Product Standards and Performance Evaluation Testing system for Decentralized Wastewater Treatment Plants in India

A. A. Kazmi
Department of Civil Engineering
IIT Roorkee

ENVIRONMENTAL PROTECTION ACT 1986 & FURTHER AMENDMENTS

Main objective to provide the protection and improvement of the environment and for matters connected therewith.

For any new construction project clearance:

Sewage Can be disposed off as below:

- By Septic tank & soak pit during the construction phase.
- By Package Sewage treatment plant in operational phase if the project don't fall under Central Sewage treatment plant.

[1][SCHEDULE – VI]
(See rule 3A)

GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENTAL POLLUTANTS PART-A : EFFLUENTS

S. No.	Parameter	Standards			
		Inland surface water	Public Sewers	Land for irrigation	Marine coastal areas
1	2			3	
		(a)	(b)	(c)	(d)
12.	Biochemical Oxygen demand [1][3 days at 27°C] mg/l max.	30	350	100	100
13.	Chemical Oxygen Demand, mg/l, max.	250	--	--	250

Many projects on Interception, Diversion and Centralized Sewage Treatment Come up from Government Funding, but decentralized funded by private entities

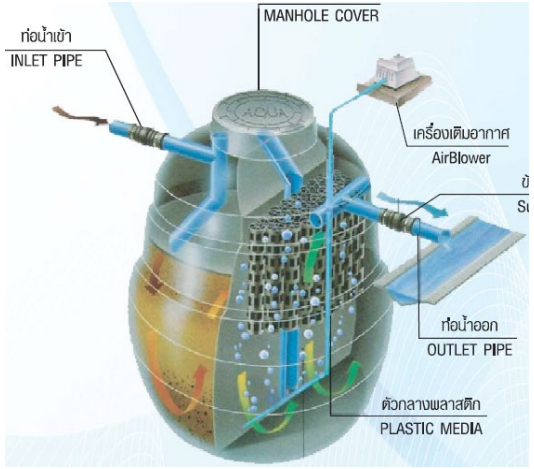
EVALUATION OF DECENTRAIZED PLANTS UNDER INDO-EU PROJECT 2011-

AERATED ALGOON (20 mg/L-91 %)

VORTEX SYSTEM (102 mg/L-75 %)

BORDA DEWATS (4mg/L-90 %)

PACKAGE ANAEROBIC FILTER
(191 mg/L-60 %)



On-site Aerobic Package(47 mg/L-77 %)

ISSUES

- Less Funds Available for CAPEX & OPEX
- Lack of Interest in Operation & Maintenance
- Inadequate design to cope with hydraulic and Organic Loading Variations & Influent values are much higher than centralized systems.
- Unskilled Manpower
- Low End Electromechanical Equipments

NOT STRICT REGULATORY FRAMEWORK &

MANUALS, TECHNOLOGIES AND STANDARD DESIGNS ARE NOT AVAILABLE IN PUBLIC DOMAIN

MANUAL ON SEWERAGE & SEWAGE TREATMENT-2013

CHAPTER-9 -ON-SITE SANITATION

सत्यमेव जयते

MANUAL ON SEWERAGE
AND SEWAGE TREATMENT SYSTEMS

PART A: ENGINEERING
THIRD EDITION - REVISED AND UPDATED

MINISTRY OF URBAN DEVELOPMENT, NEW DELHI
http://moud.gov.in

CENTRAL PUBLIC HEALTH AND ENVIRONMENTAL ENGINEERING ORGANIZATION

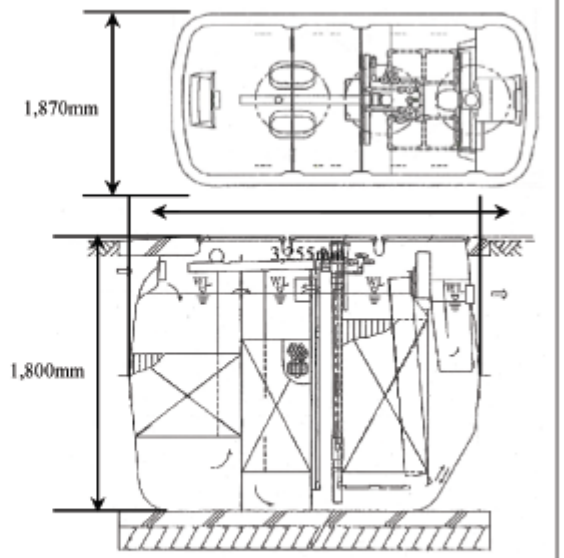
IN COLLABORATION WITH

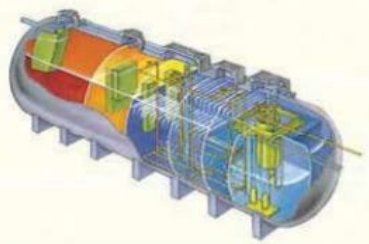
JICA

JAPAN INTERNATIONAL COOPERATION AGENCY

NOVEMBER 2013

Capacity (A)	
10 Persons (2.0 m^3/day*)	
Weight (equipment only)	
470 kg	
Main body material	
FRP	
Tank volume, Equipment capacity	
Anaerobic filter tank	No. 1: 2.13 cum No. 2: 1.414 cum
Contact aeration tank	2.037 cum
Sedimentation tank	0.717 cum
Blower	120 L/min × 130 W



Package-type			On-site construction-type
Small-scale	Medium-scale	Large-scale	Medium/Large-scale
(About 5 to 50 people)	(About 51 to 500 people)	(Approx. 500 to 5,000 people)	(More than 500 people)
			

MONITORING WATER BODIES IN INDIA-2015--

NATIONAL GREEN TRIBUNAL (NGT)
Matter OA No. 673 of 2018

- *Many States/ UTs are constructing or have proposed to develop STPs in Polluted River Stretches with capacity less than 2 MLD. States, in such situations, may consider to adopt installation of* ***decentralized modular STPs; which offer advantages in form of lesser time involved in commissioning of systems, less land footprints, easy operations; instead of conventional centralized STPs based on techno-commercial considerations.*** *This will also enable them to comply to NGT stipulated timelines.*

Johkasou system introduced in India by Daiki Axis- 2018

STRICT EFFLUENT STANDARDS-NGT ORDER 2019

Industry	Parameters	Standards(Applicabletoallmodeof disposal)
Sewage Treatment Plants (STP)	pH	5.5-9.0
	Bio-Chemical Oxygen Demand (BOD), mg/l	10
	Total Suspended Solids (TSS), mg/l	20
	Chemical Oxygen Demand (COD), mg/l	50
	Nitrogen-Total, mg/l	10
	Phosphorus-Total (For Discharge into Ponds, Lakes), mg/l	1.0
	Fecal Coliform (FC)(Most ProbableNumber per 100 mililiter, MPN/100 ml	Desirable- 100 Permissible-230

PROPOSAL FOR STANDADS FOR PACKAGE SEWAGE TREATMENT PLANT TO BUREAU OF INDIAN STANDARDS AUGUST 2020

A. Proposal Details

Part - 1

Organization Type: Others

1. Name of Proposer	Jenish Jeyakumar
2. Email ID	j.jenish@daiki-axis.com
3. Phone	9940532272
4. Address	Daiki-Axis India Pvt Ltd, No-17, Ground Floor, DLF Tower B, Jasola, New Delhi - 110025

Kickoff meeting
—Field test with IIT-Roorkee

Jan-14,2021

PROTECT×CHANGE

Daiki AXIS

INSTALLATION AND TESTING- STP PREMISES IIT ROORKEE-2021

SEWAGE PUMPING STATION

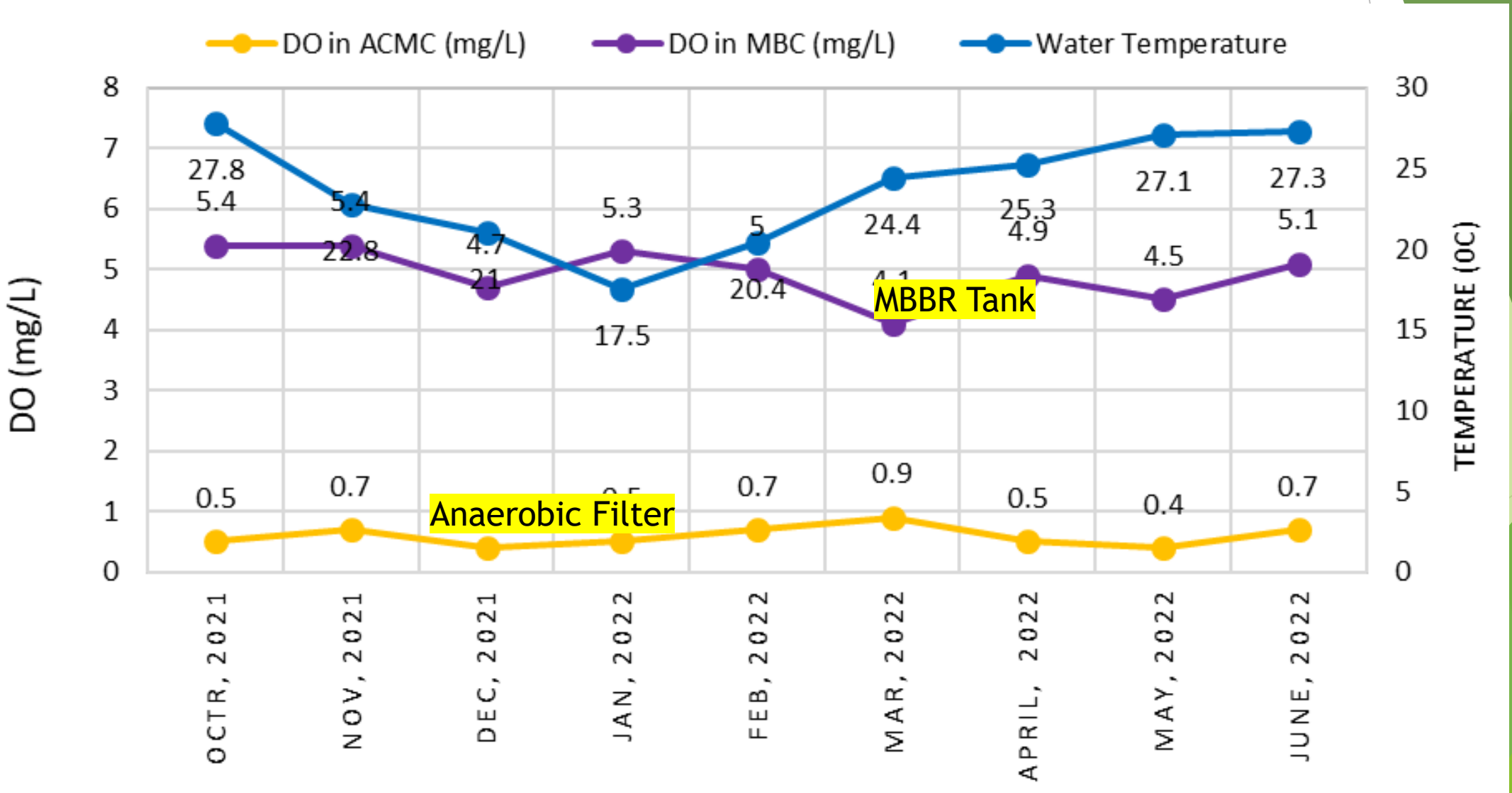
RAW SEWAGE TANK

JOHKASOU (7 KLD)

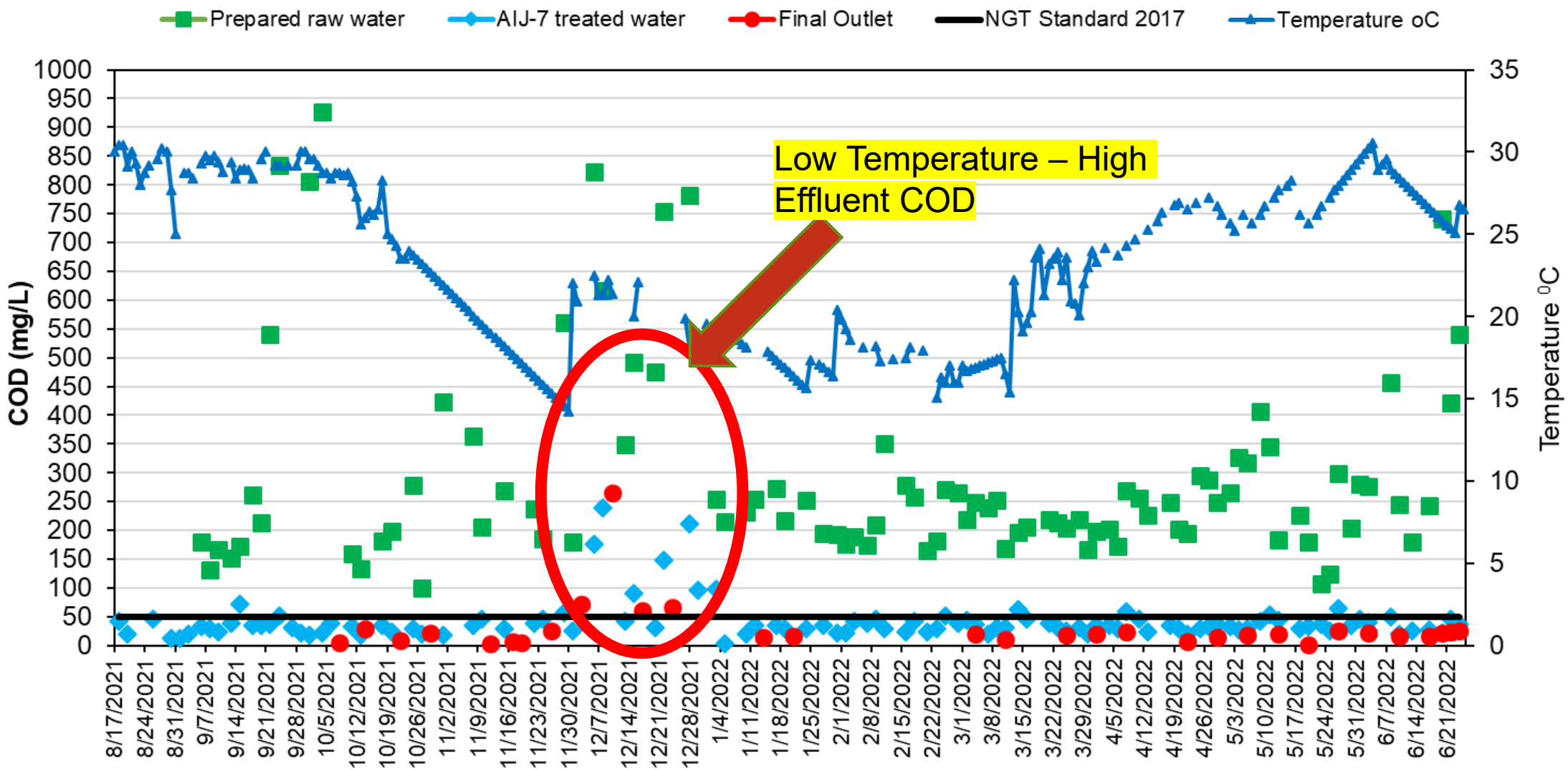
TERTIARY TREATMENT

7 KLD Johkasou Plant : 10-15 Households
50-70 Users
250 W Blower

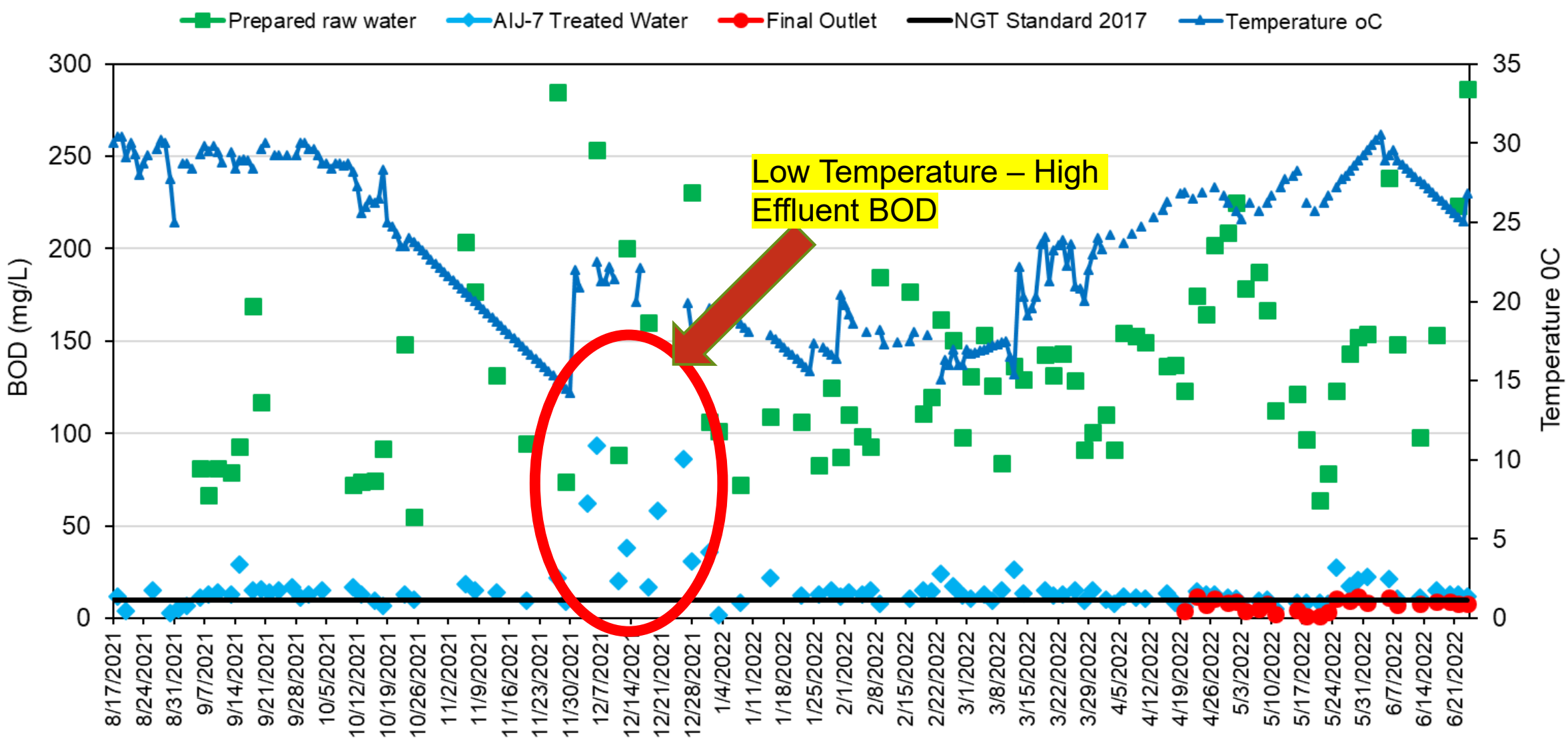
TEMPERATURE & DISSOLVED OXYGEN



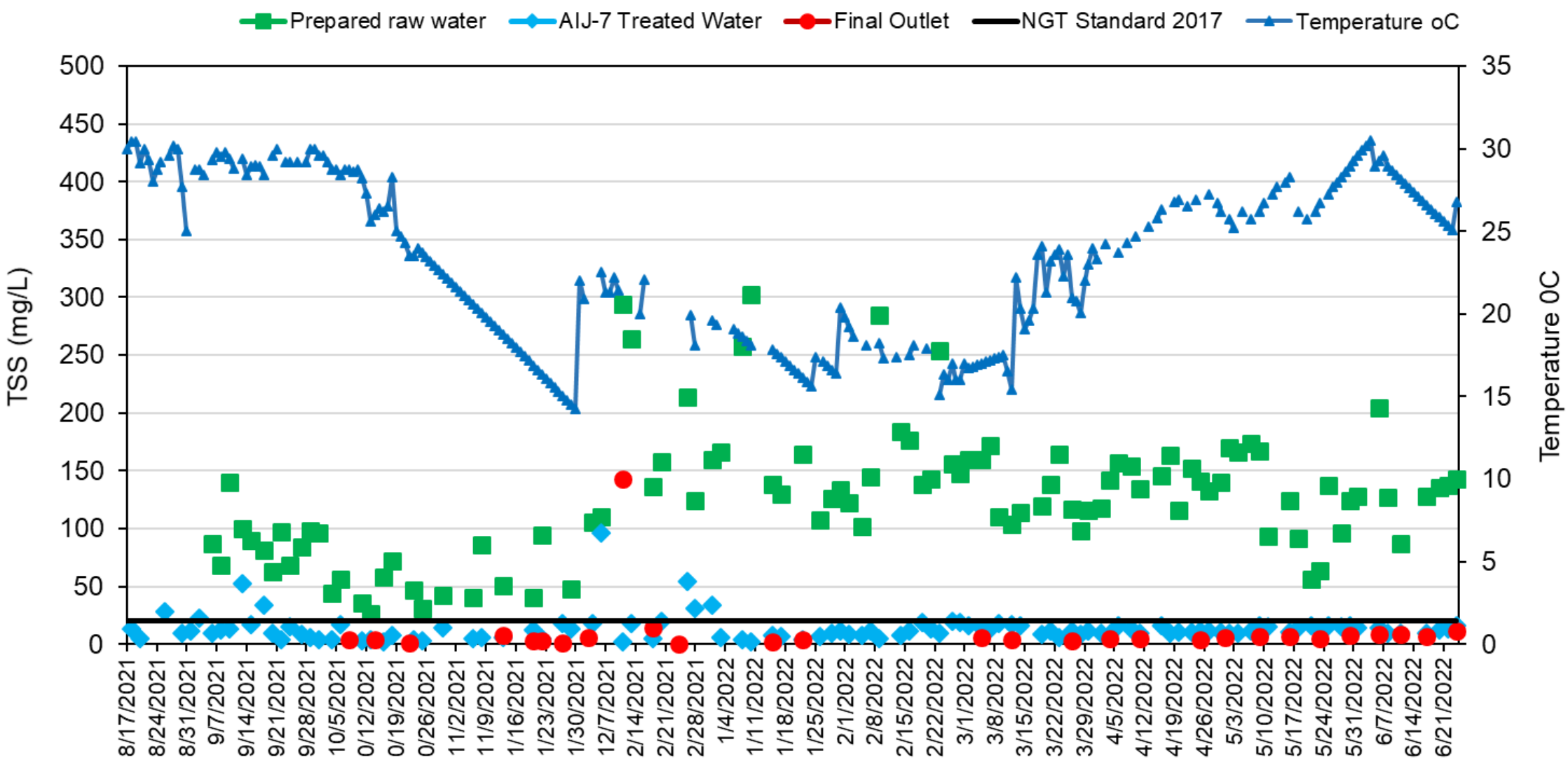
CHEMICAL OXYGEN DEMAND (COD)



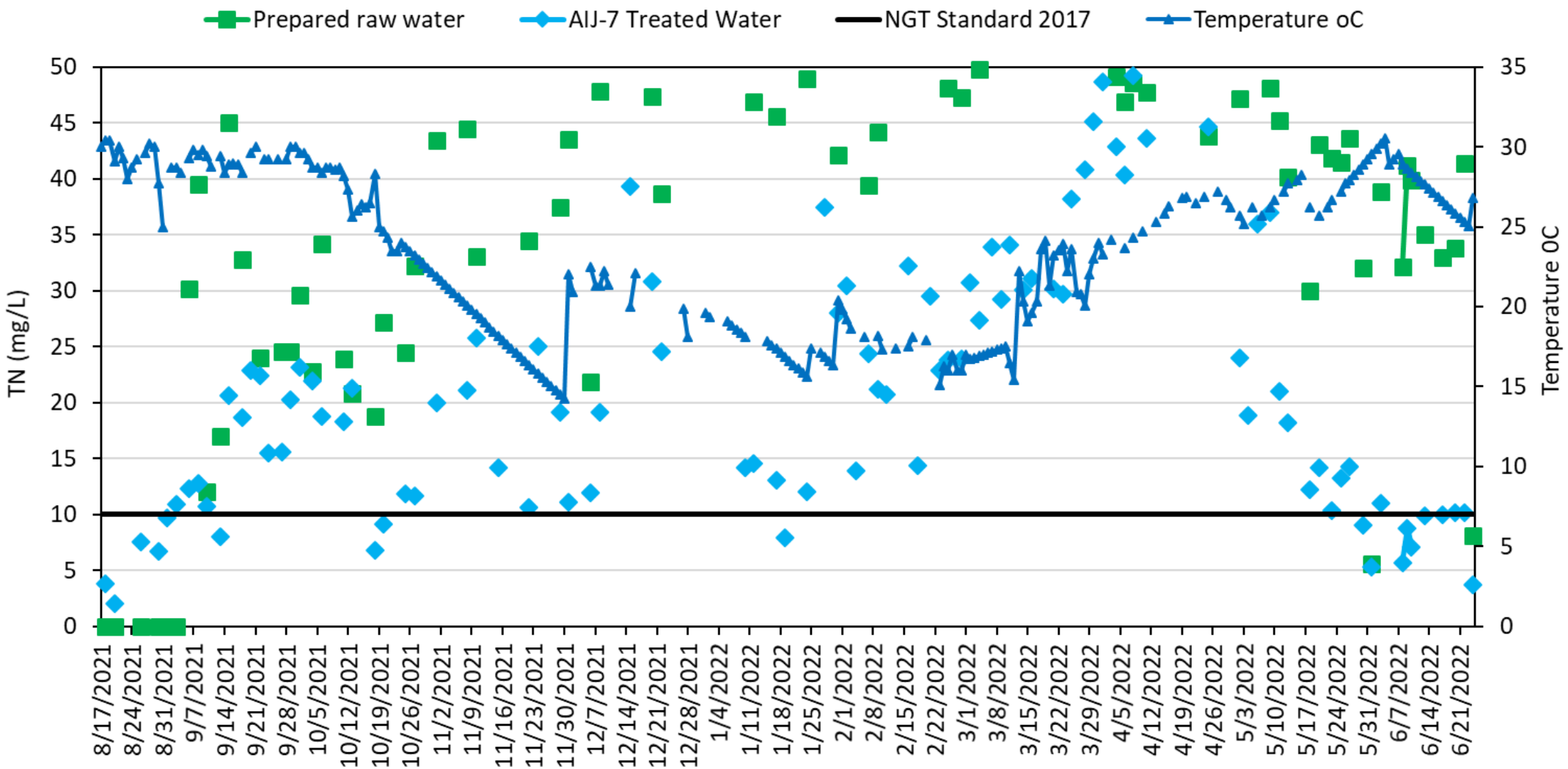
BIOCHEMICAL OXYGEN DEMAND (BOD)



TOTAL SUSPENDED SOLIDS

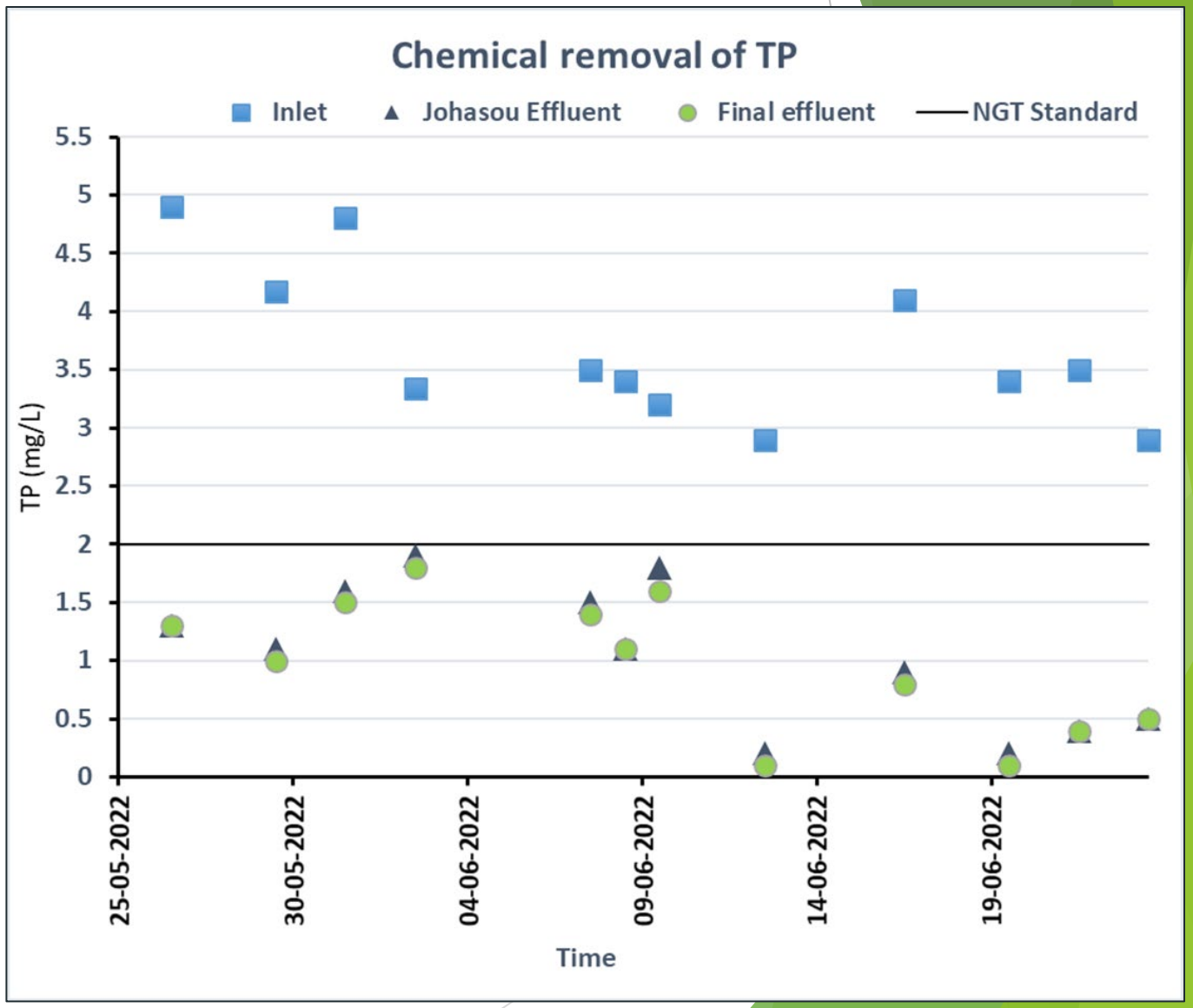


TOTAL NITROGEN (TN)



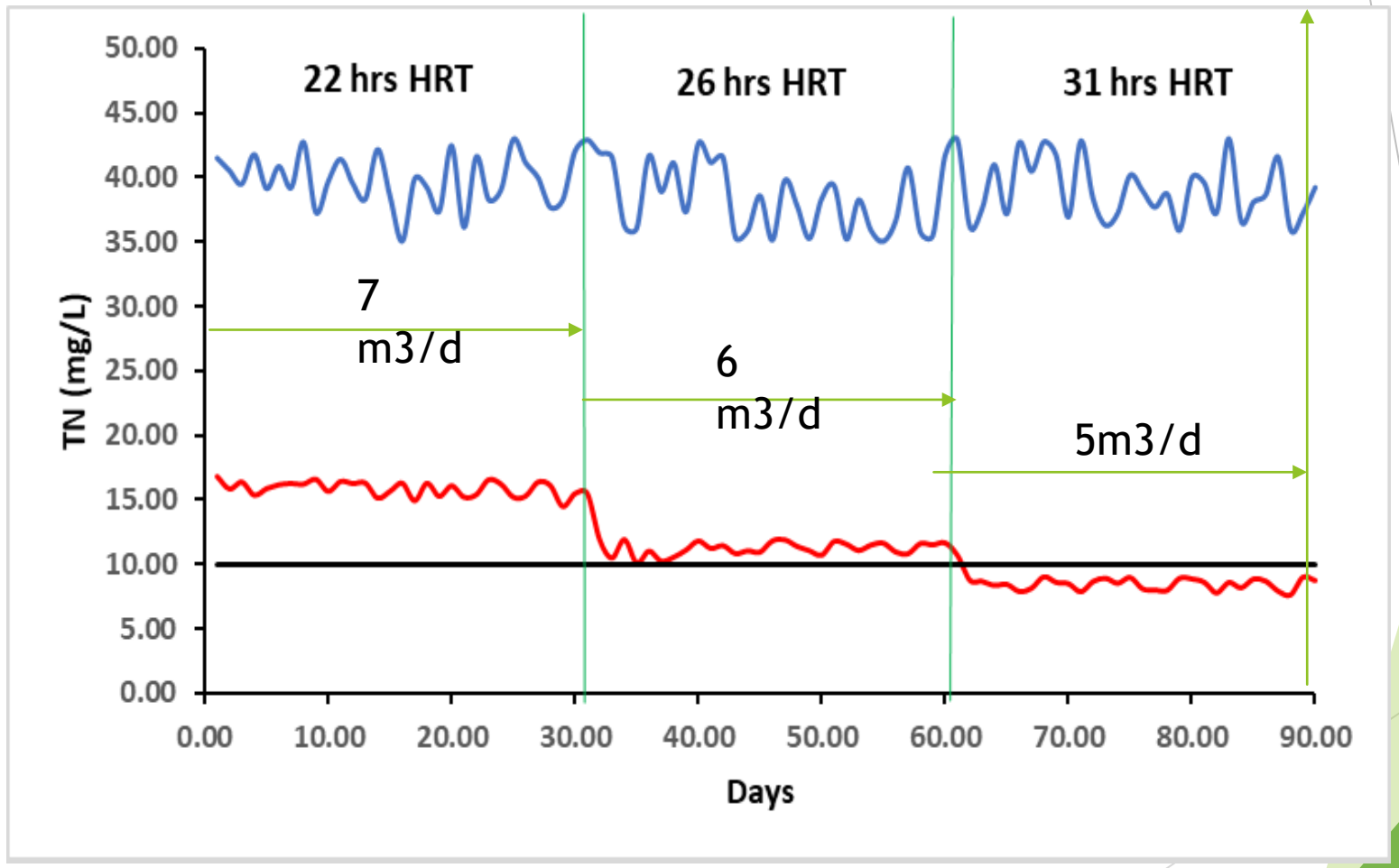
CHEMICAL PHOSPHOROUS REMOVAL

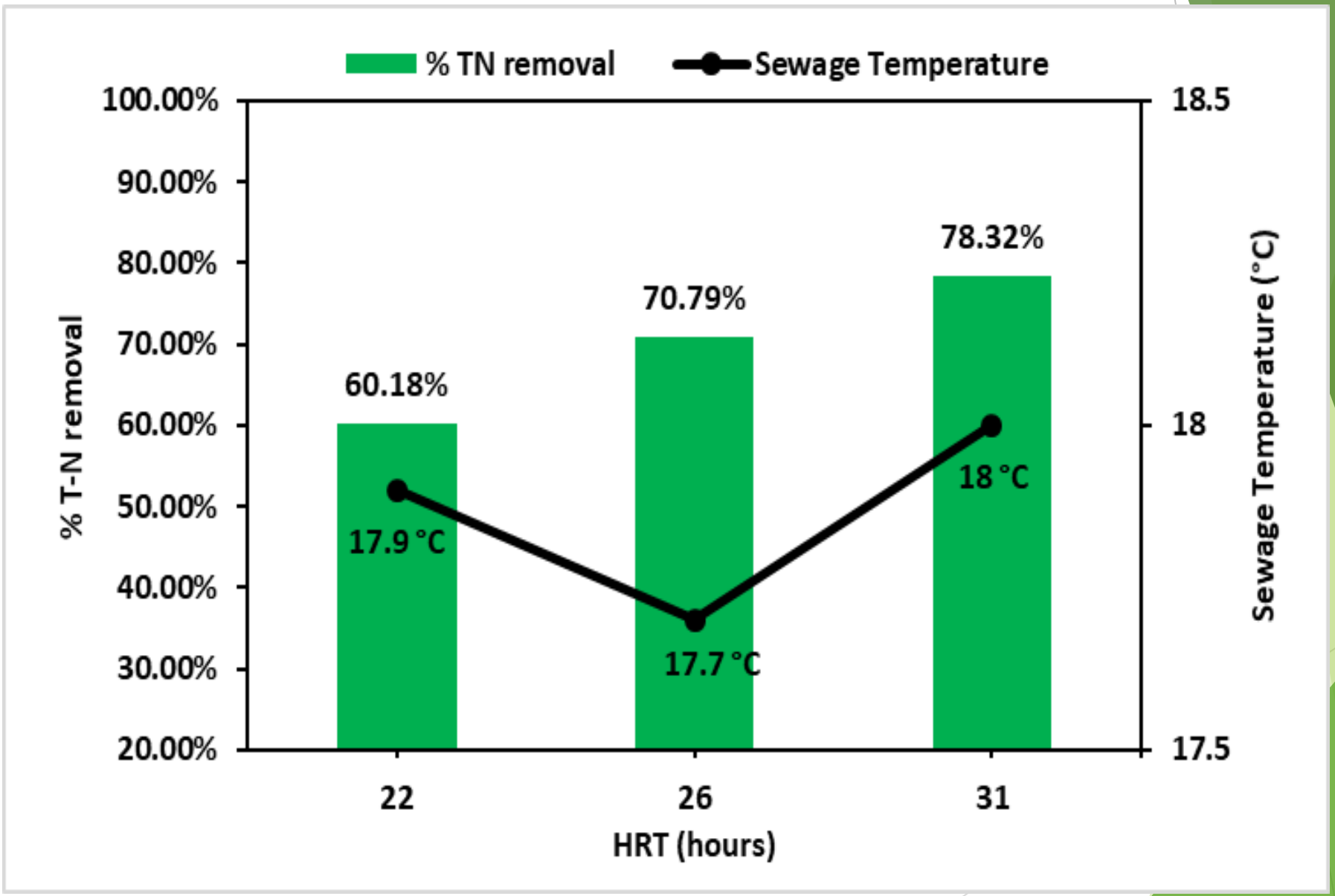
Alum Dose 200 mg/L



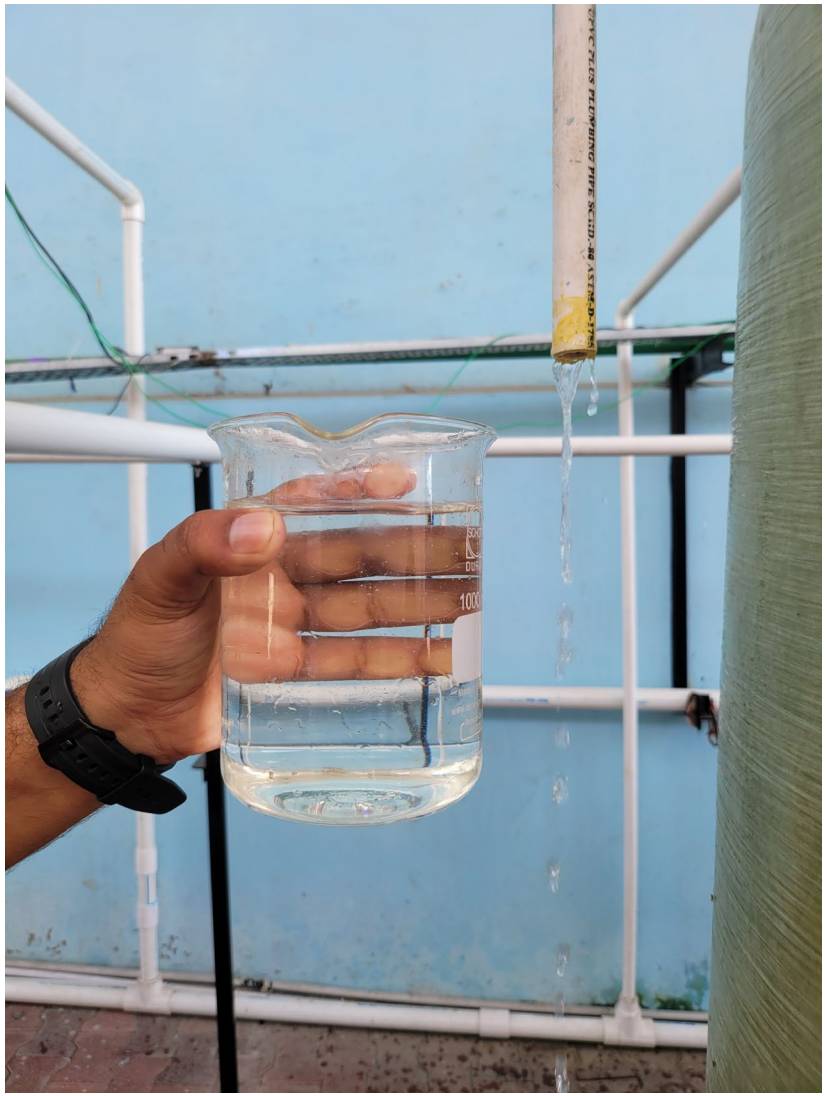
LOW TEMPERATURE STUDIES- Winter months 17-18 °C sewage Temperature

REDUCING ITS TREATMENT CAPACITY FROM 7 KLD TO 5 KLD



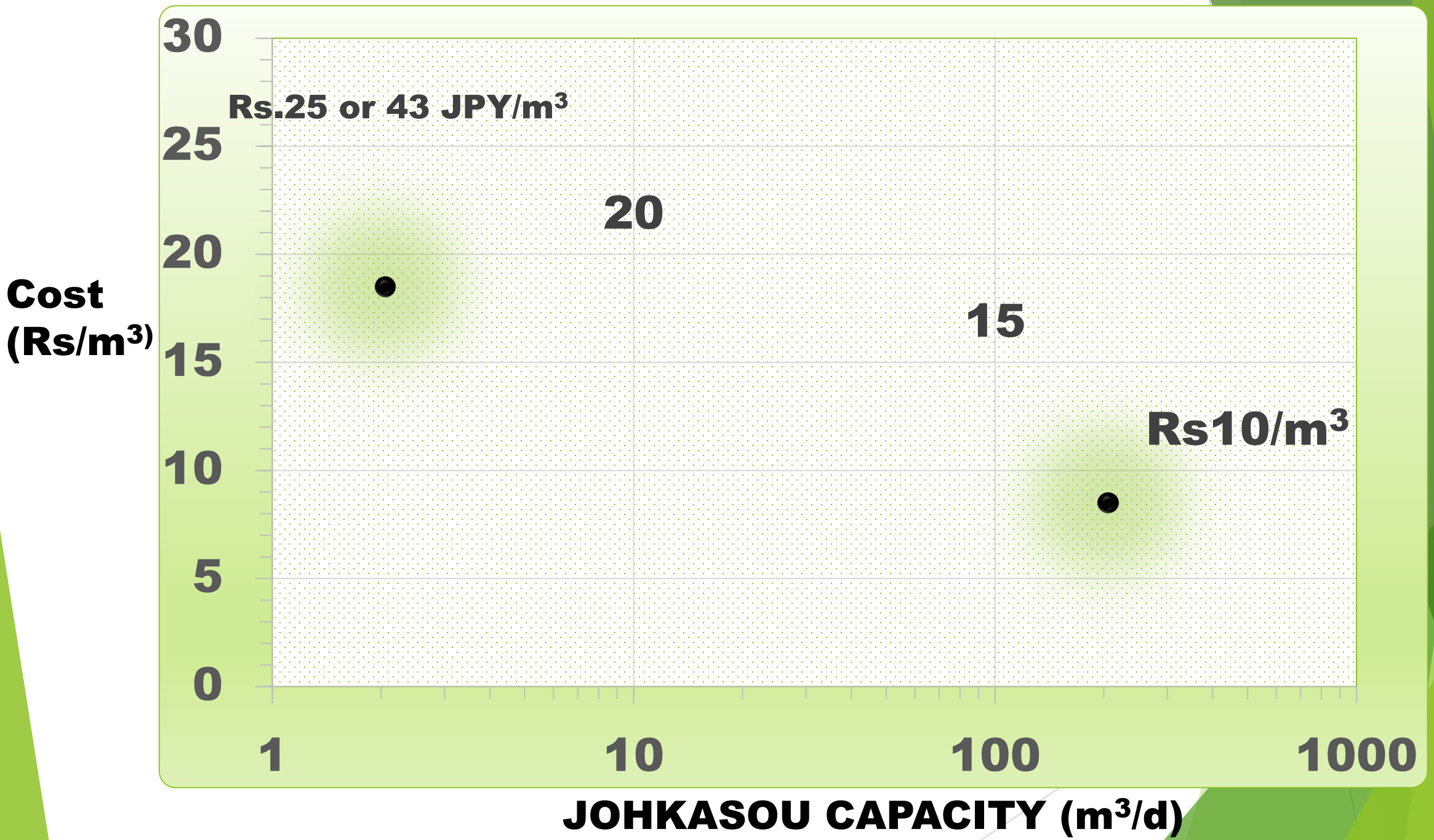

% TN removal
Sewage Temperature
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
% T-N removal
18.5
18
17.5
Sewage Temperature (°C)
60.18%
70.79%
78.32%
17.9 °C
17.7 °C
18 °C
22
26
31
HRT (hours)

FINALLY



Parameters	Inlet	Outlet
BOD (mg/L)	300	10
COD (mg/L)	450	50
TSS (mg/L)	240	20
TN (mg/L)	50	10

Phosphorus and Coliform Removal by Alum and Chlorine


Cost (Rs/m3)
30
25
20
15
10
5
0
Rs.25 or 43 JPY/m3
20
15
Rs10/m3
1
10
100
1000
JOHKASOU CAPACITY (m3/d)

NATIONAL NEWSPAPER

THE TIMES OF INDIA

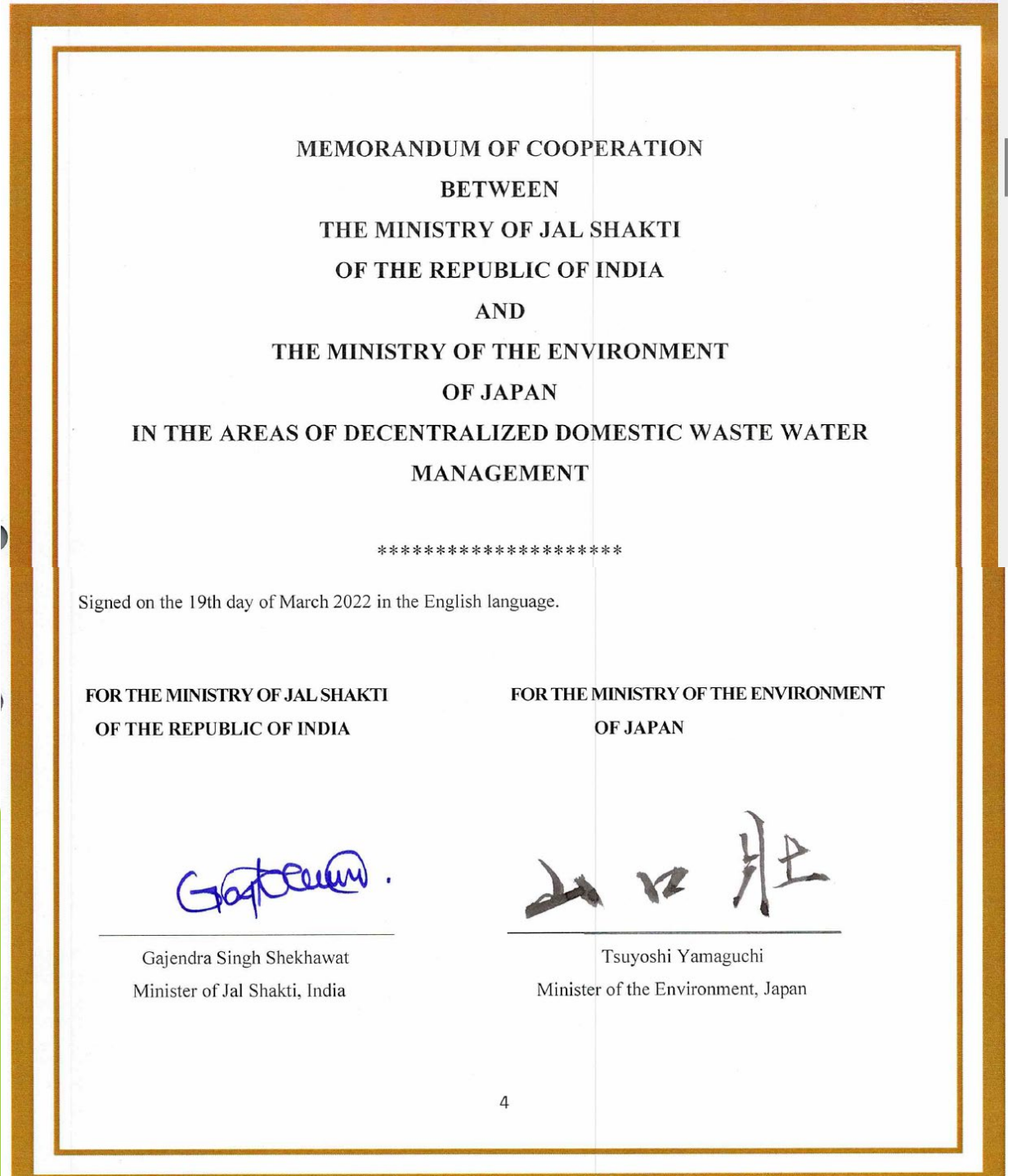
IIT-Roorkee validates adaptability of Japanese technology-based STPs for hilly regions

Tapan Susheel / TNN / Oct 12, 2022, 23:19 IST

Environmental researchers at IIT-Roorkee have carried out research on Japan's Johkasou technology (JT) for its adaptation and validation in Indian conditions. JT deals in sewage treatment plants (STPs).

ROORKEE: Environmental researchers at IIT-Roorkee have carried out research on Japan's Johkasou technology (JT) for its adaptation and validation in Indian conditions. JT deals in sewage treatment plants (STPs).

Japanese company Daiki signed an MoU in December 2020 with IIT-R. The researchers said that although JT can work effectively across the country, its implementation in Uttarakhand, particularly in



MEMORANDUM OF COOPERATION
BETWEEN
THE MINISTRY OF JAL SHAKTI
OF THE REPUBLIC OF INDIA
AND
THE MINISTRY OF THE ENVIRONMENT
OF JAPAN
IN THE AREAS OF DECENTRALIZED DOMESTIC WASTE WATER MANAGEMENT

****

Signed on the 19th day of March 2022 in the English language.

FOR THE MINISTRY OF JAL SHAKTI
OF THE REPUBLIC OF INDIA

Gajendra Singh Shekhawat
Minister of Jal Shakti, India

FOR THE MINISTRY OF THE ENVIRONMENT
OF JAPAN

Tsuyoshi Yamaguchi
Minister of the Environment, Japan

4

INDO-JAPAN-MEMORANDUM OF COOPERATION- MARCH 2022

- Exchanging information and expertise on decentralized domestic wastewater management.
- Seminars, conferences and meetings.
- Capacity building through trainings, workshops and on job sites.
- Other forms to be mutually decided upon

IIT Roorkee | Daiki AXIS INDIA

IIT Roorkee and Daiki Axis India

are organising a workshop on

Advanced On-site Wastewater Management System (Johkasou).

KEY TOPICS

- Technical Evaluation of Johkasou performance in Indian conditions by IIT Rookee
- Johkasou learnings from Japan and other developing countries
- Various Outlet Parameters Standards and compliance for onsite systems
- Opportunity for Onsite Treatment Systems in Various Government Missions
- Sustainable Cost and Financial models for Onsite Solutions-PPP, BOOT, HAM Suitability for onsite systems
- Holistic development of onsite/ Decentralized Treatment- Daiki Axis Vision, Strategy and roadmap

You are cordially invited.

In person

9.30 am - 3.35pm | 5th August 2022
Gulmohar, **India Habitat Centre**
New Delhi

Online

Watch the live streaming of workshop on
and YouTube - Daiki Axis India

Namami Gange
@cleanganganmcg

Prof. A.A Kazmi- @iitroorkee, talked about the performance evaluation of Johkasou in Indian conditions and various other steps that can be taken to improve the wastewater management system.

#NamamiGange

FIRST MEETING BUREAU OF INDIAN STANDARDS

BUREAU OF INDIAN STANDARDS

Minutes of the 1st Meeting of the Working Group for Draft for Specification for Packaged Sewage Treatment Plant CED 24: WG 07

Meeting Mode: Virtual **Date: 23 May 2022**

ATTENDEES:

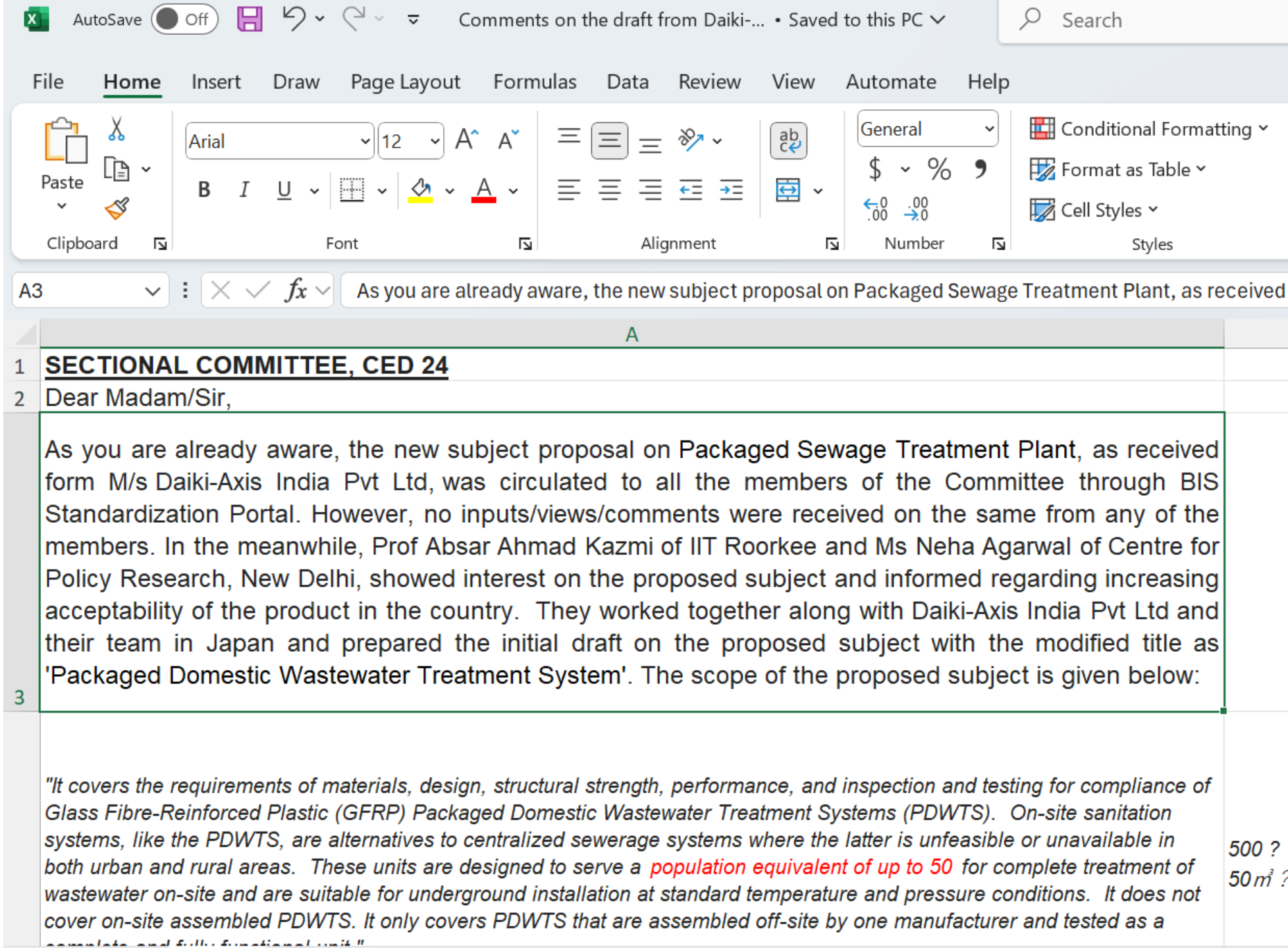
Co-ordinator: Shri A. K. Sarin, In Personal Capacity (***Co-ordinator***)

Member Secretary: Shri Shubham Agrawal

Members & Invitees:

1.	Prof Absar Ahmad Kazmi, IIT Roorkee
2.	Prof Nityanand S. Maurya, National Institute of Technology Patna
3.	Ms Neha Agarwal, Centrefor Policy Research
4.	Ms Shaivi, Centre for Policy Research
5.	Shri Girish Chandra Mishra, Saviram Engg. Consultants Pvt Ltd
6.	Shri Rio Waza, Daiki-Axis India Pvt Ltd.
7.	Shri Kamal Tiwari, Daiki-Axis India Pvt. Ltd

PREPARATION OF FIRST DRAFT
July 7, 2022



IS 18797 : 2024 Packaged Sewage Treatment Plant — Specification

September 2024

services.bis.gov.in/php/BIS_2.0/StandardsFormulationV2/doc_details_outside.php?ID=MjQzMjU%3D

Bureau of Indian Standards
The National Standards Body of India

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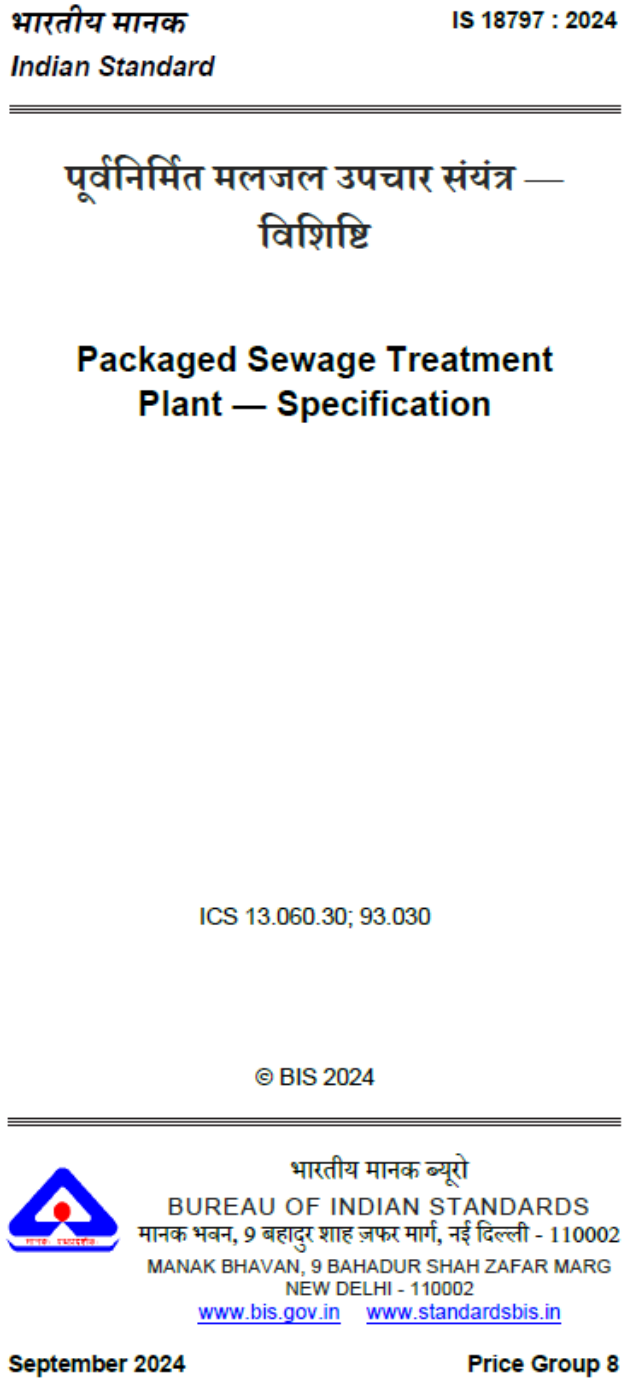
History

Document Details	
Name of Department/Committee :	CED 24
Document Number :	CED 24 (24325)
Document Title [English] :	Packaged Sewage Treatment Plant - Specification
Document Title [Hindi] :	पूर्वनिर्मित मलजल उपचार संयंत्र – विशिष्टि
Document Type :	New
Language :	English
Priority :	3
ICS Code :	93.030, 13.060.30
Date of Project Approval :	31-08-2023

S.No.	P-Draft Completion Date	WC-Draft Completion Date	Final-Draft Completion Date	Project Completion Date(Gazette)	Entered By	Entered On
1	04-12-2023	04-05-2024	19-07-2024	04-12-2024	Mr. Dheeraj Damachya	04-12-2023



भारतीय मानक IS 18797 : 2024
Indian Standard

पूर्वनिर्मित मलजल उपचार संयंत्र — विशिष्टि

Packaged Sewage Treatment Plant — Specification

ICS 13.060.30; 93.030

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
www.bis.gov.in www.standardsbis.in

September 2024 Price Group 8

Packaged sewage treatment systems (PSTP) can provide a turnkey solution to the need of advanced on-site sewage treatment and are suitable for installation at the level of individual households or as a decentralized community-level solution. This standard for packaged sewage treatment plant (PSTP) aims to ease the implementation of these products as India amplifies its efforts to meet the United Nations Sustainable Development Goal 6 ‘Clean water and sanitation for all’.

This standard provides a comprehensive framework to manufacturers of packaged sewage treatment systems for assuring the quality and performance of their products such that they can provide consistent and adequate on-site sewage treatment and aid in the achievement of safe sanitation for all.

- This standard covers the requirements of materials, design, structural strength, performance and inspection and testing for compliance Of packaged sewage treatment plant (PSTP) made using glass fibre reinforced plastic (GFRP), polyethylene (PE), poly propylene (PP) or dicyclopentadiene (DCPD). On-site sanitation systems, like the PSTP, are alternatives to centralized sewerage systems where the latter is infeasible or unavailable in both urban and rural areas.

INFLUENT CHARACTERISTICS & EFFLUENT DISCHARGE STANDARDS

Sl No.	Parameter	Unit	Concentration
(1)	(2)	(3)	(4)
i)	Biological/biochemical oxygen demand (BOD)	mg/l	250
ii)	Chemical oxygen demand (COD_{cr})	mg/l	425
iii)	Total suspended solids (TSS)	mg/l	375
iv)	Total nitrogen (TN)	mg/l	50
v)	Total phosphorous (TP)	mg/l	7.1

.

Parameter	Concentration Not to Exceed
(2)	(3)
*p*H	5.5 to 9.0
Biological/biochemical oxygen demand (BOD)	30 mg/l
Chemical oxygen demand (COD)	250 mg/l
Total suspended solids (TSS)	100 mg/l
Total nitrogen (TN)	100 mg/l
Dissolved PO_4 as P	5 mg/l

IMPOSTANT CLAUSES

- **4.3.5** The minimum HRT of the system shall be16.5 h for average sewage temperature of 25 °C or above. However, the HRT shall be significantly higher for colder areas. Alternatively, heating element may be used for maintaining the desired temperature.
- The system shall be designed with two or more compartments.
- **4.3.4** The system shall be sized such that it is able to safely store at least six month's sludge production without compromising the treatment performance OR the system shall be designed to have a minimum desludging period of six months under normal operating conditions

PERFORMANCE TESTING

B-5 The system shall be tested for average flow, if equalization tank is provided, otherwise it shall be tested for hourly variation of inflow. An illustrative temporal pattern of inflow rate diagram for such systems is described in Fig. 1 with an allowable error of ± 5 percent. The evaluation shall be conducted under three modes of flow rates: normal flow mode (Q) for a period of 40 weeks, low flow mode ($0.5Q$) for 4 weeks and high flow mode ($1.25Q$) for 4 weeks for a total of 48 weeks.

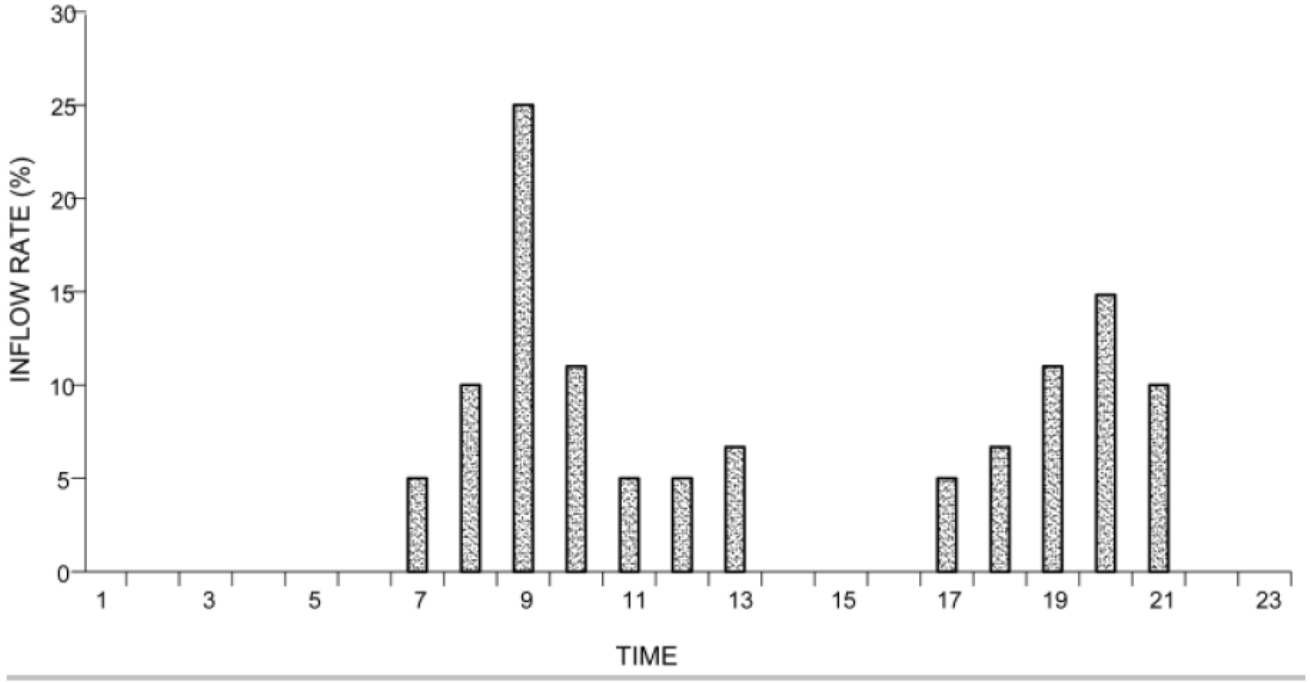


FIG. 1 TEMPORAL PATTERN OF INFLOW RATE

Table 7 Parameters for Evaluation and Frequency of Testing

(*Clause* B-6)

Sl No.	Parameter	Unit	Frequency
(1)	(2)	(3)	(4)
i)	Daily influent flow	litre/day	As desired
ii)	Inflow period	hour/day	As desired
iii)	Inflow pattern	Percentage versus hour	As desired
iv)	Peak influent flow	litre/minute	As desired
v)	Temperature of influent	°C	As desired
vi)	Daily effluent flow	litre/day	As desired
vii)	Sludge level	metre	Monthly (or more frequent)
viii)	Scum level	metre	Weekly (or more frequent)
ix)	Biological/biochemical oxygen demand (BOD)[1]	mg/l	Weekly (or more frequent)
x)	Chemical oxygen demand (COD_{cr})[1]	mg/l	Weekly (or more frequent)
xi)	Total suspended solids (TSS)[1]	mg/l	Weekly (or more frequent)
xii)	Total nitrogen (TN)[1]	mg/l	Weekly (or more frequent)
xiii)	Total phosphorous (TP)[1]	mg/l	Weekly (or more frequent)
xiv)	Faecal coliform (FC)	Most probable number (MPN) per 100 ml	Weekly (or more frequent)
xv)	*p*H[1]		Weekly (or more frequent)

(Clause 9)

ROUTINE OPERATION AND MAINTENANCE PROCEDURES

F-1 ROUTINE OPERATION AND MAINTENANCE PROCEDURES

F-1.1 The following routine inspection shall be carried out by the user once a week:

a) Check pretreatment units (bar screens, O and G trap, grit chamber, etc);

b) Check state of operation of blowers;

c) Check state of operation of pumps and float switch/level switch/float; and

d) Check state of operation of disinfection system.

F-1.2 The following routine inspection shall be carried out by the service provider once a month:

a) Check media or filter conditions;

b) Clean air filters of blowers; and

c) Check leakage, clogging, etc, in influent, effluent, internal, inter-connection, aeration pipes for leakage, clogging.

F-1.3 The following routine inspection shall be carried out by the service provider once in six months:

a) Replacement of air filters of blowers;

b) Sludge level check;

c) Check scum in all chambers;

d) Sludge removal; and

e) Cleaning of media and filter.

Table 3 Requirements of Raw Material and Laminate for FRP

(*Clause* 5.1)

Sl No.	Parameter	Threshold	Method of Test, Ref to
(1)	(2)	(3)	(4)
i)	Minimum heat distortion temperature	> 65 °C	Annex C
ii)	Percent (w/w) glass content*	> 30 % (w/w)**	IS 14856
iii)	Surface hardness for FRP tank	> 35 BHU	IS 13360 (Part 5/Sec 14)

Table 4 Requirements for Demonstrating Structural Strength of FRP

(*Clause* 5.6)

Sl No.	Parameter	Threshold	Method of Test, Ref to
(1)	(2)	(3)	(4)
i)	Tensile strength	≥ 60 MPa	IS 13360 (Part 5/Sec 1)
ii)	Flexural strength	≥ 100 MPa	IS 14856
iii)	Tensile modulus	≥ 6 500 MPa	IS 13360 (Part 5/Sec 1)
iv)	Flexural modulus	≥ 5 800 MPa	IS 13360 (Part 5/Sec 7)

* Percent (w/w) glass content is not applicable to rotomoulded PE tanks.

** For GFRP manufactured by chop hoop winding process, minimum glass content required may be reduced to 22 percent.

Workshop

on

"NEW TECHNOLOGIES FOR DECENTRALIZED TREATMENT OF SEWAGE AND SLUDGE MANAGEMENT"

September 23rd -24th, 2024

Sponsored by

National Mission for Clean Ganga (New Delhi)

Organized by

Department of Civil Engineering and Continuing Education Centre

IIT Roorkee

100 PARTICPANTS (POLLUTION CONTROL BOARDS, MUNICIPALITIES & PUBLIC HEALTH & SANITATION DEPARTMENT – 22 STATES

LECTURES ON JOHKASOU

FIELD DEMONSTRATION


SBR-1

WAY FORWARD

- REPLICATION OF SYSTEM ALL OVER INDIA
- TESTING FACILITY UNDER MEMORANDUM OF COOPERATION.
- MORE WORKSHOP/TRAININGS AND AWARENESS PROGRAMS