1495

Improving Sludge Dewatering Performance With the Platinum System

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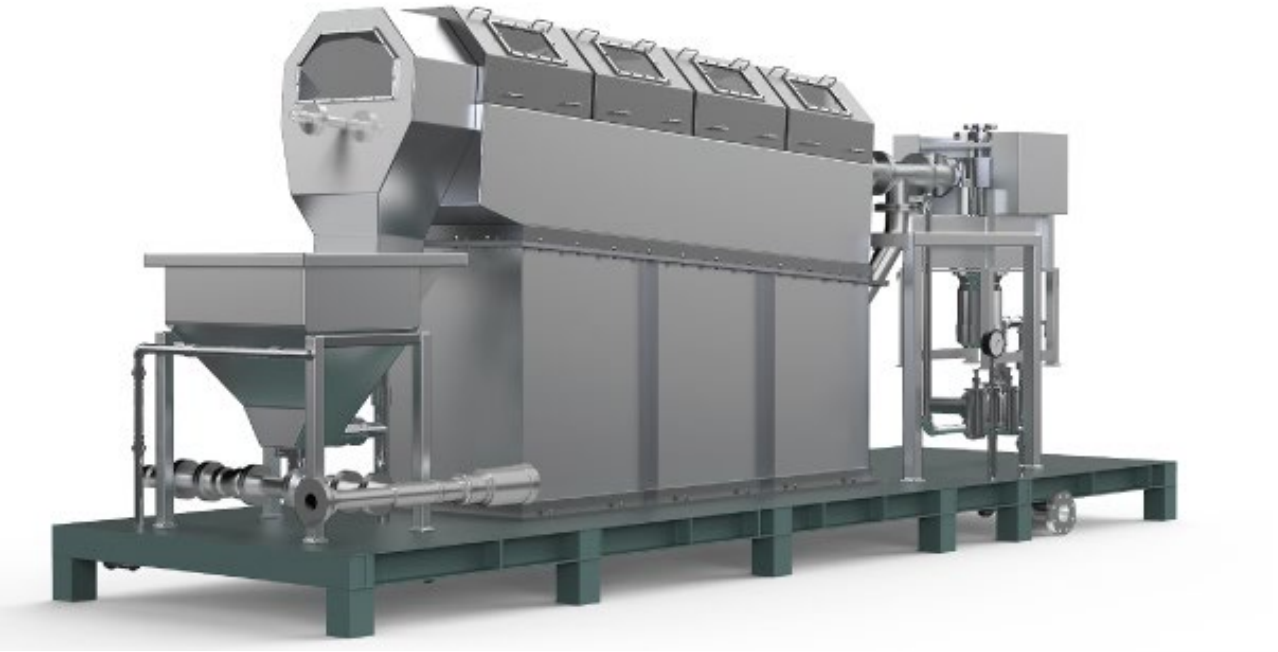
TABLE OF CONTENTS



Recovery Unit – Main Component of Platinum System

BACKGROUND

BACKGROUND

- In Japan (and increasingly elsewhere globally)
  - Limited landfill disposal space
  - Expensive energy costs
  - Goal of carbon neutrality

Increasing usage of anaerobic digestion

- Anaerobically digested sludge dewaterability concerns
  - Poor dewaterability
    - Can impact project economics
    - Large operating expense
  - Improving dewaterability is critical

FIBER

- Fiber sourced from outside of the treatment plant and has been used as a dewatering aid[1] - Expensive!
- Existing primary sludge is rich in fiber – toilet paper
- Goal is to utilize **sludge-derived fiber**

Pulp fiber	Bagasse fiber	Synthetic fiber
		

Primary Sludge Fiber

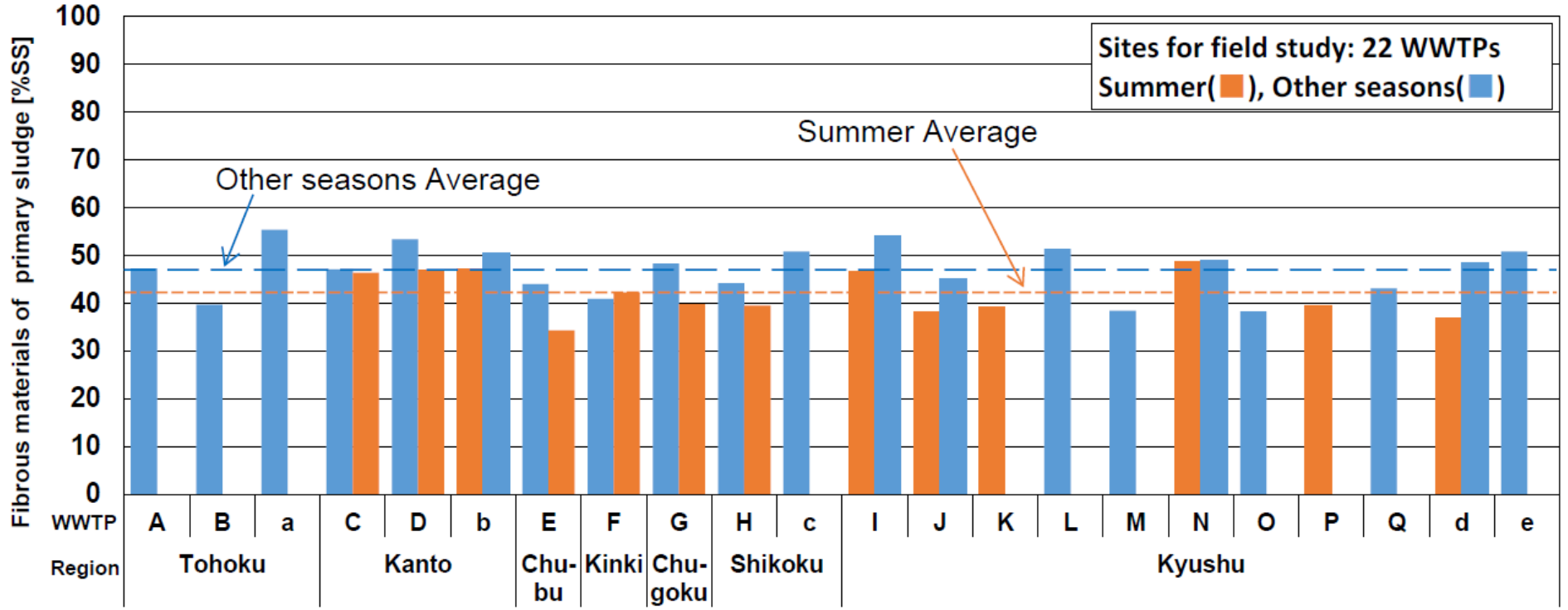
1: Jaafrazadeh et al., 2016; Zou and Hoekstra, 2017

Fiber Content by Slurry

Sludge Type	Typical Range of Fiber Content	Typical Range of Cake Solids
Waste Activated	3-5%	15 - 18%
Anaerobically Digested	~5%	18 - 20%
Blended (WAS + Primary)	20 - 30%	25 - 35%

FIBER CONTENT IN PRIMARY SLUDGE

- Average fiber content = 45%[2]
- Primary sludge is a suitable source for fiber recovery

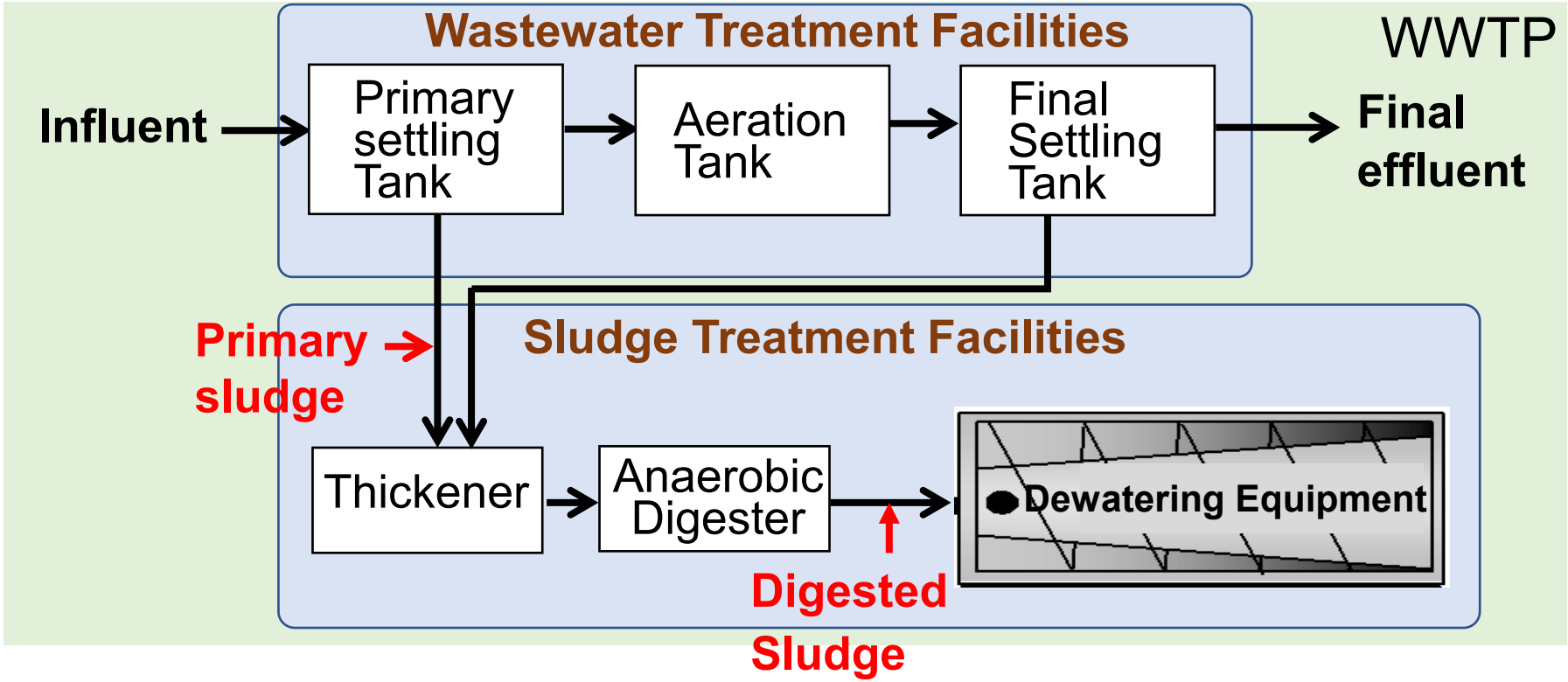


2 – Residuals from a 100 mesh screen (150µm)

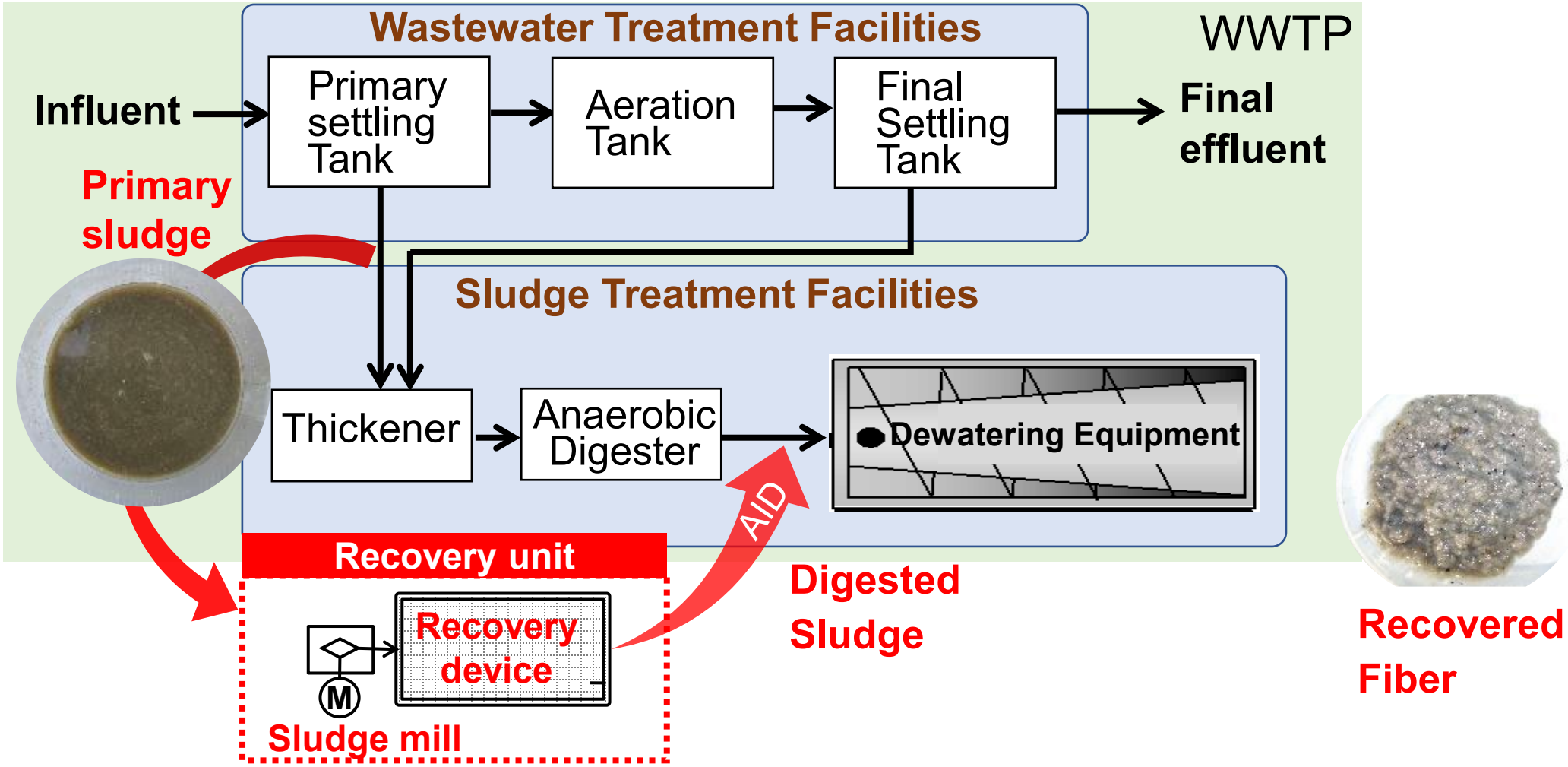
TECHNICAL OVERVIEW

FIBER

- Primary Sludge – significant fiber
- Digested Sludge – minimal fiber (AD decomposes fiber)

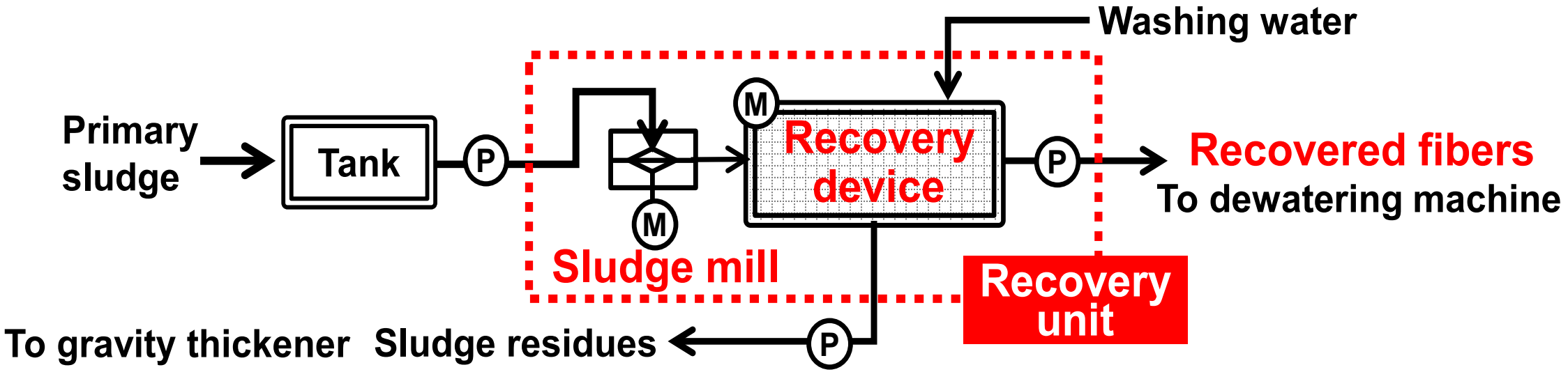


RECOVERED FIBER - A DEWATERING AID



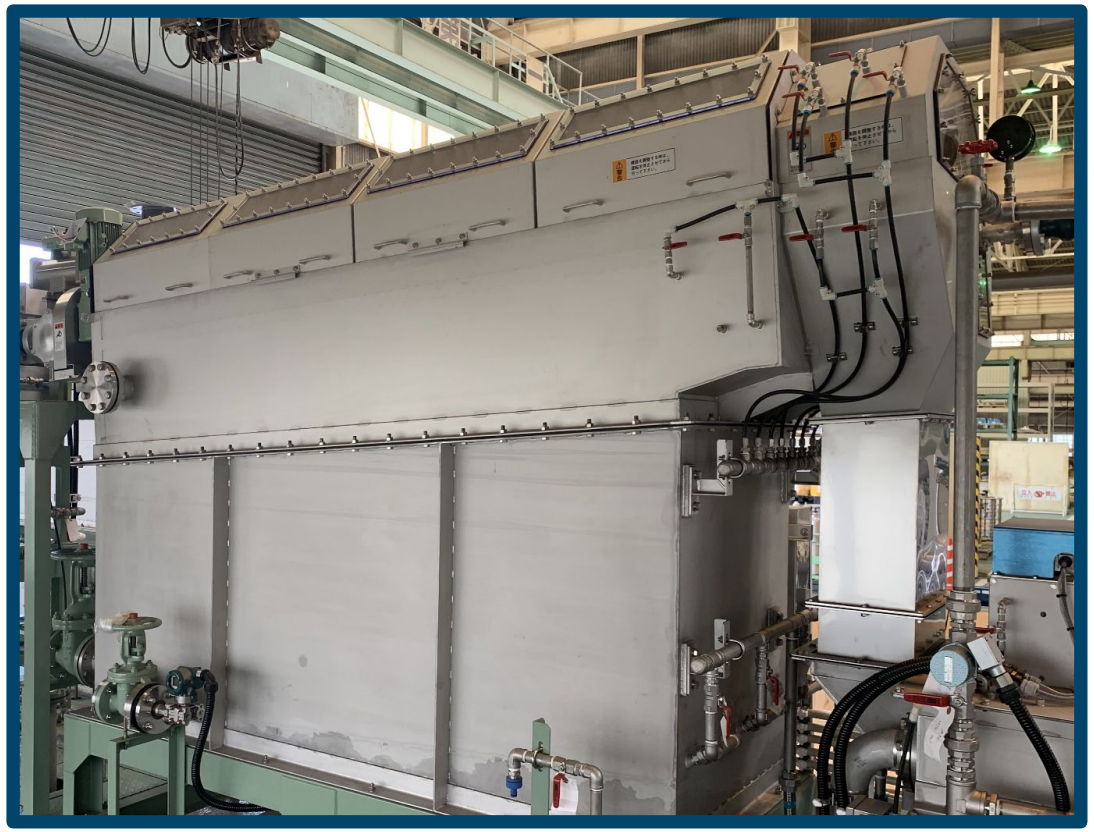
TECHNICAL OVERVIEW

- Platinum System Main Components
  - Sludge Mill - grinds primary sludge
  - Recovery Device - rotating drum w/ mesh screen
  - Various tanks & pumps



TECHNICAL OVERVIEW

Sludge Mill

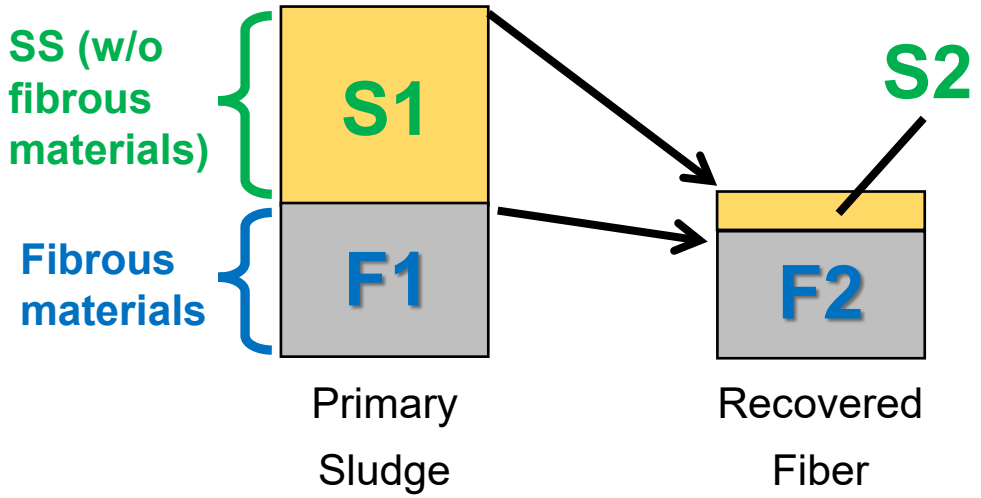


Recovery Device

PREVIOUS RESULTS

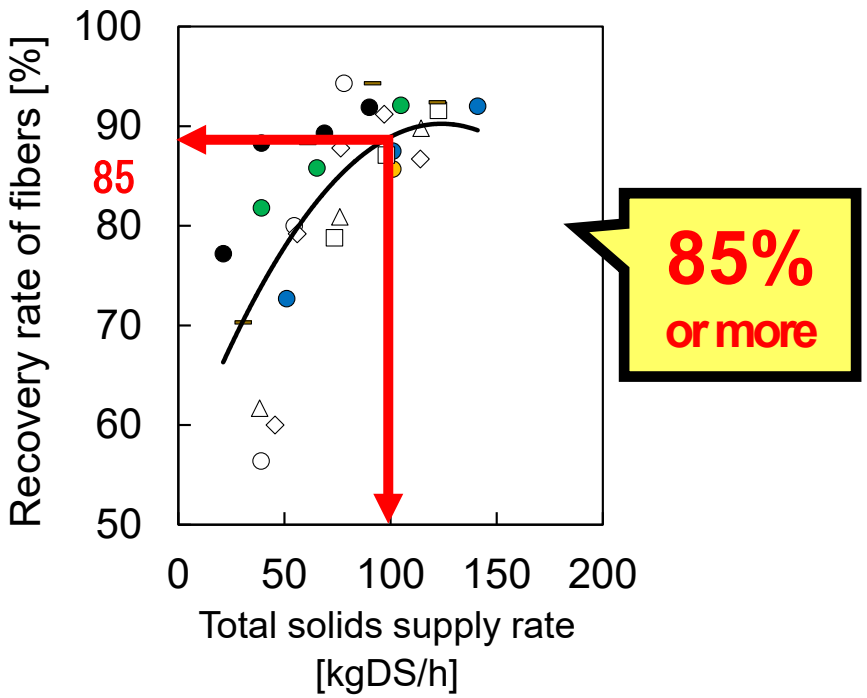
FIBER RECOVERY

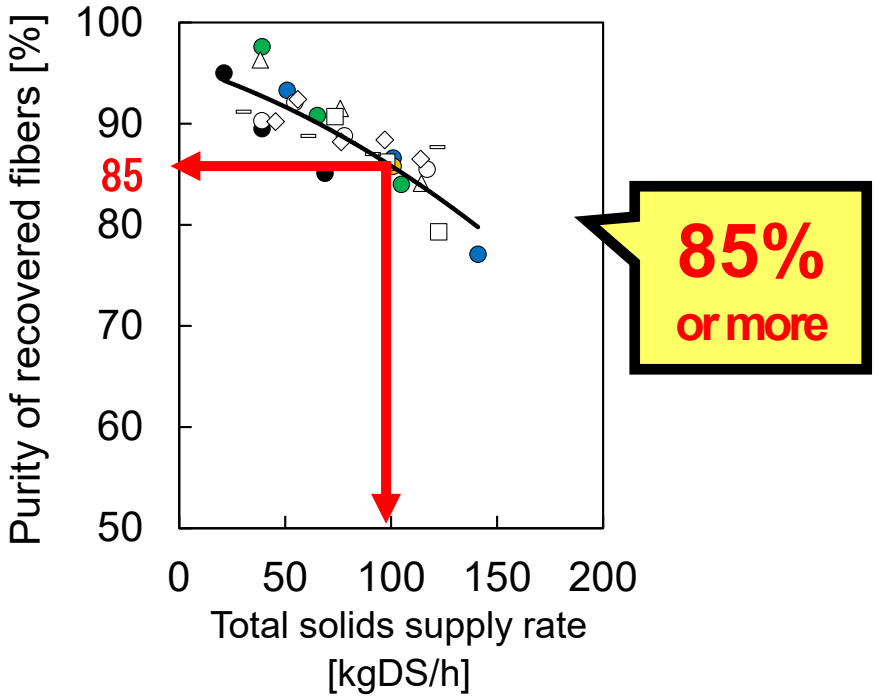
- Recovery rate of fiber **(R_F)**
  - $R_F = F_2 / F_1 \times 100$
- Purity of recovered fiber **(P_F)**
  - $P_F = F_2 / (F_1 + S_2) \times 100$



FIBER RECOVERY

- **Recovery and Purity measured at 9 WWTPs with pilot scale recovery unit**
- **R_F & R_P >85%**
- **Recovery unit can reliably recover high-purity fiber**

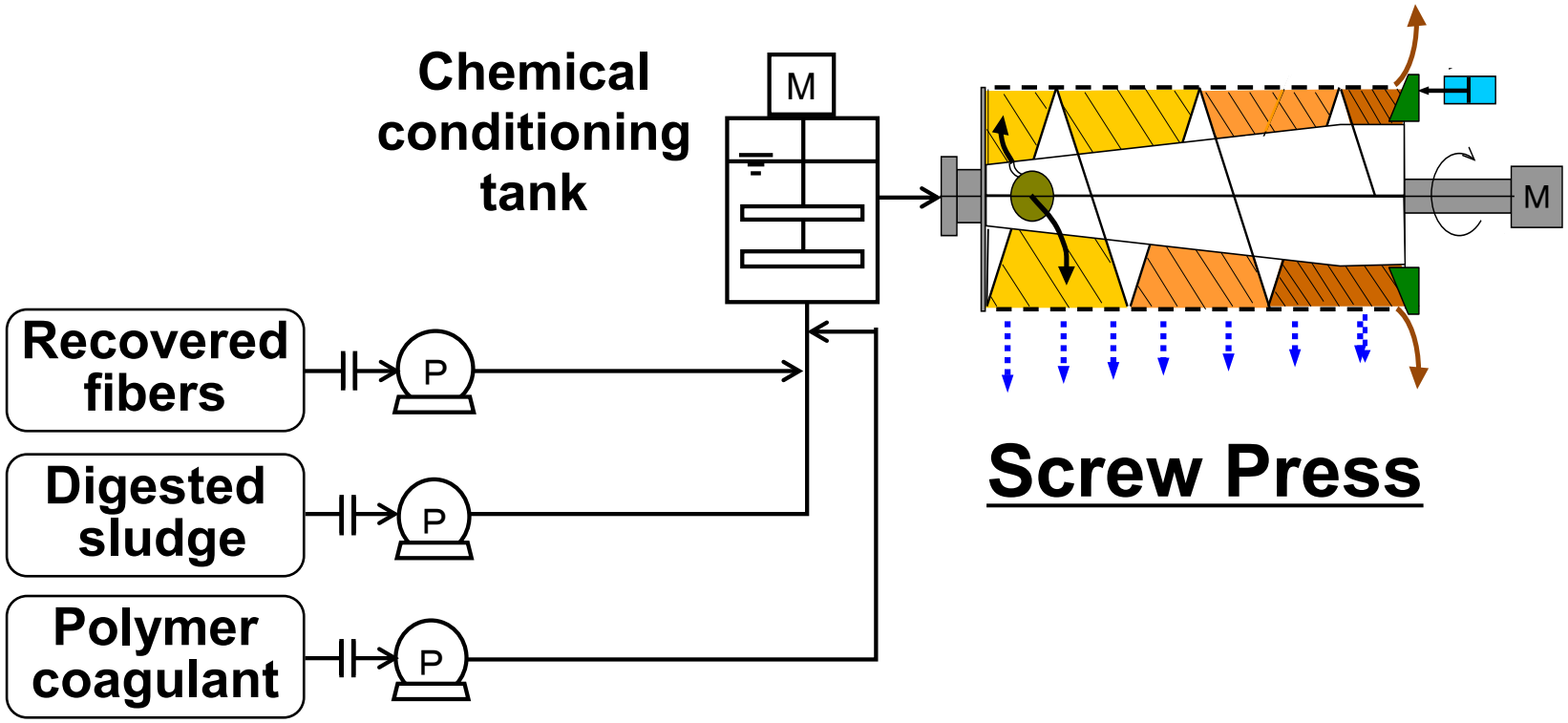




	Region	WWTP
●	Tohoku	B
●	Chubu	R
●	Chugoku	G
●	Shikoku	S
○	Kyushu	I
△		J
□		M
◇		N
—		Q

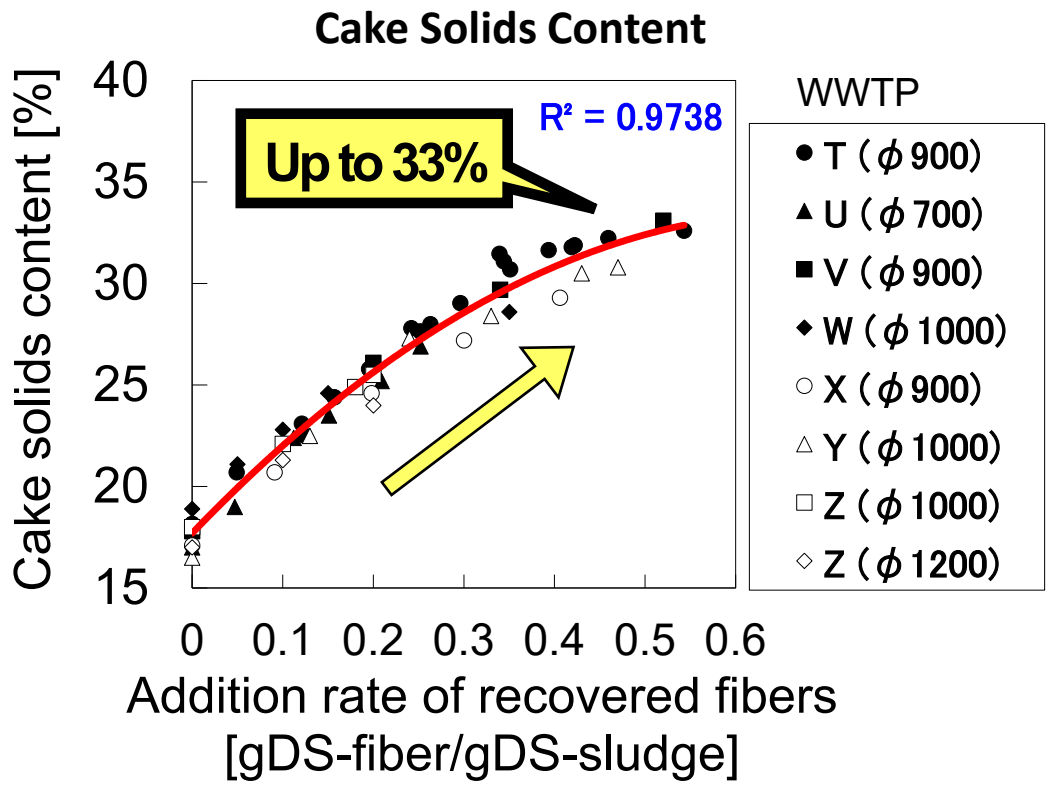
EFFECT ON DEWATERING PERFORMANCE

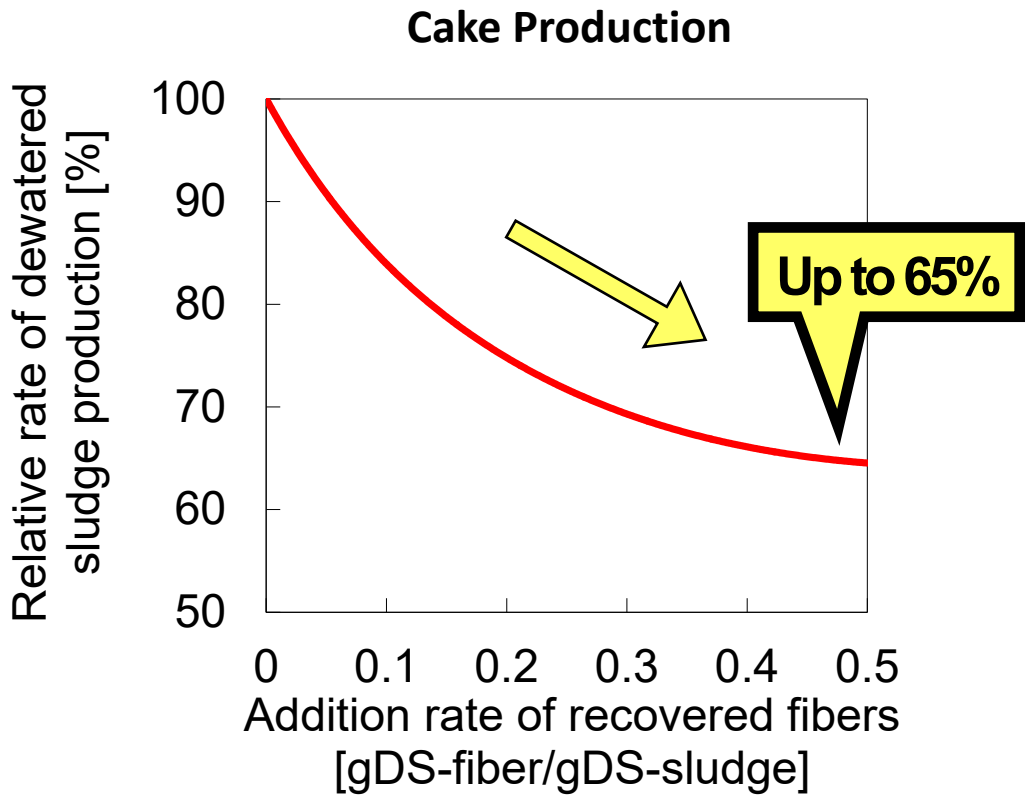
- How recovered fiber effects the dewaterability of digested sludge – Pilot scale testing



EFFECT ON DEWATERING PERFORMANCE

- Cake solids increases proportionally with addition rate of recovered fibers
- Volume of cake reduction





EFFECT ON DIGESTION PERFORMANCE

- Lab-scale test – 2, 5-liter tanks (digesters)
- 30-day acclimation period, 35-day evaluation period
- Temperature = 35° C
- Gas production measured daily

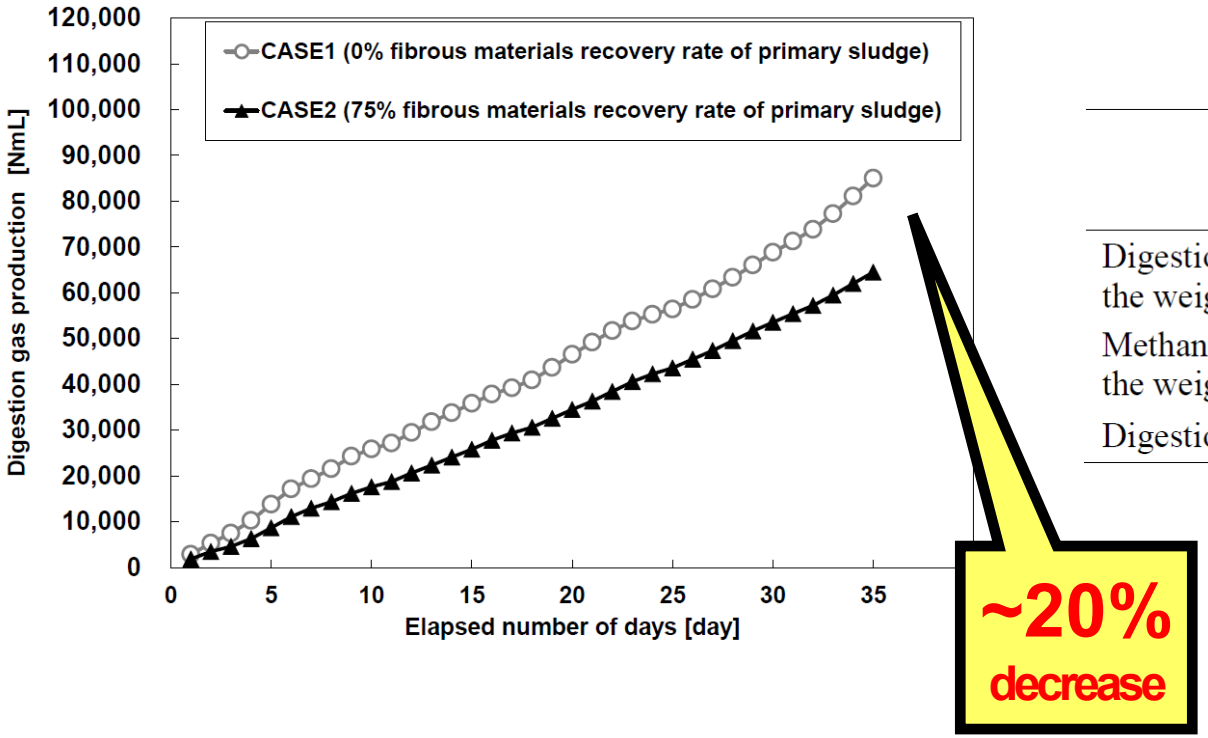
Case 1 (control)

- % of fiber removed: 0%
- Primary sludge:WAS mass ratio: 1:1
- Thickened blended sludge with polymer

Case 2

- % of fiber removed: 75%
- Primary sludge:WAS mass ratio: 0.7:1
- Thickened blended sludge with polymer

EFFECT ON DIGESTION PERFORMANCE

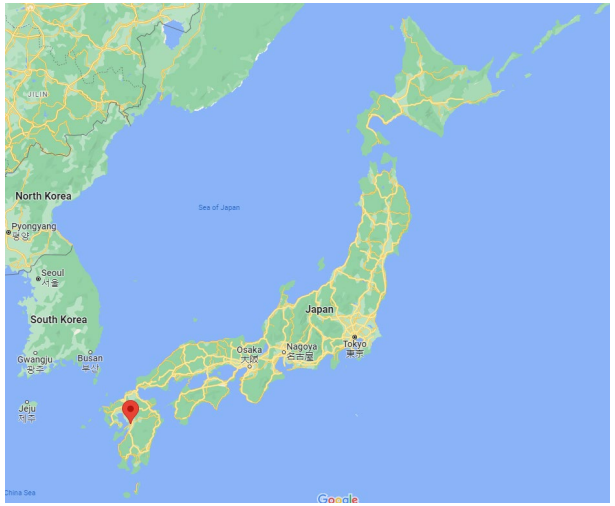


Parameters	Units	CASE1 (0% recovery rate)	CASE2 (75% recovery rate)
Digestion gas production per the weight of organic matter	[NmL/g-VS]	414	418
Methane gas production per the weight of organic matter	[NmL/g-VS]	265	266
Digestion ratio	[%]	54	52

PERFORMANCE, RESULTS, AND CONCLUSIONS

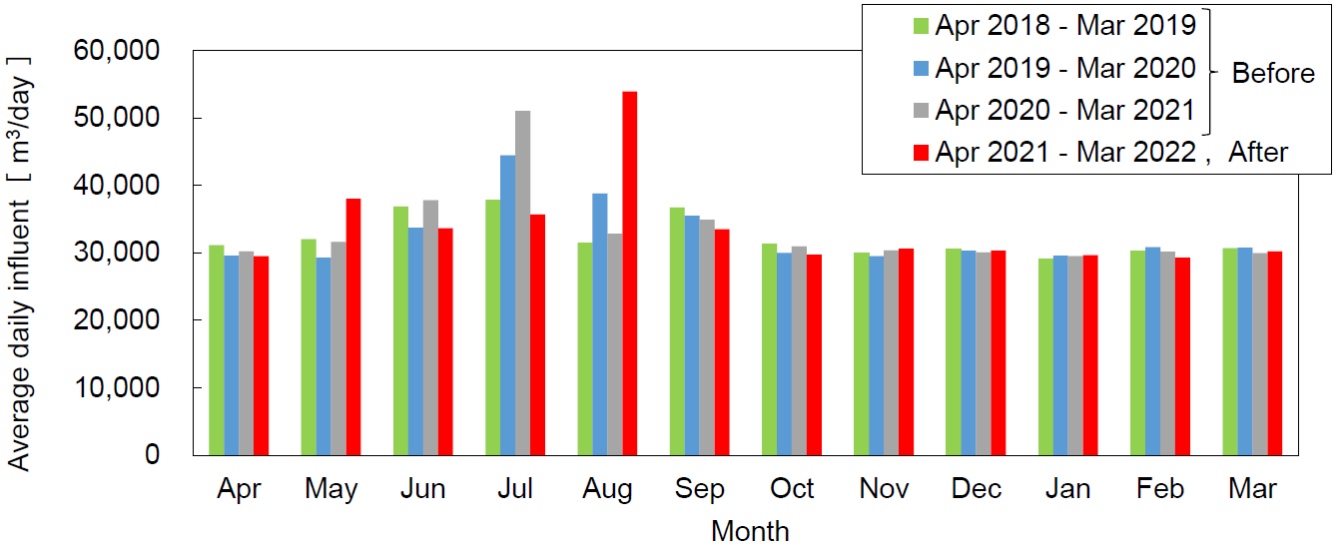
INSTALLATION

- Plant: Southern Purification Center
- Country: Japan
- Prefecture: Kumamoto
- City: Kumamoto-shi
- Design Capacity: 55,500 m^3/day (14.6 MGD)
- ADF: 33,700 m^3/day (8.9 MGD)
- Liquids Treatment: Conventional activated sludge system
- Solids Treatment: Thickening, digestion, dewatering
- Dewatering Technology: Screw Press
- Average Cake Solids Content: 19%
- Cake Disposal: Beneficial Reuse - Cement Material

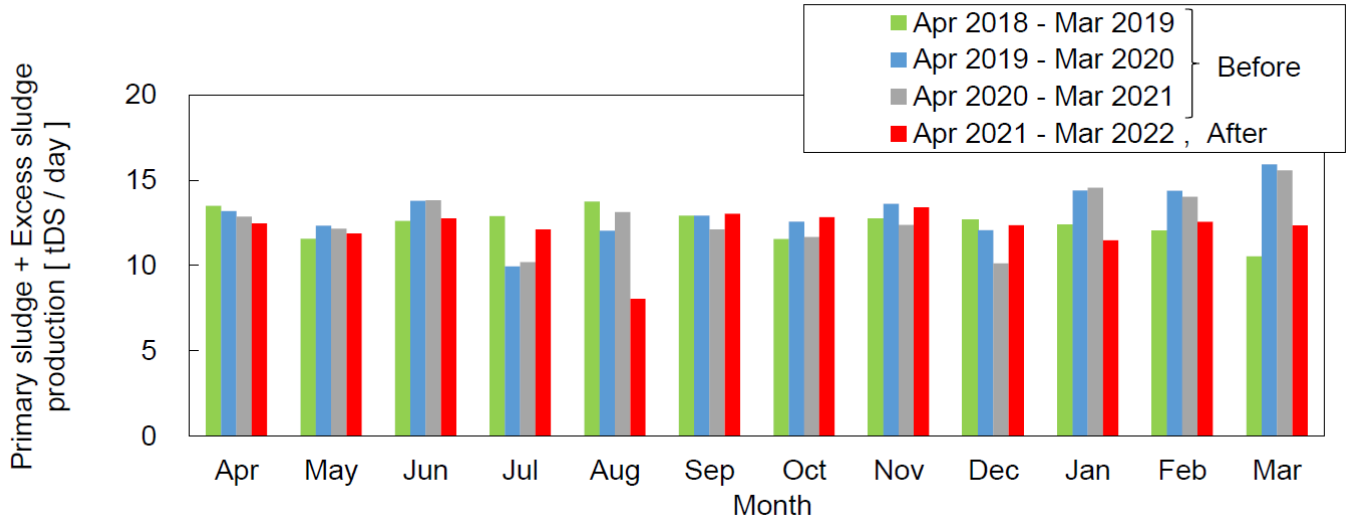


OPERATING CONDITIONS

Plant Influent Flow Rate
(m^3/day)



Sludge Production
(primary + WAS)
(tDS/day)



EFFECT ON CAKE SOLIDS

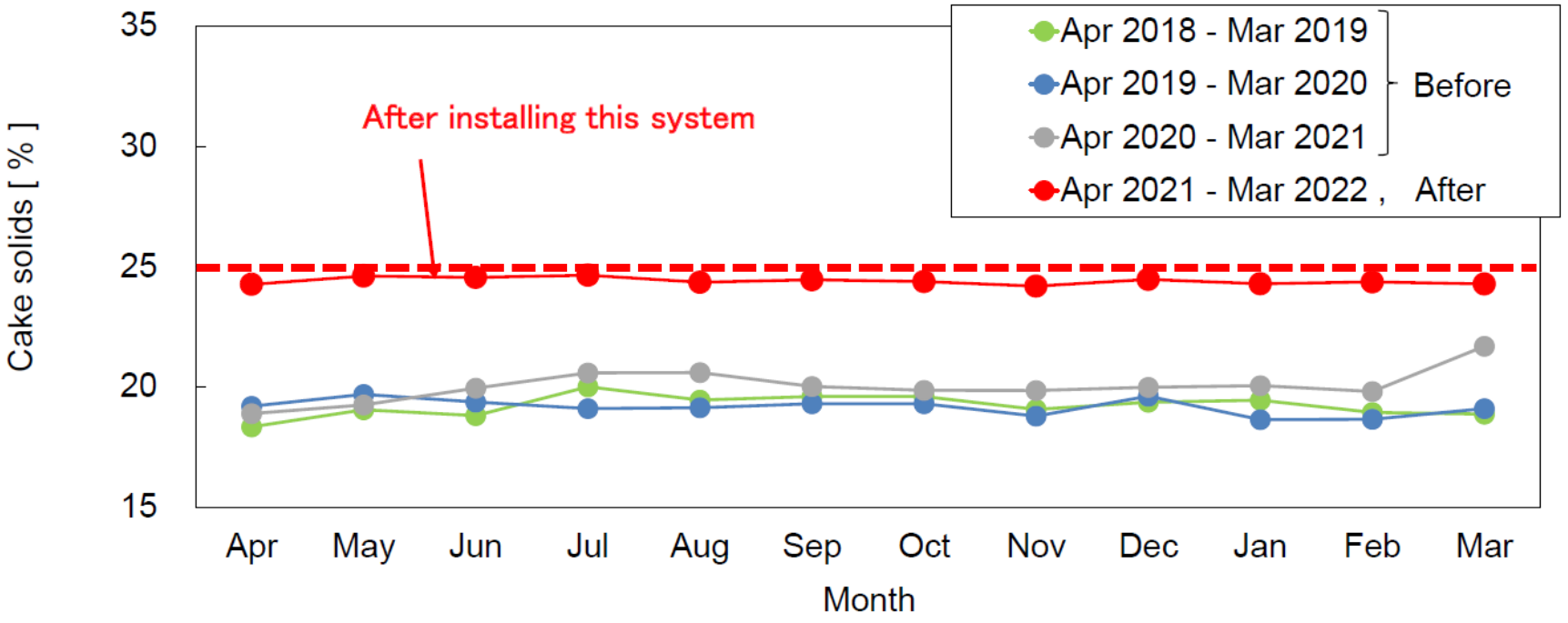


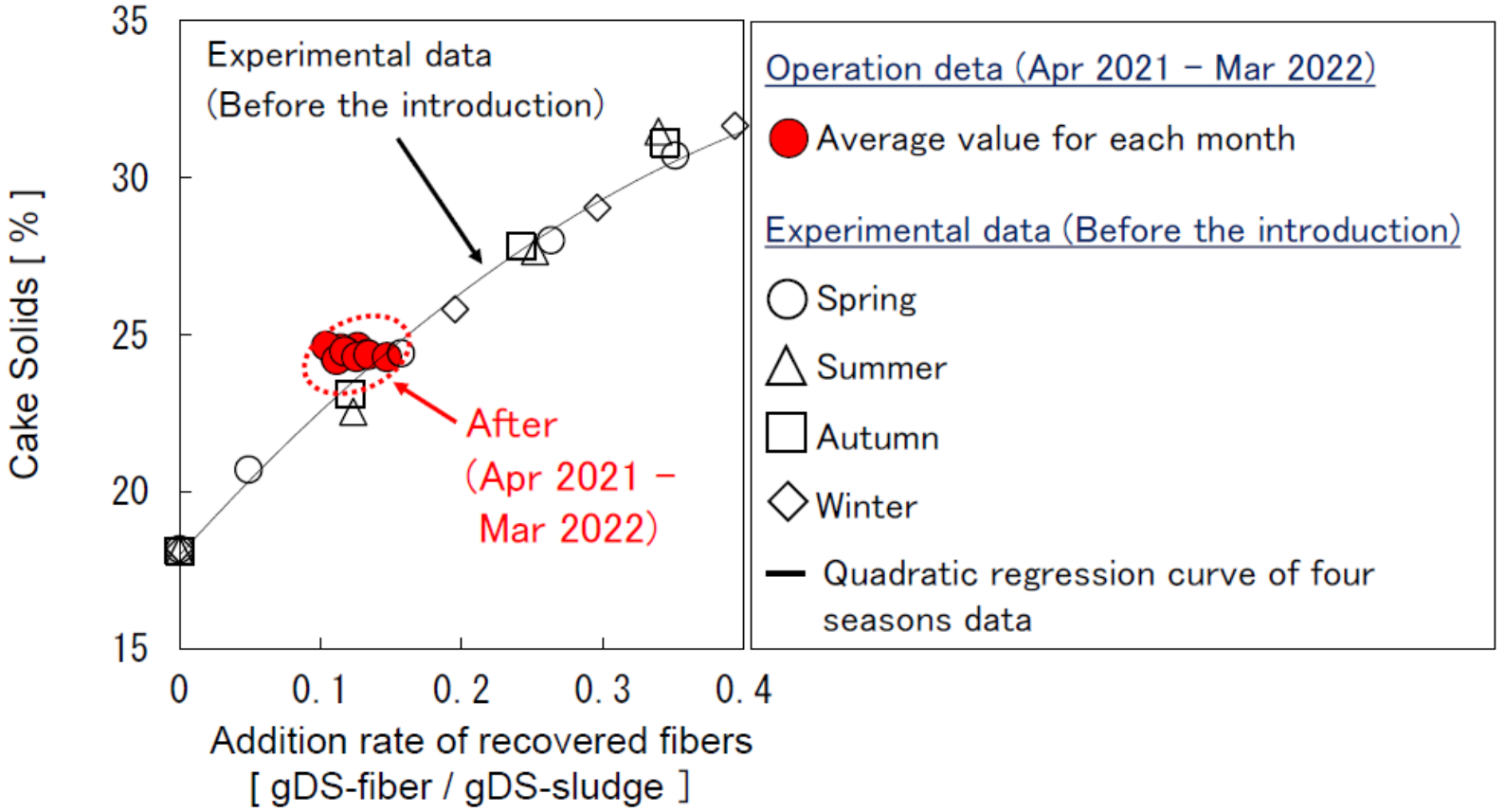
Figure 11 Dewatered sludge cake solids

Max Allowable – 25%
Average$_{After}$ – 24.4%

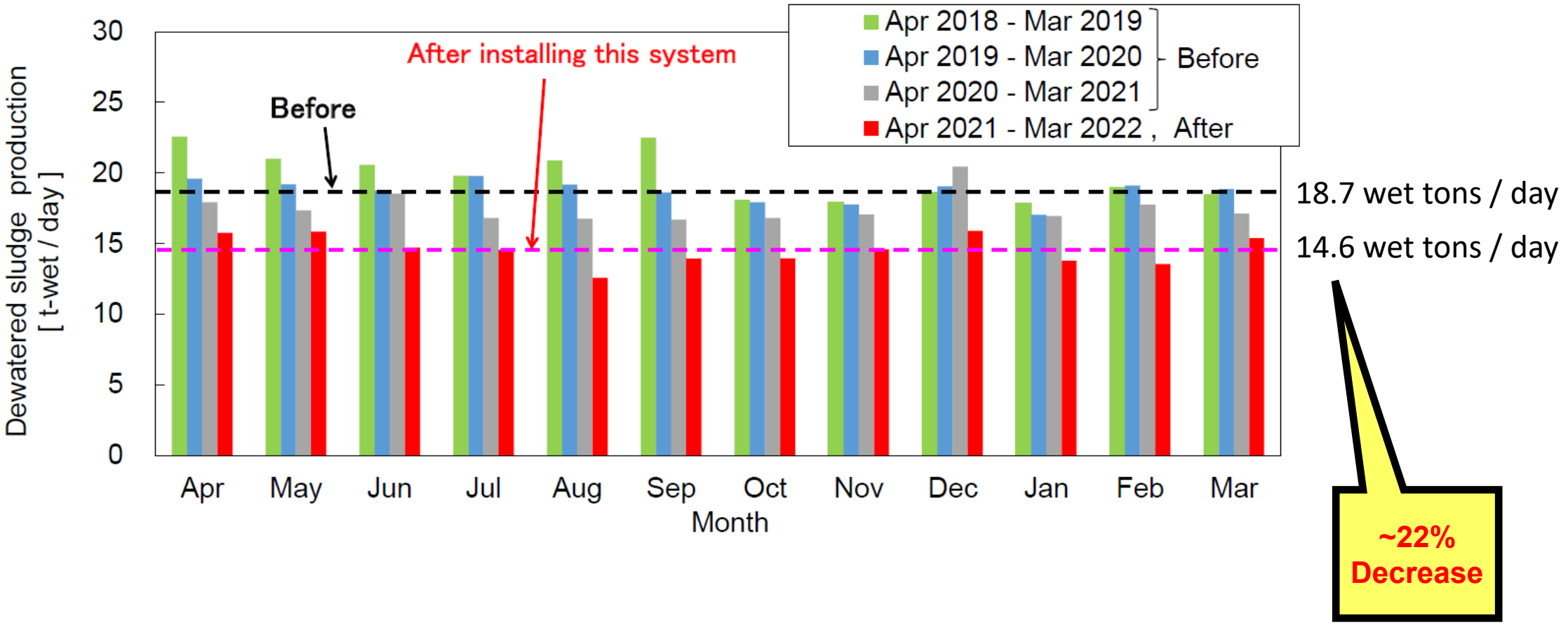
Average$_{Before}$ – 19%

~5 Point Increase

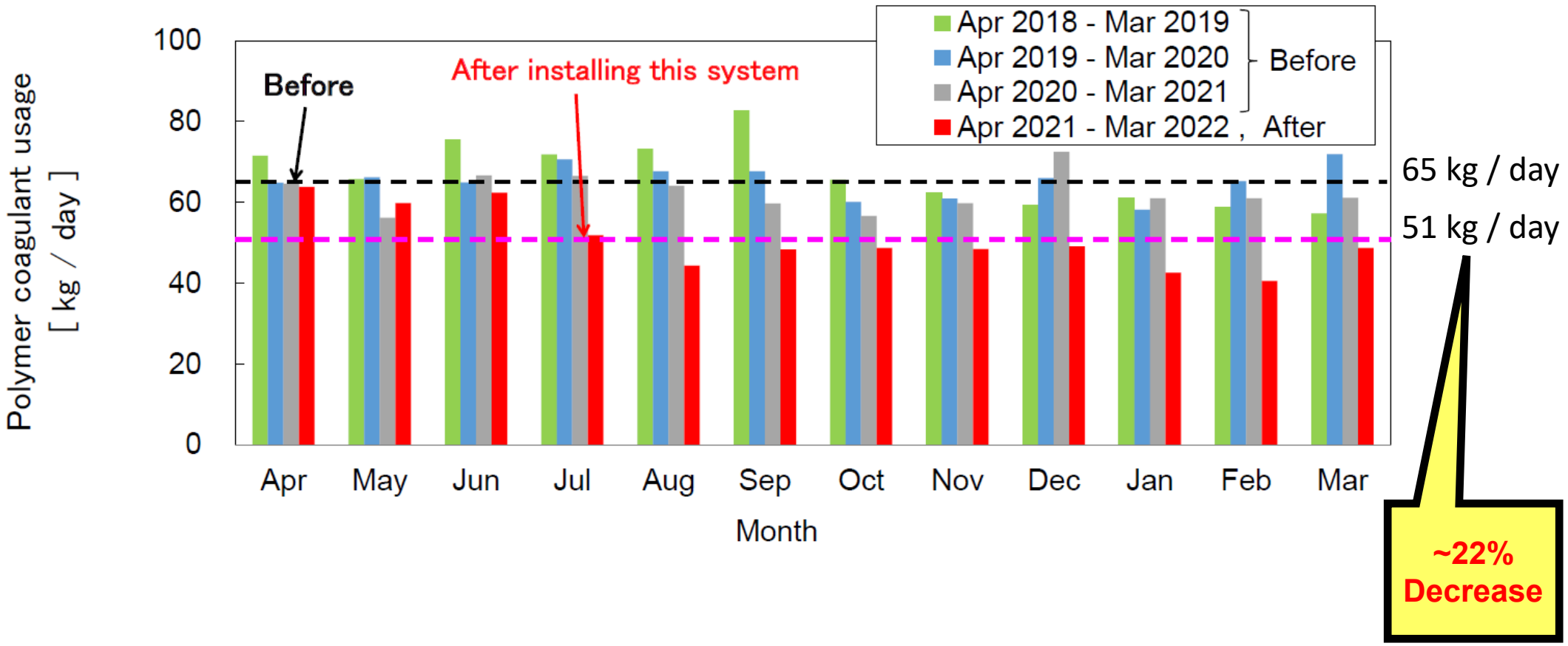
EFFECT ON CAKE SOLIDS



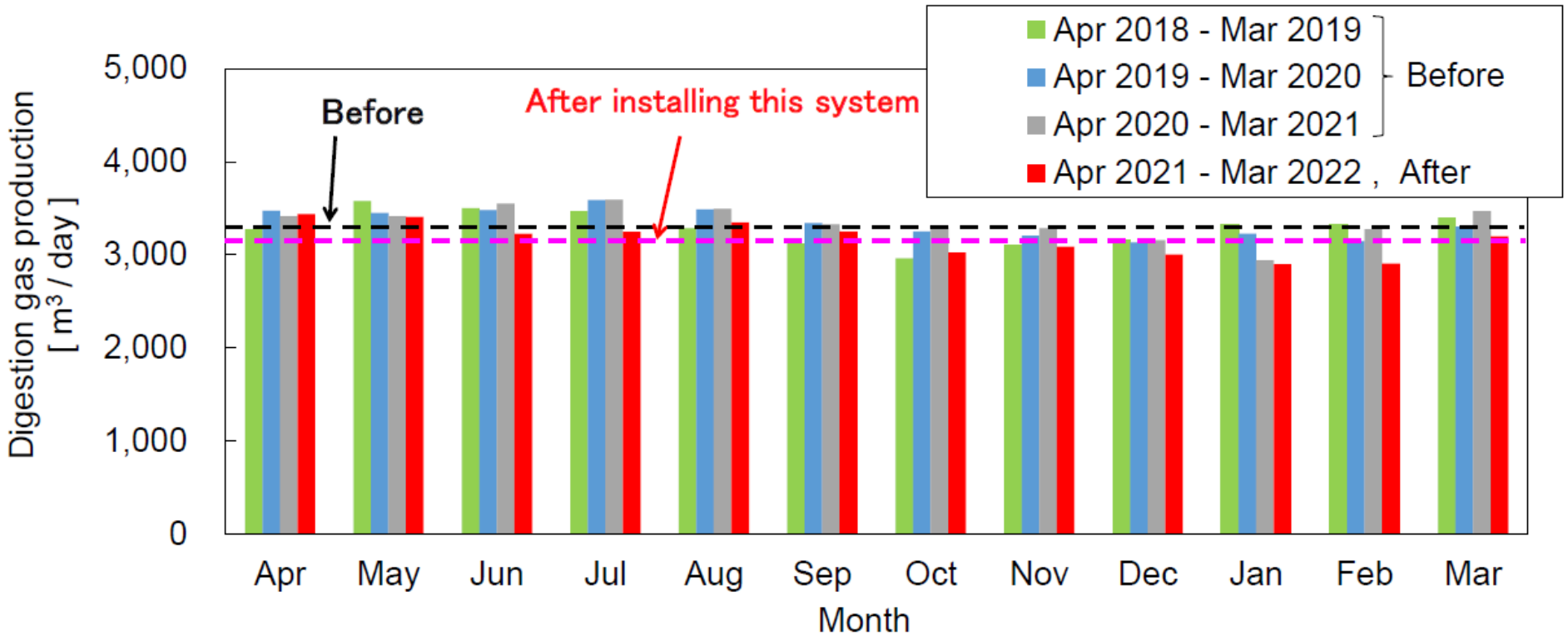
EFFECT ON AMOUT OF SOLIDS PRODUCED



EFFECT ON POLYMER CONSUMPTION



EFFECT ON DIGESTION GAS

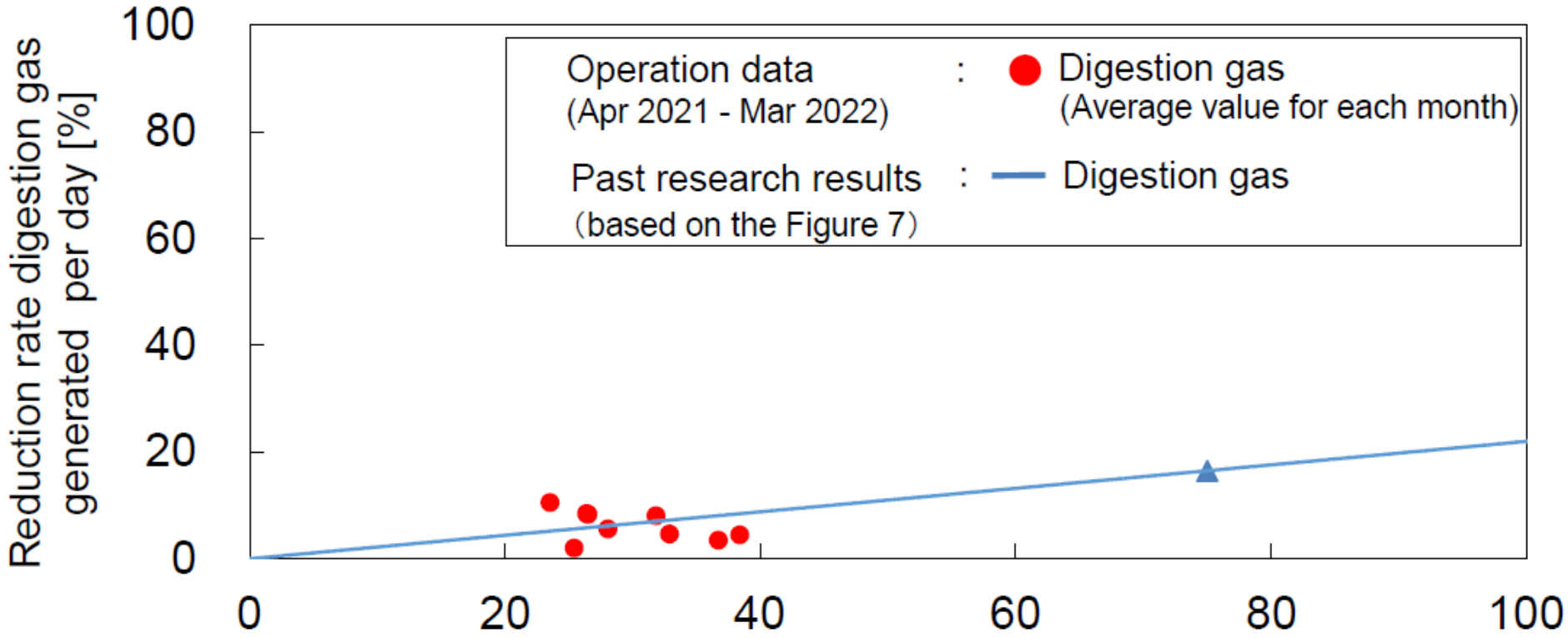


3,329 m^3 / day

3,172 m^3 / day

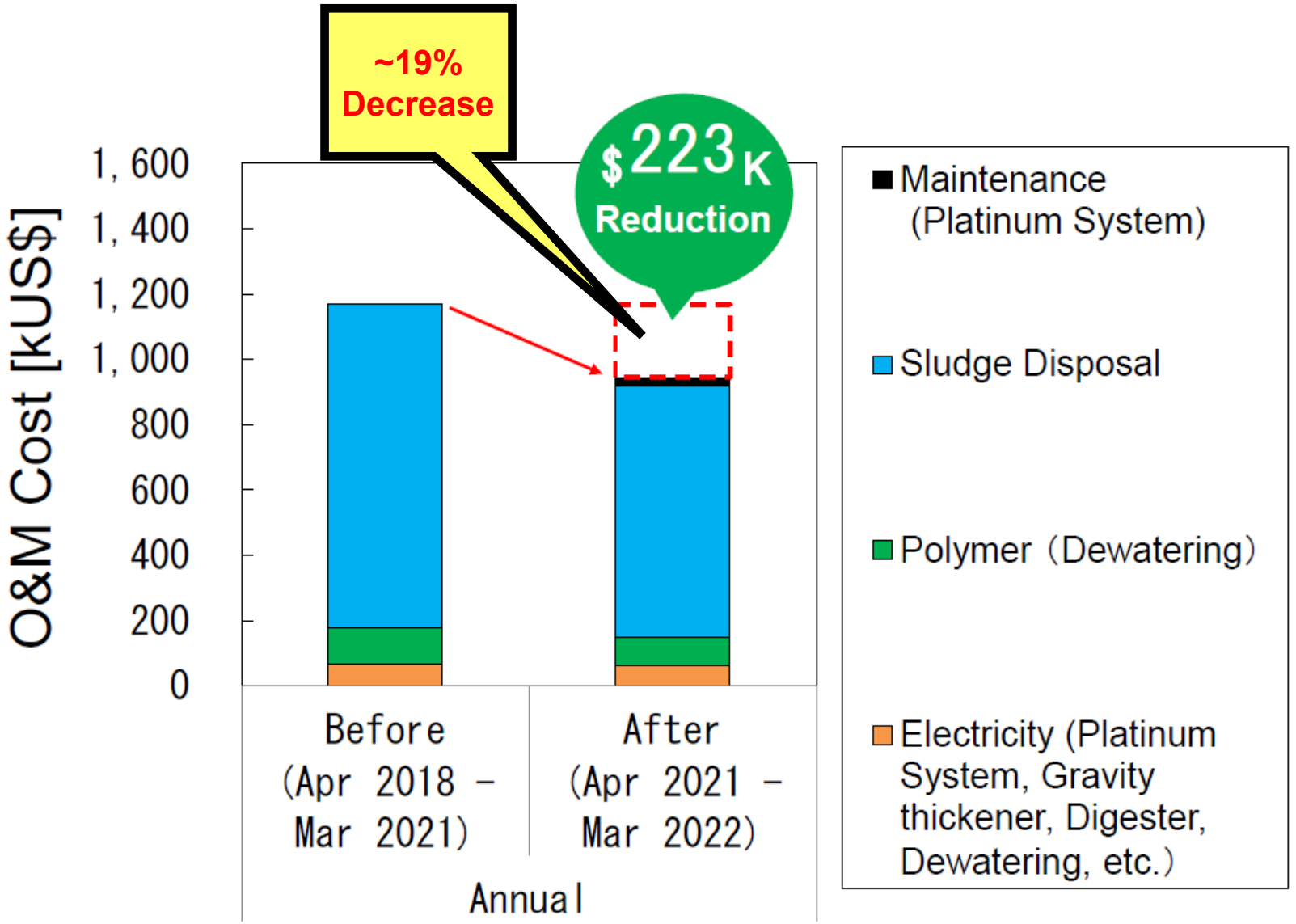
~5% Decrease, no impact

EFFECT ON DIGESTION GAS

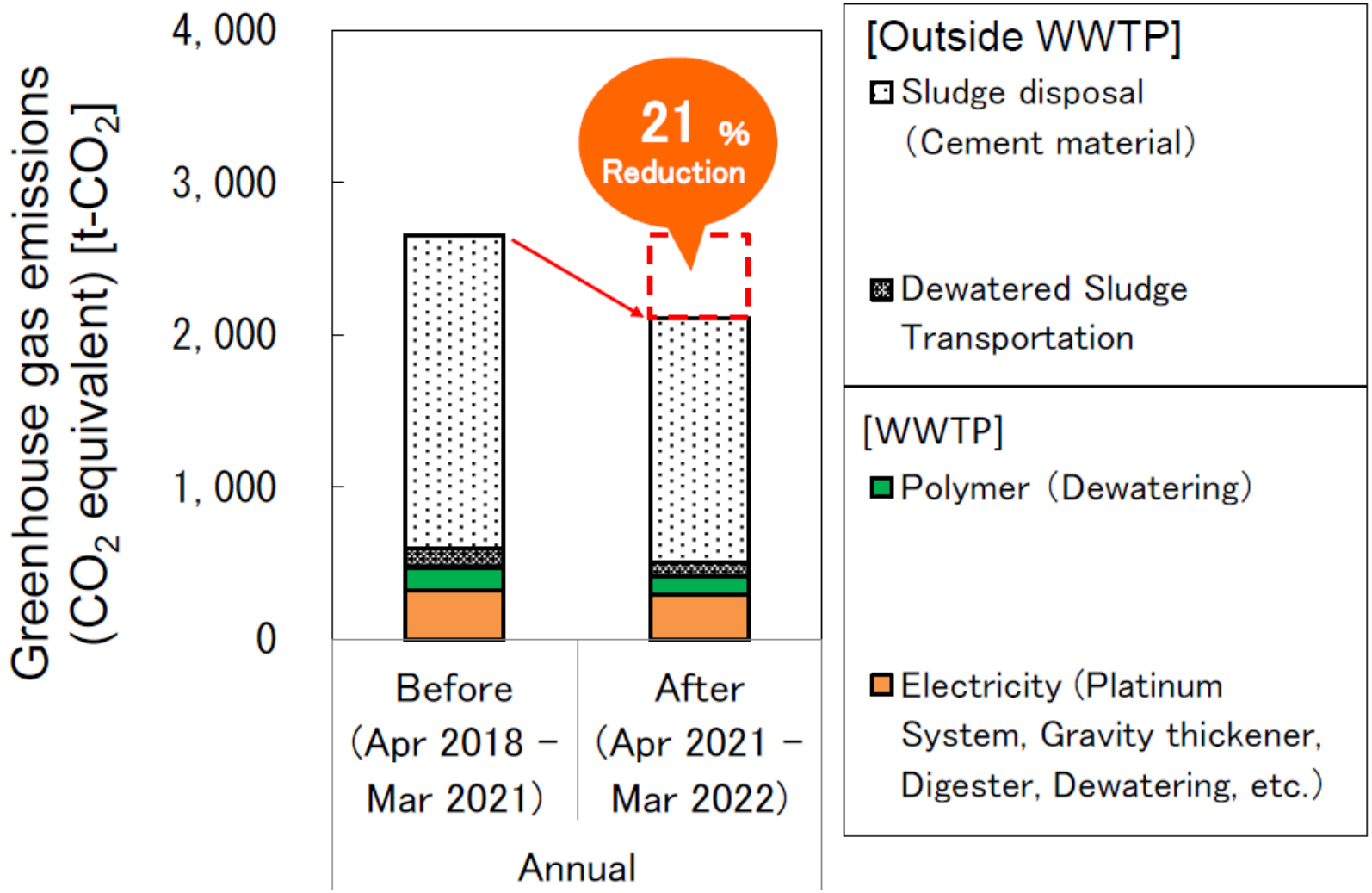


Ratio of the amount of fibrous materials in recovered fibers to the total amount of fibrous materials in the primary sludge [%]

OPEX


~19% Decrease
$223K Reduction
O&M Cost [kUS$]
1,600
1,400
1,200
1,000
800
600
400
200
0
Before (Apr 2018 - Mar 2021)
After (Apr 2021 - Mar 2022)
Annual
Maintenance (Platinum System)
Sludge Disposal
Polymer（Dewatering）
Electricity (Platinum System, Gravity thickener, Digester, Dewatering, etc.)

GREENHOUSE GAS EMISSIONS



CONCLUSIONS

- Full year of operating data proved Platinum System can
  - Improve dewaterability of sludge
    - Increase cake solids content
    - Reduce polymer consumption
  - Reduce volume of dewatered sludge
  - Reduce operating costs of sludge treatment & disposal
  - Reduce greenhouse gas emissions
- Cake solids limit (by cement manufacturer) suggests improved performance and economics are possible.
- Wide-spread use in Japan is likely

Discussion

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