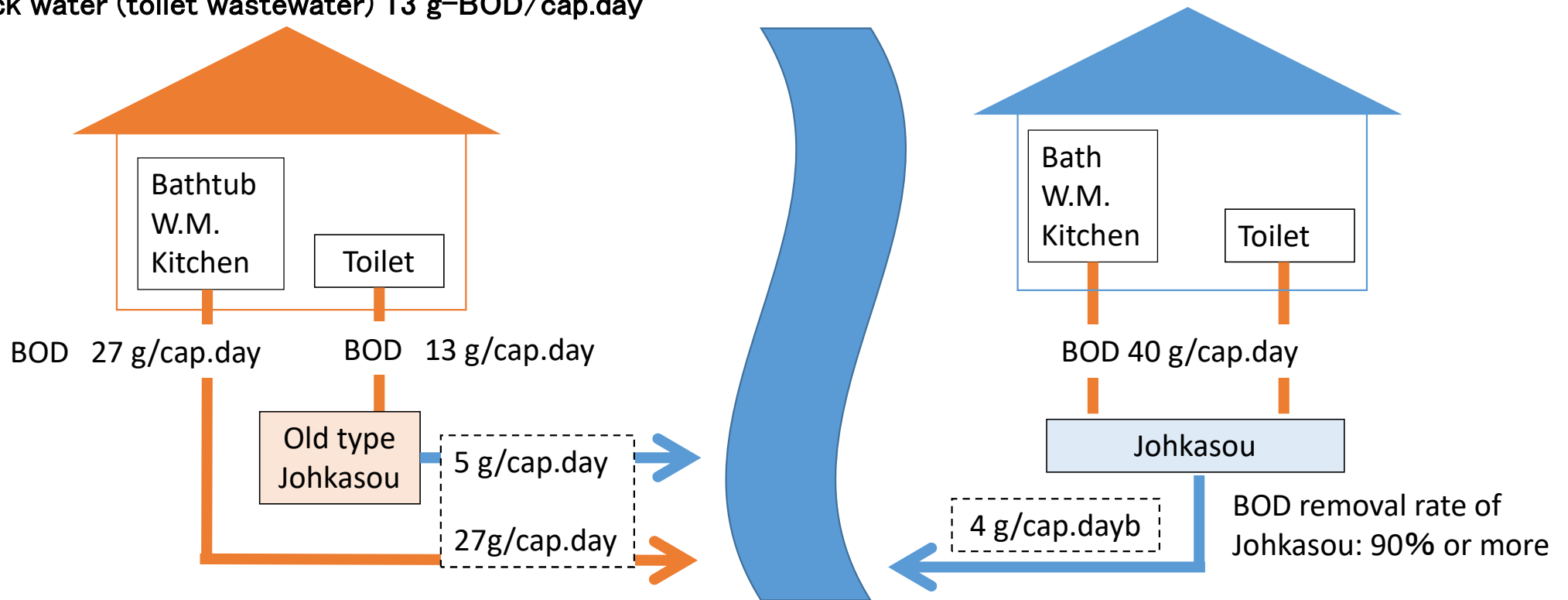
Figure Trend of the old type johkasou/johkasou installation

(Data source: Ministry of the Environment, 2019)

Although the newly installed johkasou is increasing year by year, there are still about 3.8 million old type johkasou in operation in Japan. Untreated gray water from these old type johkasou is a big issue of water environment conservation.

## Pollutant loads of domestic wastewater

- Gray water (bathtub, washing machine (W.M.), kitchen) 27 g-BOD/cap.day
- Black water (toilet wastewater) 13 g-BOD/cap.day

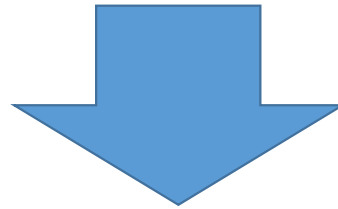


BOD removal rate of Old type Johkasou: 65% or more.  
Old type Johkasou treats only Black water.

Compared to old type johkasou, johkasou can reduce pollutant load of BOD to  $1/8$  of that by old type johkasou.

# 1. Objective

To further promote replacing old type johkasou by johkasou, it is necessary to measure of the effect quantitatively by confirming the water quality improvement by the conversion to johkasou, and widely disseminate and utilize the results.



Conduct water quality survey of treated water of old type johkasou and the untreated gray water from individual household where the old type johkasou is used.

Replace the old type johkasou by johkasou, and assess the **effect on environment improvement**, and prepare materials for publicity based on the results.

Conduct water quality survey for the old type johkasou and the johkasou installed to replace them, and summarized the results.  
Further, survey the sanitary aspects and the influence of LAS (detergent component), assess the effect of the conversion to johkasou.

## 2. Survey Content

- ① Water quality survey after installation of johkasou
- ② Usage survey
- ③ Questionnaire survey



### 3. Site of survey

- Fifteen houses that received the water quality survey of treated water of old type johkasou and the gray water in 2016.
- Additional five houses using johkasou as the reference to check the bias of the data above.

## 4. Sampling method

- When wastewater discharged after cooking, washing and using bathing, sampling the treated water from johkasou
- Sampling is conducted twice a day in the morning and in the afternoon
- On-site measurement (pH, residual chlorine, transparency index)
- Samples for other items of water quality analysis



# Item of water quality analysis

Item	unit	lower limit of quantitation
pH	—	—
BOD	mg/L	0.5
CODMn	mg/L	0.5
SS	mg/L	10
n-Hex	mg/L	5.0
Coliform group	count/mL	30
Coliform	MPN/mL	30
Cl-	mg/L	0.1
T-N	mg/L	0.4
HN4-N	mg/L	0.1
NO2-N	mg/L	0.10
NO3-N	mg/L	0.10
T-P	mg/L	0.20
LAS	mg/L	0.10
Tr (transparency index)	cm	1.0



## 5. Item of survey on johkasou usage

1. Size of house (floor area, number and usage of room, type and number of water areas such as toilets, kitchens)
2. Number of residents and composition (men and women, age (age))
3. Working status of the residents (working hours, home / absence time)
4. Everyday life pattern (cooking, eating, bathing and bathtub cleaning time, washing time/time zone)
5. Presence / absence and type of drugs used regularly (blood pressure, diabetes, etc.)
6. Maintenance inspection / cleaning implementation status and its contents
7. Information on the type and amount of detergent used
8. Information on tap water consumption
9. List of water-saving equipment, if available
10. Presence / absence / type of pet

## 6. Result

### (1) condition of johkasou usage

Item	Answer	Number of case
Number of user	2 person	6
	3 person	5
	4 person	3
	5 person	2
	6 person	2
	7 person	1
	8 person	1
Nitrogen removal type johkasou Treatment process of johkasou	Contact aeration and trickling filter process	10
	Sedimentation filtration – recirculation process	3
	Sedimentation anaerobic filter aerobic recirculation process	2
	Moving bed filtration recirculation process	2
	Sedimentation moving bed recirculation process	1
	Anaerobic filter contact aeration process	1
	Moving bed recirculation process	1

## 6. Result

### (1) condition of johkasou usage

Item		Answer	Number of case
Implementation status of O&M	Maintenance	Implemented	20
		Unimplemented	0
	Desludging	Implemented	0
		Unimplemented	20
Time of discharging wastewater	a.m.	6~8	7
		6~9	7
		6~10	2
		7~8	1
		7~9	3
	p.m.	16~19	1
		17~20	6
		17~21	4
		18~20	4
		18~21	4
		18~23	1

## (2) Tap water consumption and condition of johkasou usage

No.	Tap water consumption (m <sup>3</sup> )	User of johkasou (person) A	Johkasou capacity (PE) B	Ratio of A/B
1	0.380	3	5	0.60
2	0.367	3	7	0.43
3	0.345	2	5	0.40
4	0.503	2	7	0.29 min
5	0.330	2	5	0.40
6	0.716	3	5	0.60
7	0.554	3	5	0.60
8	0.133 min	2	5	0.40
9	—	3	7	0.43
10	0.495	6	7	0.86
11	0.729	4	7	0.57
12	1.860 max	6	7	0.86
13	0.614	2	5	0.40
14	0.990	4	7	0.57
15	0.418	2	7	0.29
16	0.721	5	5	1.00
17	0.554	7	7	1.00
18	0.548	5	7	0.71
19	0.185	4	5	0.80
20	0.696	8	7	1.14 max
<b>Avg.</b>	0.586	3.8	—	0.62

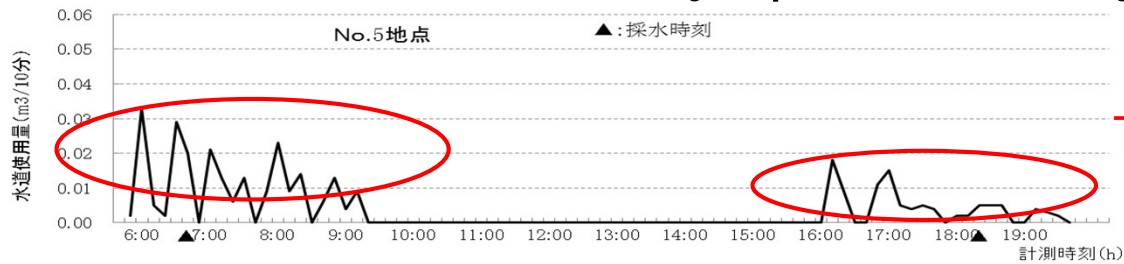
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# Tap water consumption

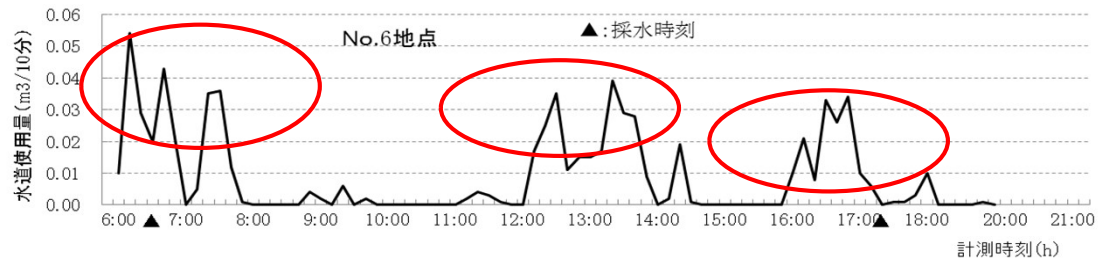
- Questionnaire survey
- Monitoring the water meter by taking interval photos

Max. 1.860 m<sup>3</sup>/day (6person-family)

Min. 0.133 m<sup>3</sup>/day (2person-family)



Two peaks: in the morning and the night



Three peaks: in the morning, noon, and at night.  
In this case, some family member stay home during a day.

## (4) Result of water quality survey

Item		Type of sample	Result
Analysis item	unit		Avg.
pH	—	Eff. of old type johkasou	7.5
		Gray water	7.3
		Eff. of johkasou	7.1
BOD	mg/L	Eff. of old type johkasou	46
		Gray water	161
		Eff. of johkasou	7.4
COD	mg/L	Eff. of old type johkasou	66
		Gray water	114
		Eff. of johkasou	13.5
SS	mg/L	Eff. of old type johkasou	44
		Gray water	61
		Eff. of johkasou	10
n-Hex	mg/L	Eff. of old type johkasou	5.0
		Gray water	35
		Eff. of johkasou	Less than 5.0
Coliform G.	count/mL	Eff. of old type johkasou	$1.4 \times 10^3$
		Gray water	$9.5 \times 10^3$
		Eff. of johkasou	$1.7 \times 10^2$
Coliform	MPN/mL	Eff. of old type johkasou	$3.8 \times 10^2$
		Gray water	$2.1 \times 10^2$
		Eff. of johkasou	$6.9 \times 10^1$
Residual chorine	mg/L	Eff. of old type johkasou	Less than 0.1
		Gray water	—
		Eff. of johkasou	0.8

Item		Type of sample	Result
Analysis item	Unit		Avg.
T-N	mg/L	Eff. of old type johkasou	106
		Gray water	7.0
		Eff. of johkasou	10.9
NH4-N	mg/L	Eff. of old type johkasou	78
		Gray water	1.1
		Eff. of johkasou	4.1
NO2-N	mg/L	Eff. of old type johkasou	6.3
		Gray water	0.14
		Eff. of johkasou	0.46
NO3-N	mg/L	Eff. of old type johkasou	16
		Gray water	0.59
		Eff. of johkasou	5.1
T-P	mg/L	Eff. of old type johkasou	14
		Gray water	1.0
		Eff. of johkasou	3.2
LAS	mg/L	Eff. of old type johkasou	Less than 0.10
		Gray water	4.97
		Eff. of johkasou	0.14
Tr	cm	Eff. of old type johkasou	12.0
		Gray water	11.3
		Eff. of johkasou	29.7
Temperature	°C	Eff. of old type johkasou	3.8
		Gray water	4.1
		Eff. of johkasou	13.7
Water temperature	°C	Eff. of old type johkasou	7.2
		Gray water	11.5
		Eff. of johkasou	22.3

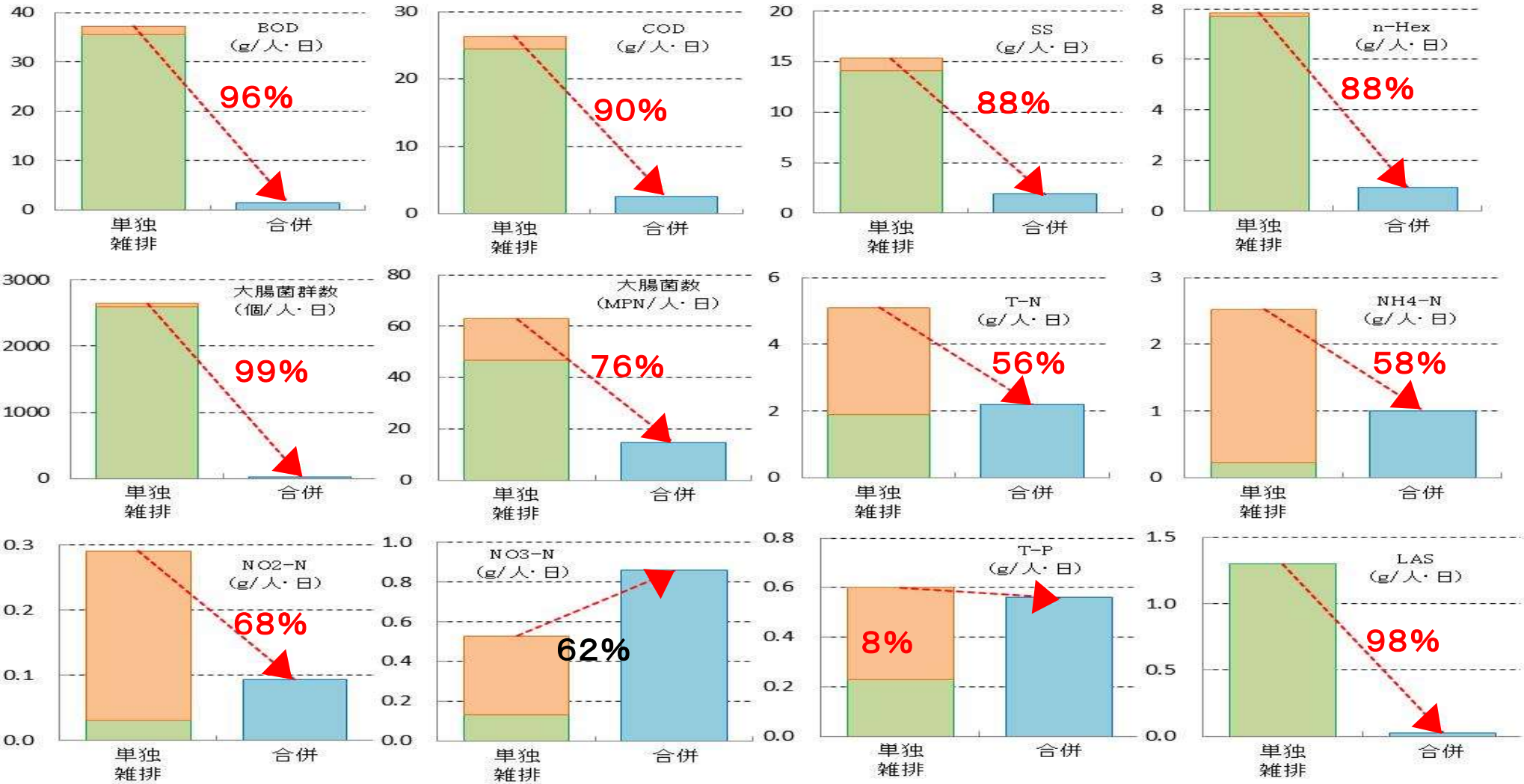
## (5) Estimation of unit load, g/cap.day

Item	Before		After	Reduction rate
	Old type johkasou	Gray water	johkasou	
BOD	1.6	36	1.5	96%
COD	1.9	24	2.6	90%
SS	1	14	2	88%
n-Hex	0.1	7.7	0.9	88%
T-N	3.2	1.9	2.2	56%
NH4-N	2.3	0.2	1.0	58%
NO2-N	0.26	0.031	0.09	68%
NO3-N	0.40	0.13	0.86	62%
T-P	0.37	0.23	0.56	8%
LAS	0.003	1.3	0.03	98%

Unit load = Amount of pollutant load ÷ number of resident

Amount of pollutant load = Amount of wastewater × concentration

# Variation of pollutant loads Before & After of johkasou installation, g/cap.day



: Old type johkasou
  : Gray water
  : Johkasou



## Pollutant loads (discharge unit load), g/cap.day

Item	Old type johkasou		Gray water		Johkasou	
	2016 Sur.	Reference	2016 Sur.	Reference	2017 Sur.	Reference
BOD	1.6	3.2~6.3	36	13~35	1.5	0.88~4.0
COD	1.9	3.2~3.8	24	2.7~15	2.6	2.8~4.5
SS	1	2.3	14	11~24	2	1.5
n-Hex	0.1	–	7.7	6.1	0.9	–
T-N	3.2	5.0~6.6	1.9	1.2~2.3	2.2	3.0~6.5
NH <sub>4</sub> -N	2.3	–	0.2	–	1.0	1.6
NO <sub>2</sub> -N	0.26	–	0.031	–	0.09	0.051
NO <sub>3</sub> -N	0.40	–	0.13	–	0.86	1.7
T-P	0.37	0.60~1.0	0.23	0.22~0.54	0.56	0.50~0.92
LAS	0.003	–	1.3	–	0.03	–

# 10. Summary

- The influence of old type johkasou and gray water have become clearer, and the effects of domestic wastewater on the environment can be shown in comparison with the treated water of johkasou.
- Comparing to the literature values, the values of most water quality items in our survey are found to be lower.
- It is expected that the results of this survey will be widely understood and the implementation of replacing old type johkasou by johkasou is promoted.