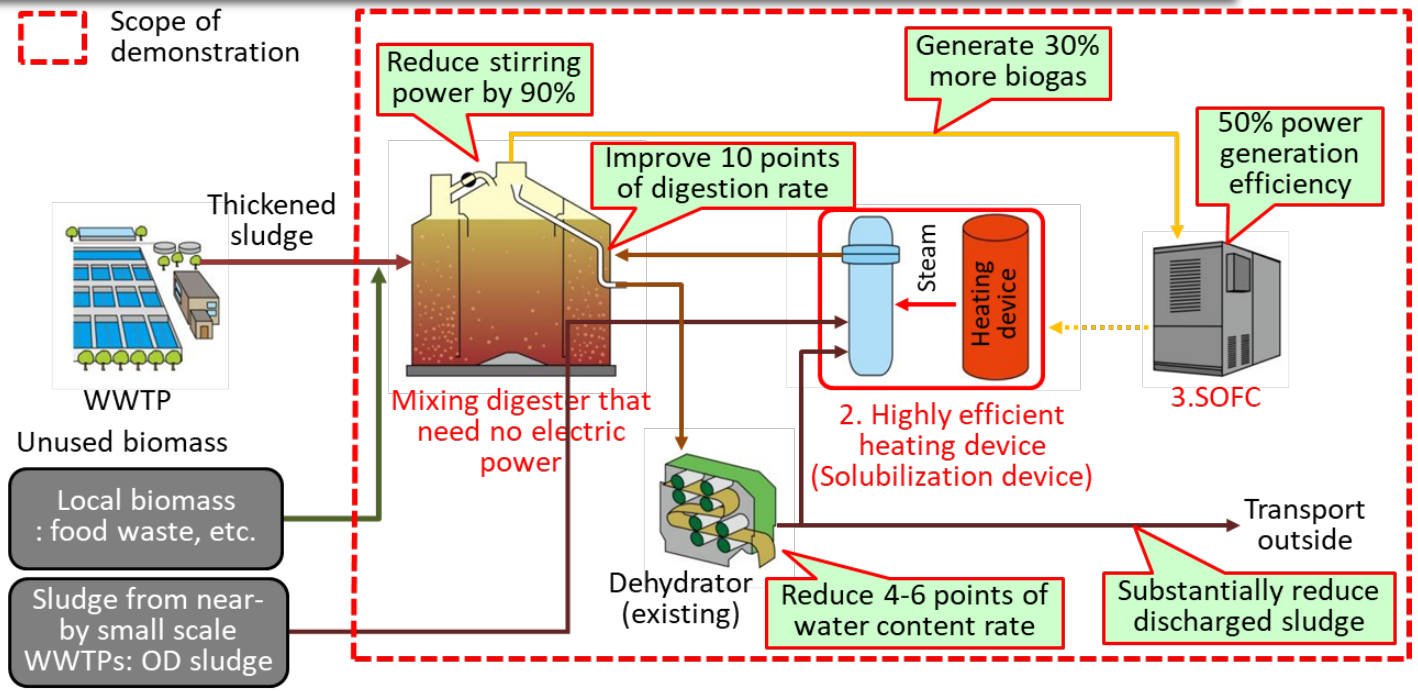
Improving Sludge Dewaterability by High Performance Anaerobic Digestion System Combined with Sludge Disintegration

Introduction

Demonstration Project for the Practical Use of Local Energy Production and Local Consumption Technology with High-efficiency Anaerobic Digestion System

Demonstration on B-DASH project for 2017-18



Project name	Demonstration project for the practical use of local energy production and local consumption technology with high-efficiency anaerobic digestion system
Project period	Demonstration : 2017-18 Independent research : 2019-2021 *Guideline has been published in 2019
Implementer	The consortium of Mitsubishi Kakoki Kaisha, Ltd., Kyushu University, JS, and Karatsu City
Demonstration site	Karatsu WWTP (24,750m^3/day), Karatsu city, Saga prefecture

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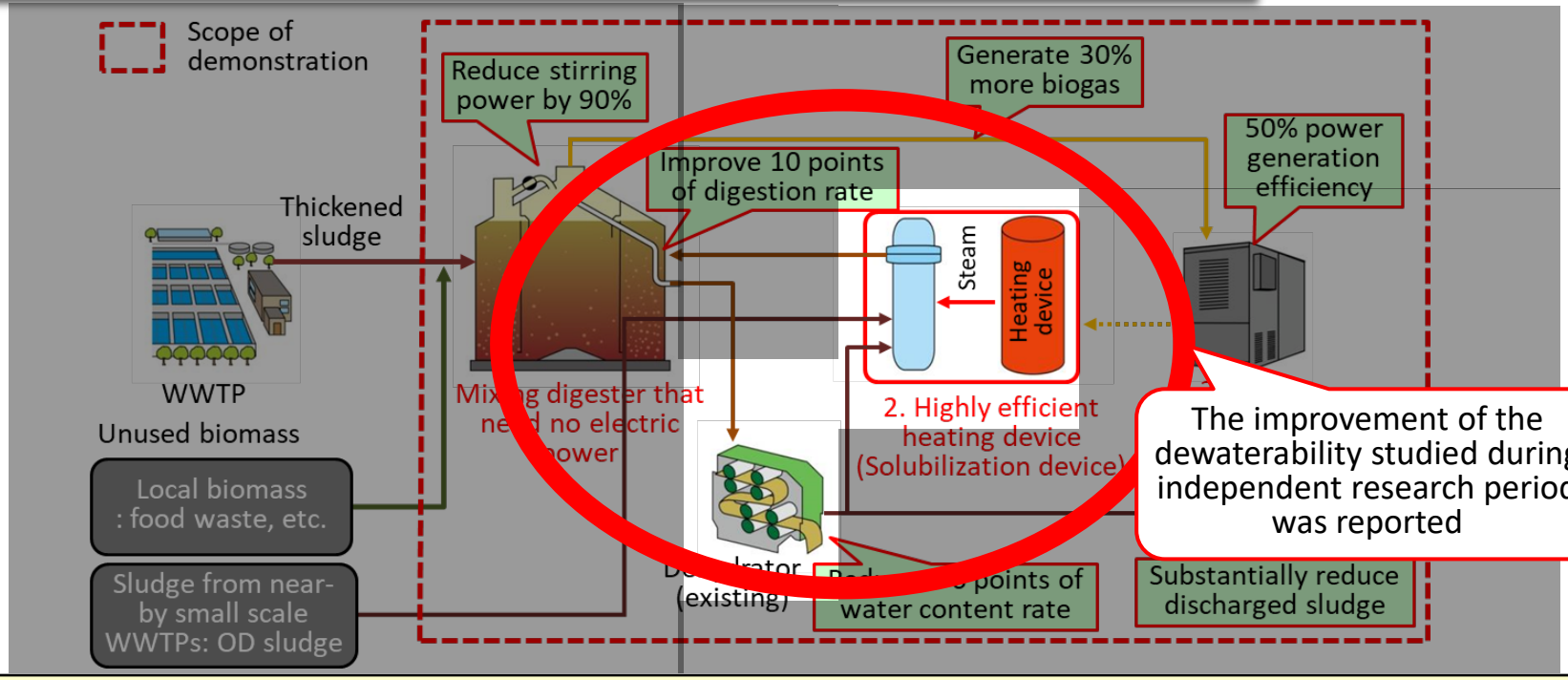


＜Benefits of the technology＞

- ○ Reduction of LCC: Reduction of water content rate of sludge reduces massive amount of transferred sludge and power of stirrer in digestion tank
- ○ Accepting local biomass and outside sludge enables sludge intensiveness, increasing in gas generation, and reducing sludge disposal costs
- ○ Increase in energy self-sufficiency rate by improvement of digestion rate: increase in bio gas yields and power generation efficiency by 50%

Purpose of the Study

Verify the applicability of various dehydrator for the digested sludge of solubilization treatment

- ✓ Sludge dewaterability of each dehydrator
- ✓ Reduction effects on water content rates of dewatered sludge
- ✓ Reduction effects on discharge amount of dewatered sludge

- In B-DASH project, we verified the reduction effects on water content rates of dewatered sludge using a belt press dehydrator and centrifugal dehydrator.
- In this study, a screw press dehydrator was used to verify the reduction effects on water content rates.

What is Solubilization?

Solubilization device
（highly efficient heating system)

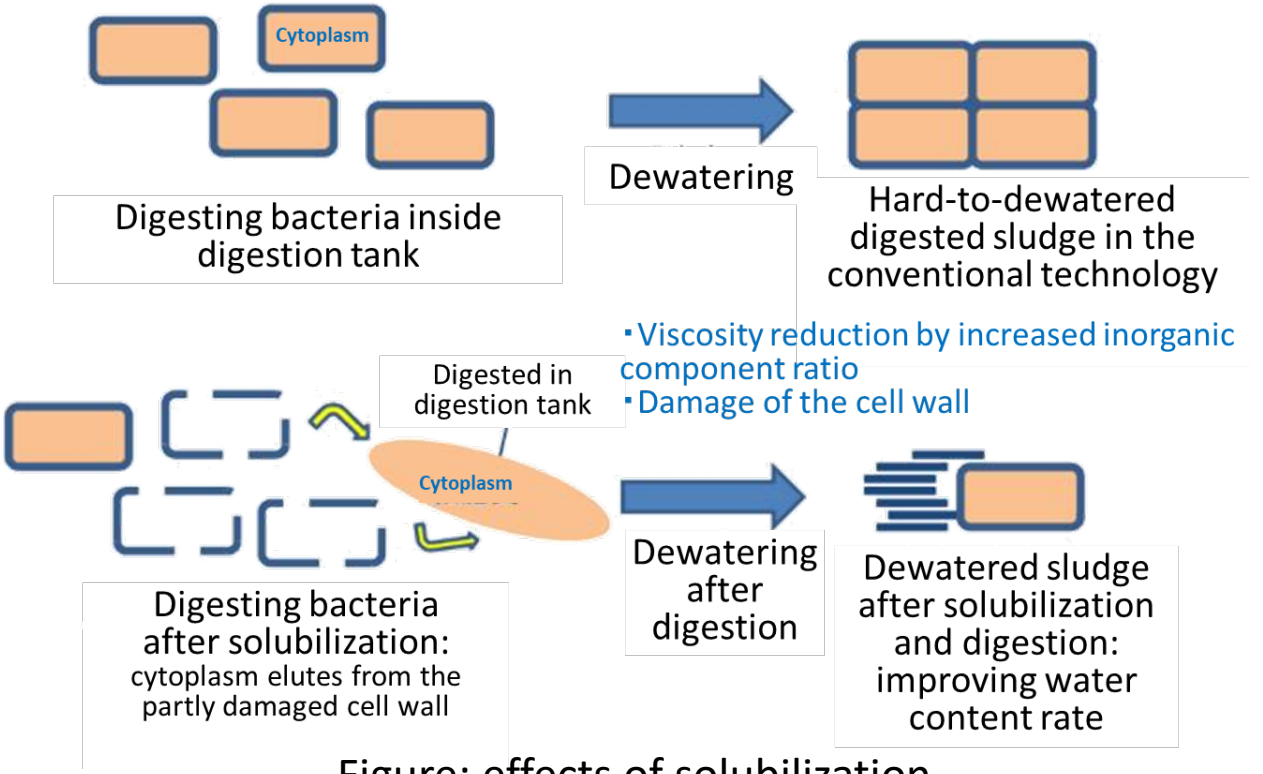


Figure: effects of solubilization

- Solubilization reduces digestion time
- Digestion heating system can substitute
- Cytoplasm elution increases biogas generation
- Sludge reforming decreases water content rates of sludge and reduces its emissions

Demonstration Flow Chart and Operational Conditions ①

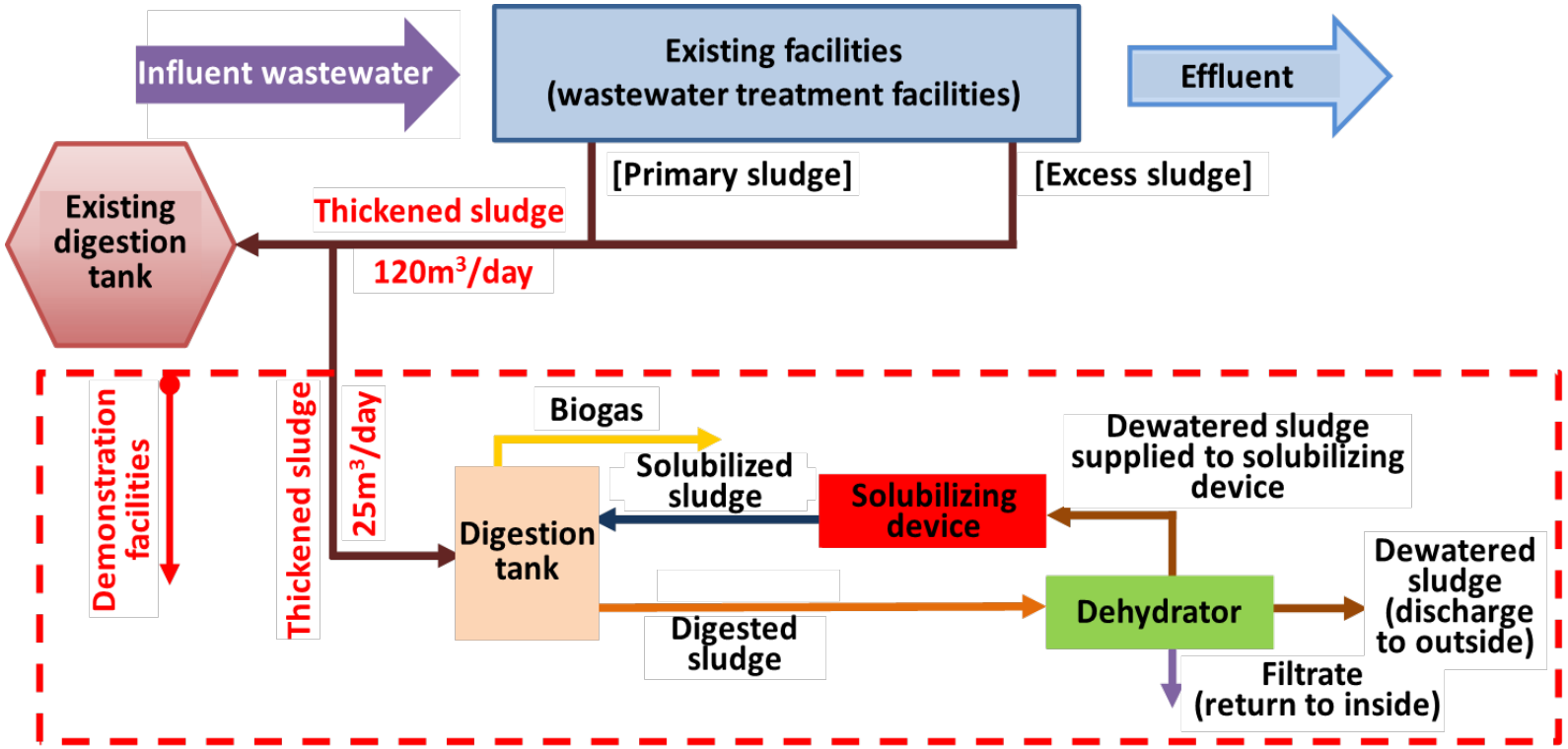


Figure: Demonstration flow chart and operational conditions

Table: Types and capabilities of dehydrators

Type of dehydrator	Capability	Test period
Belt press	3000mm width x 1 unit	Demonstrated as B-DASH Project for 2017-18
Screw press	Screen diameter of 900mm x 1 unit	May, 2019
Centrifugal	Mobile dewatering system(5m³/h) x 1 unit	Demonstrated as B-DASH Project for 2017-18

Demonstration Flow Chart and Operational Conditions ②

Non-powered stirring type digestion tank

Solubilizing device (highly efficient heating device)

Table: Operational conditions of demonstration facilities

Facility name	Operational conditions	
Non-powered stirring type digestion tank	Volume	500m^3
	Amount of supplied sludge	25m^3/day
	Solids concentration of supplied sludge (TS)	3.5-4.0%
	Digestion period	20 days
	Inside tank temperature	35-40℃
Highly efficient heating device (Solubilizing device)	Treatment capacity	0.7wet-t/h
	Processing amount of sludge	Digested and dewatered sludge: 2.5wet-t/day
	Supplied rates to solubilization	0.5-0.6
	Retention time	30 min
	Solubilization temperature	160-170℃
	Solubilization pressure	0.5-0.7MPa

Experimental Results: Screw Press Dehydrator

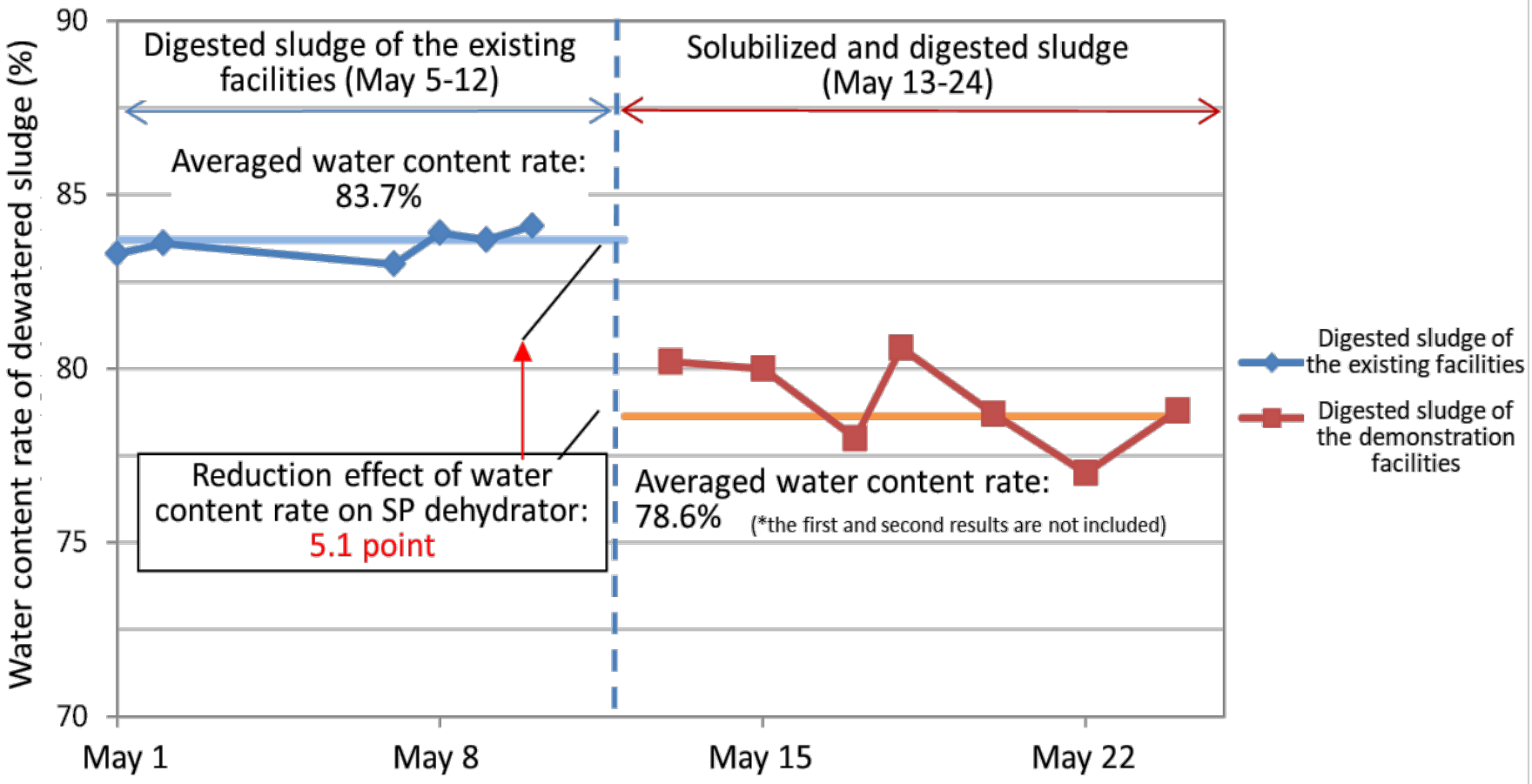


Figure: Reduction effect of water content rate on SP dehydrator

- ✓ Applying the solubilizing device improved the sludge dewaterability even when using a screw press dehydrator.
- ✓ The moisture content rate was reduced by 5.1 points from 83.7% to 78.6%.

Reducing Water Content of Sludge by Dehydrators

Table. Reduction effect of water content in dewatered sludge by solubilization treatment

Condition	① B-DASH	② This demonstration	③ B-DASH	④ B-DASH	⑤ This demonstration	⑥ B-DASH
Digestion process	Sludge digestion at the existing system			Sludge digestion + thermal solubilization at the demonstration system		
Volume of digestion tank	2000㎥ × 2*2			500㎥ × 1		
Digestion duration	32-40 days			20 days		
Type of dehydrator	Belt press	Screw press	Centrifugal	Belt press	Screw press	Centrifugal
Water content rate of dewatered cake	84.1	83.7	79.7	80.1	78.6	73.0
Improvement of water content (point)*1	-	-	-	▲ ④-①	▲ ⑤-②	▲ ⑥-③

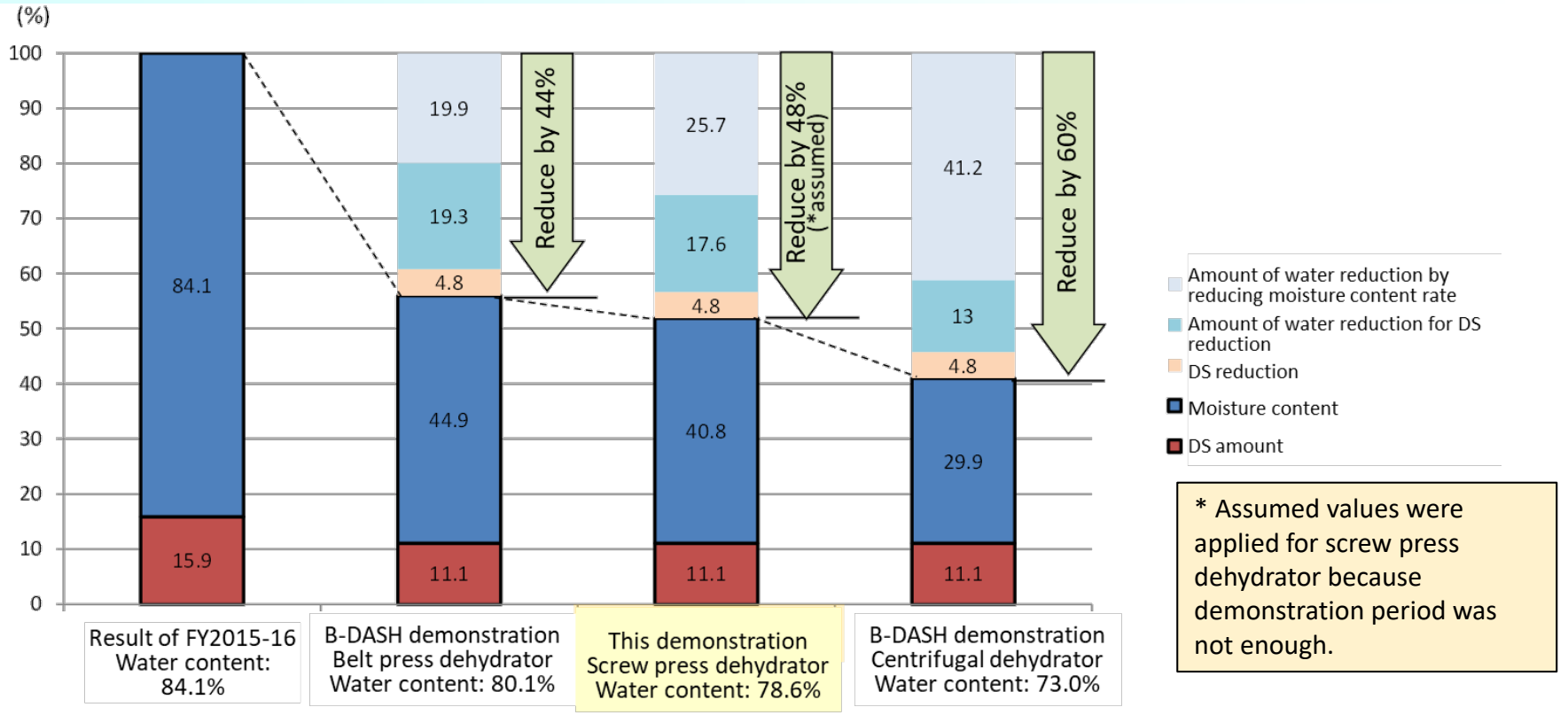
*1. Comparison between the conventional technology and demonstration results

*2. Two in-line digestion tank of 2000㎥ each, the second tank has neither heating nor agitation system.

✓ Improvement in water content of dewatered sludge by solubilization: Verified each dehydrator reduced water content **by 4.0 to 6.7 points**

*"B-DASH Project No.26 Guidelines for Introducing local energy production and local consumption technology with high-efficiency anaerobic digestion system (Draft)" (National Institute of Land and Infrastructure Management, December 2019) has added this demonstration data.

Reducing Emissions of Dewatered Sludge



* Assumed values were applied for screw press dehydrator because demonstration period was not enough.

Figure. Reduction effects on the emissions of dewatered sludge

The demonstration facilities reduced emissions of dewatered sludge by 40% and over

Reduce landfill disposal costs and energy use for incineration, fuel conversion, and fertilizer conversion

*"B-DASH Project No.26 Guidelines for Introducing local energy production and local consumption technology with high-efficiency anaerobic digestion system (Draft)" (National Institute of Land and Infrastructure Management, December 2019) has added this demonstration data.

Conclusion

- The solubilization system reduced water content of dewatered sludge even for a screw press dehydrator.
- While depending on the applied dehydrator, the demonstration system improved water content of dewatered sludge by 4.0-6.7 points.
- The demonstration system reduced sludge emissions by 40 % and is expected to reduce sludge disposal costs and energy use for sludge utilization.

➢ In future, we will confirm the effect of improvement on sludge dewaterability all year round. Besides, we will obtain data of high concentration digestion's behavior and the reduction of digestion periods, which is caused by solubilization to establish the technology.

Our gratitude to all parties involved for their cooperation in conducting this survey

Thank you for your attention