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IDRA | دائـــرة الـــطـــاقـــة DEPARTMENT OF ENERGY

INNOVATION IN RO PRE-TREATMENT

SEADAF FILTER AS TWO-IN-ONE SWRO PRE-TREATMENT FOR PROJECTS

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TECHNICAL PROGRAM

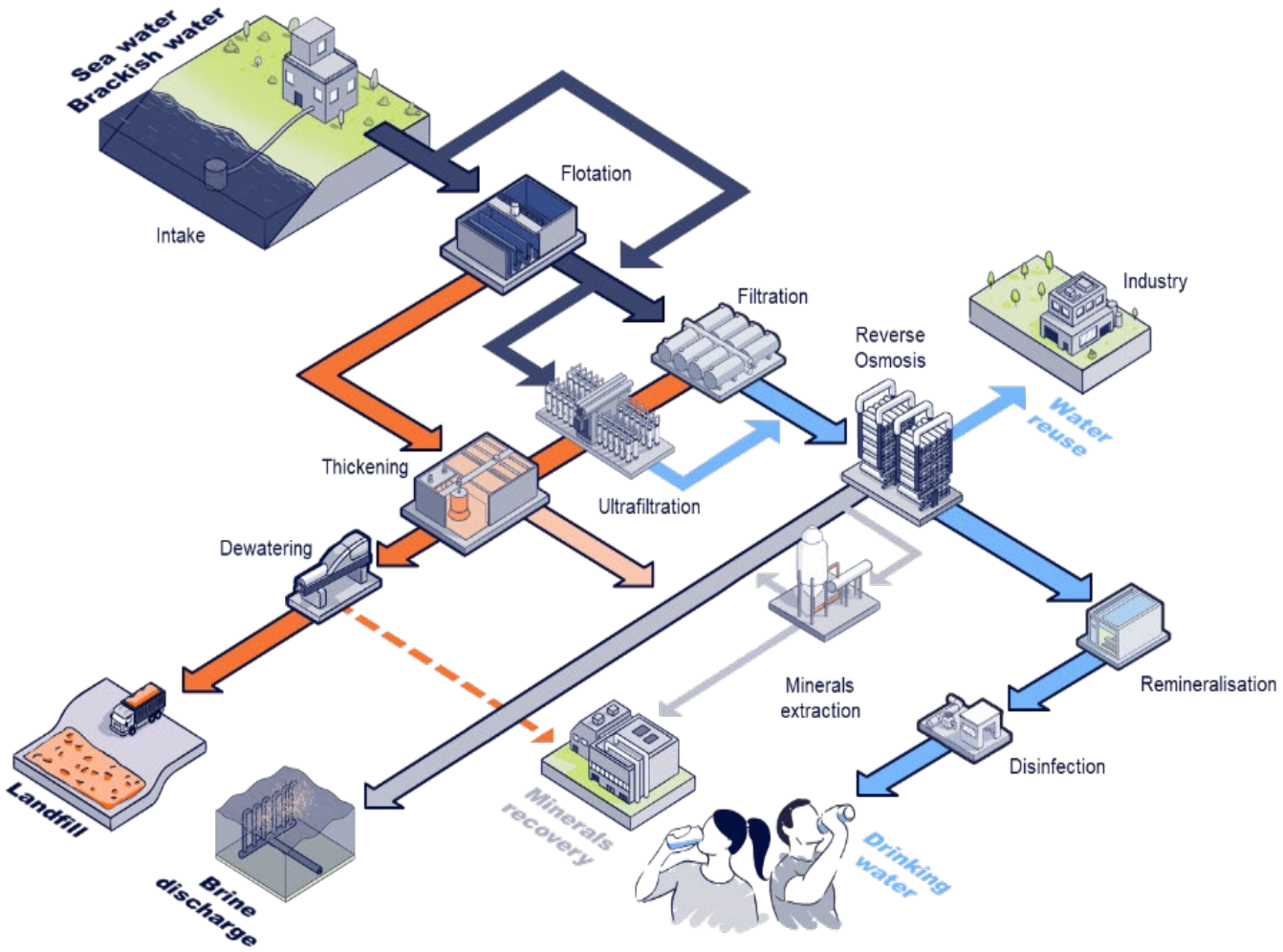
Rémy Caball – Process Design Engineer - SUEZ

SLIDES VERSION 13/09/2024

General

SWRO PRE-TREATMENT: CHALLENGES

CURRENT DRIVERS for RO pre-treatment design



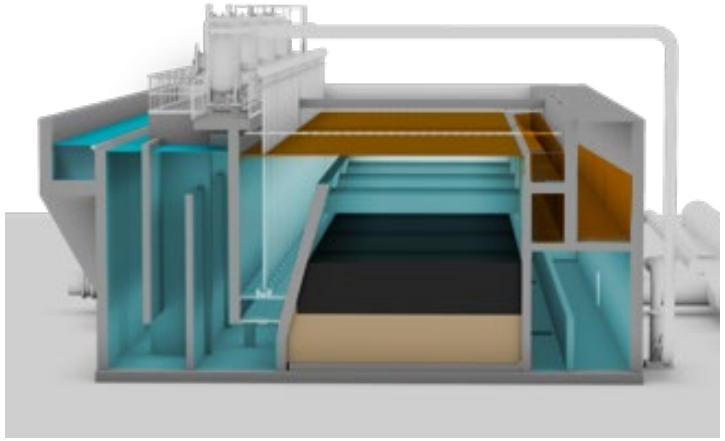
SUEZ ROADMAP

- **Expansion of technology portfolio** to adapt to expansion of desalination in ***new geographies*** and ***changing seawater*** condition
  - Treatment of higher TSS loads
  - Robustness against algae events
- **Reduction of environmental footprint** of desalination plants
- Provision of **solid proof of concept** for new technologies

THE SEADAF FILTER
Product summary

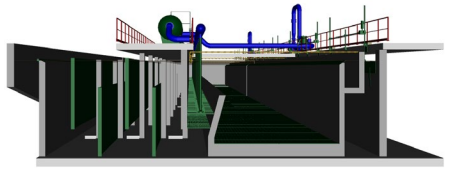
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SeaDAF® Filter



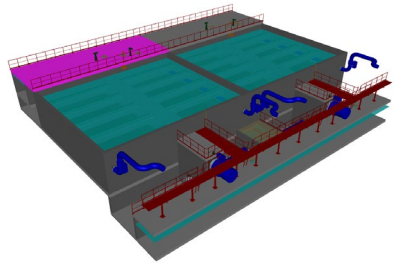
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Dissolved Air Flotation
SeaDAF®



+

Granular Filtration
Dual Media Filter



VELOCITY up to **30 m/h**

> 30 % FOOTPRINT saving

Planning saving of **1 month**

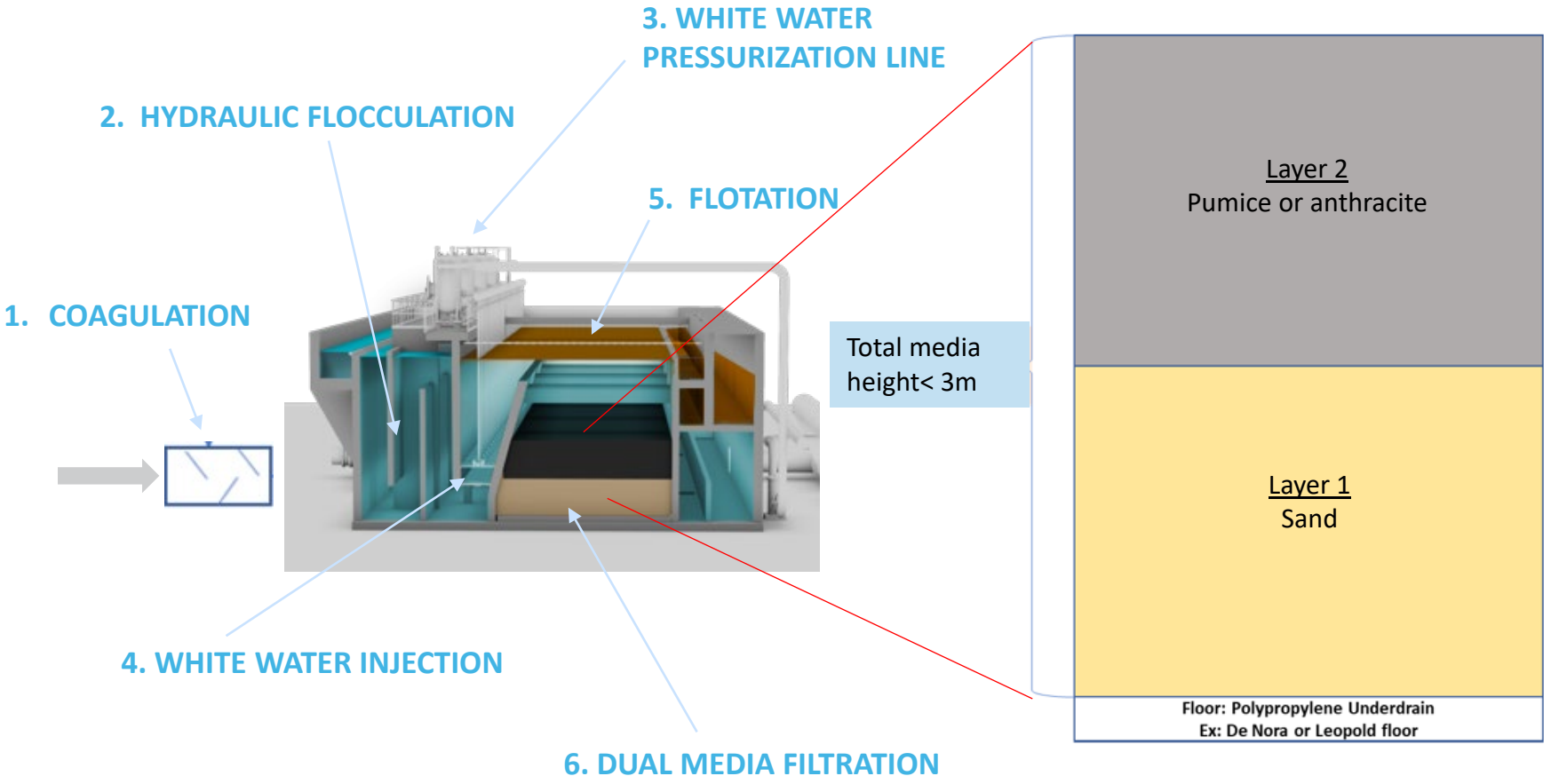
25 % **CARBON FOOTPRINT REDUCTION**

VALIDATED PERFORMANCE – SAME AS EXISTING PLANT!

- Cycle duration > 24 hours – 30 hours in average
- Compliant Filtered Water Quality with Silt Density Index (SDI) <5 **100%** of the time and <4 **80%** of the time
- **Design up to 70 mg of TSS* per Liter**

*Total Suspended Solids

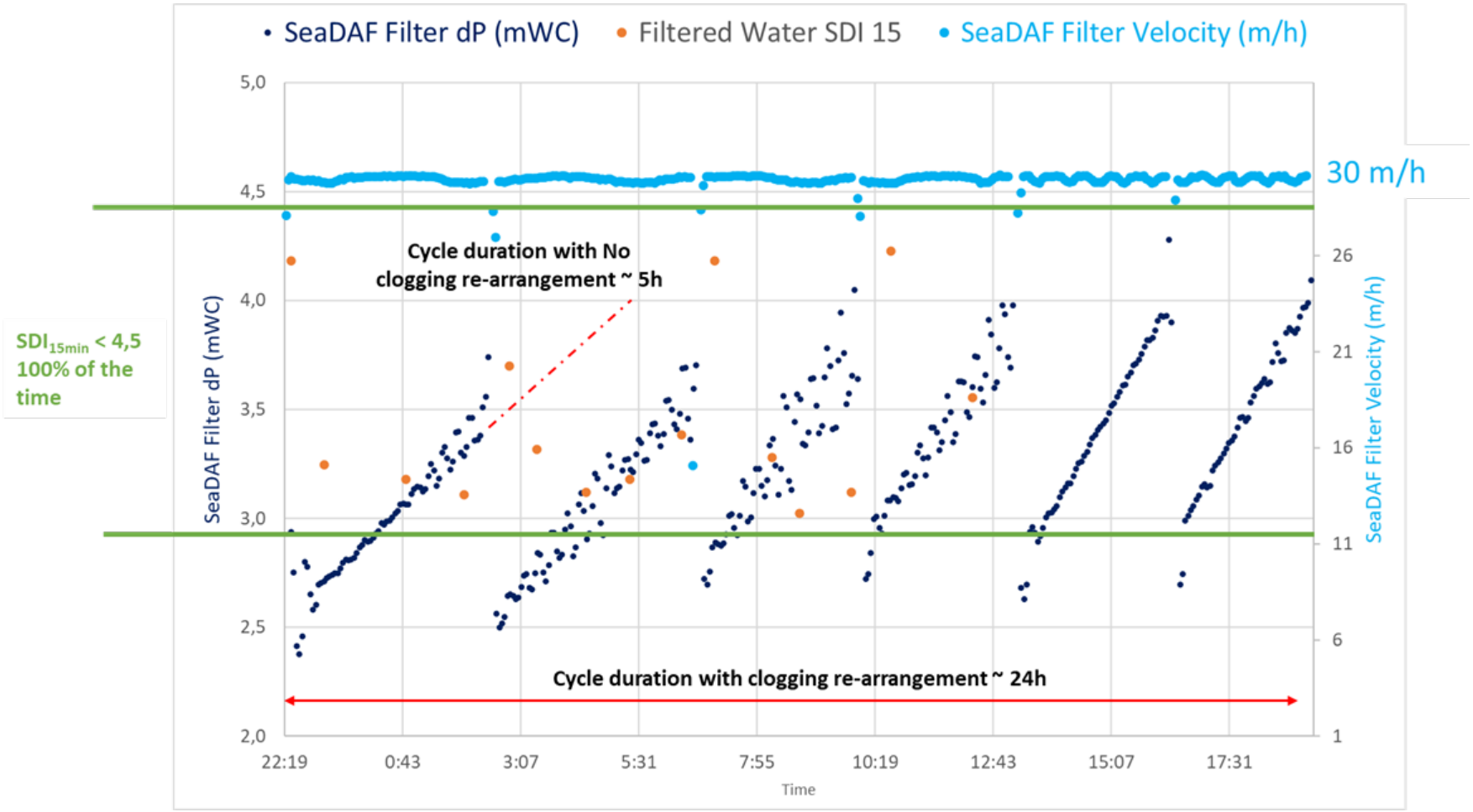
THE SEADAF FILTER
Detailed features



Mastered thanks to:

- **Increase of the filtration media height to get similar headloss available despite higher initial dP**
- **Regular media clogging re-arrangement to enhance depth filtration**

THE SEADAF FILTER
Zoom on clogging re-arrangement



SEADAF FILTER DEMO PLANT
Intermediate between pilot and full-scale technology

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SeaDAF Filter **pilot to industrialization process** articulated meticulously



Demo plant features

Filtration surface: 1m^2

Demo plant height: 7m

Filtration capacity: up to 50 m^3/h

Fully instrumented



Results produced in the two contexts consist in:

- ***long-term operation*** of the demo plant
- Witness and ***complete characterization of 4 algae events***: 2 in arabian sea and 2 in Perth
- testing of the technology in ***simulated extreme seawater condition*** (high TSS events)

SEADAF FILTER DEMO PLANT
Objective and results

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Testing philosophy of the demo plant:

- Determine the ***resistance at limits of the product design range***
  - Pushing the **velocity limits** and witnessing the response of the technology
  - testing of the technology in **extreme seawater condition**: algae blooms & high TSS events

- Deeply ***understand the filtration clogging pattern*** and ways to ***manage the headloss increase*** to maintain filtration cycle at conventional duration (> 24h) while keeping removal performance

- ***Optimize SeaDAF Filter operational condition*** at a maximum velocity of 30m/h, with cycle duration similar to conventional gravity filtration and with filtered water quality suitable for RO membranes feed

Overal objectives

→ ***determine the operating condition in specific geographies***
→ ***reduce chemical consumption through innovative operation***

SEADAF FILTER PERFORMANCE

Validation of long-term performance at 22 & 30 m/h

22 m/h
4 months of continuous stable operation

Seawater inlet average SDI_3: 20.74 %/min (min: 15.6 / max: 30.6)

SeaDAF Filter average SDI_{15} at 22 m/h: 3.6 %/min (min: 2 / max: 5)

Performance after cartridge filtration:

Percentage of SDI_{15} values <4	Percentage of SDI_{15} values <5
85.40%	100.00%

30 m/h
2 months of continuous stable operation

Seawater inlet average SDI_3: 21.08 %/min (min: 13.8 / max: 29.9)

SeaDAF Filter average SDI_{15} at 30 m/h: 3.6 %/min (min: 3 / max: 5)

Performance after cartridge filtration:

Percentage of SDI_{15} values <4	Percentage of SDI_{15} values <5
95.60%	100.00%

Achievement of filtration cycles between 24h & 30h

SEADAF FILTER PERFORMANCE

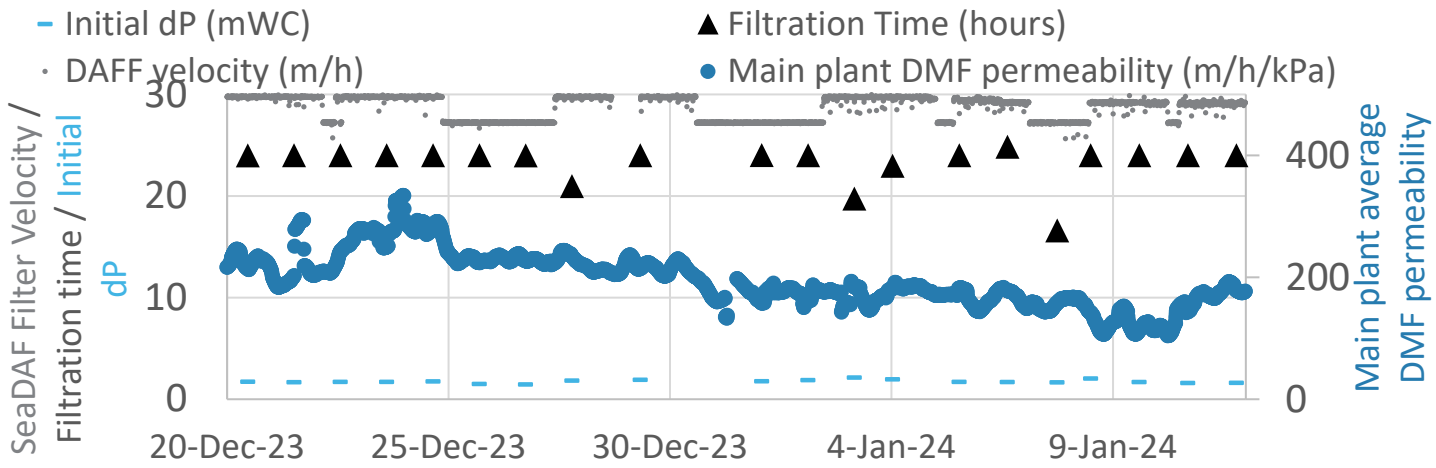
Determination of product performance during non-extreme algae events

Example of effectiveness of SeaDAF®Filter on algae **event with low count but high impact.**
(Knowing higher algae concentration enhances algae rejection capacity of the flotation process)

Algae speciation (cells/L)			
	Total count	**Proboscia alata**	**Other species**
Seawater	148 100	67 400	80 700
Floated water	3 360 (- 97.7%)	160 (- 99.8 %)	3 200 (-96.0 %)
SeaDAF Filter outlet	0 (- 100%)	0 (- 100%)	0 (- 100%)

Seawater SDI +72%
Main plant filters permeability -19%
Abundance of algae unrelated to pre-treatment difficulties

⇒ SeaDAF Filter demo plant remained with filtration cycles of 24h even during this event and stable initial dP (no long-term media clogging)

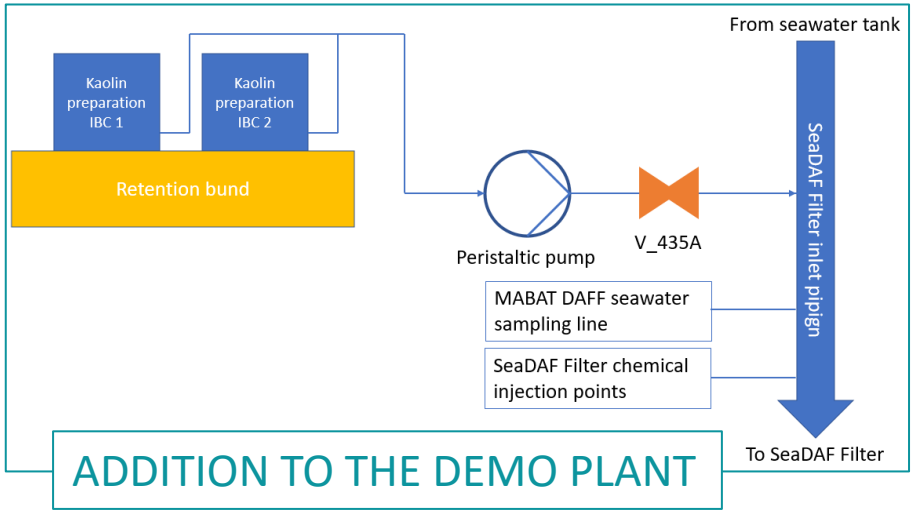


SEADAF FILTER PERFORMANCE

Determination of product performance during high TSS events

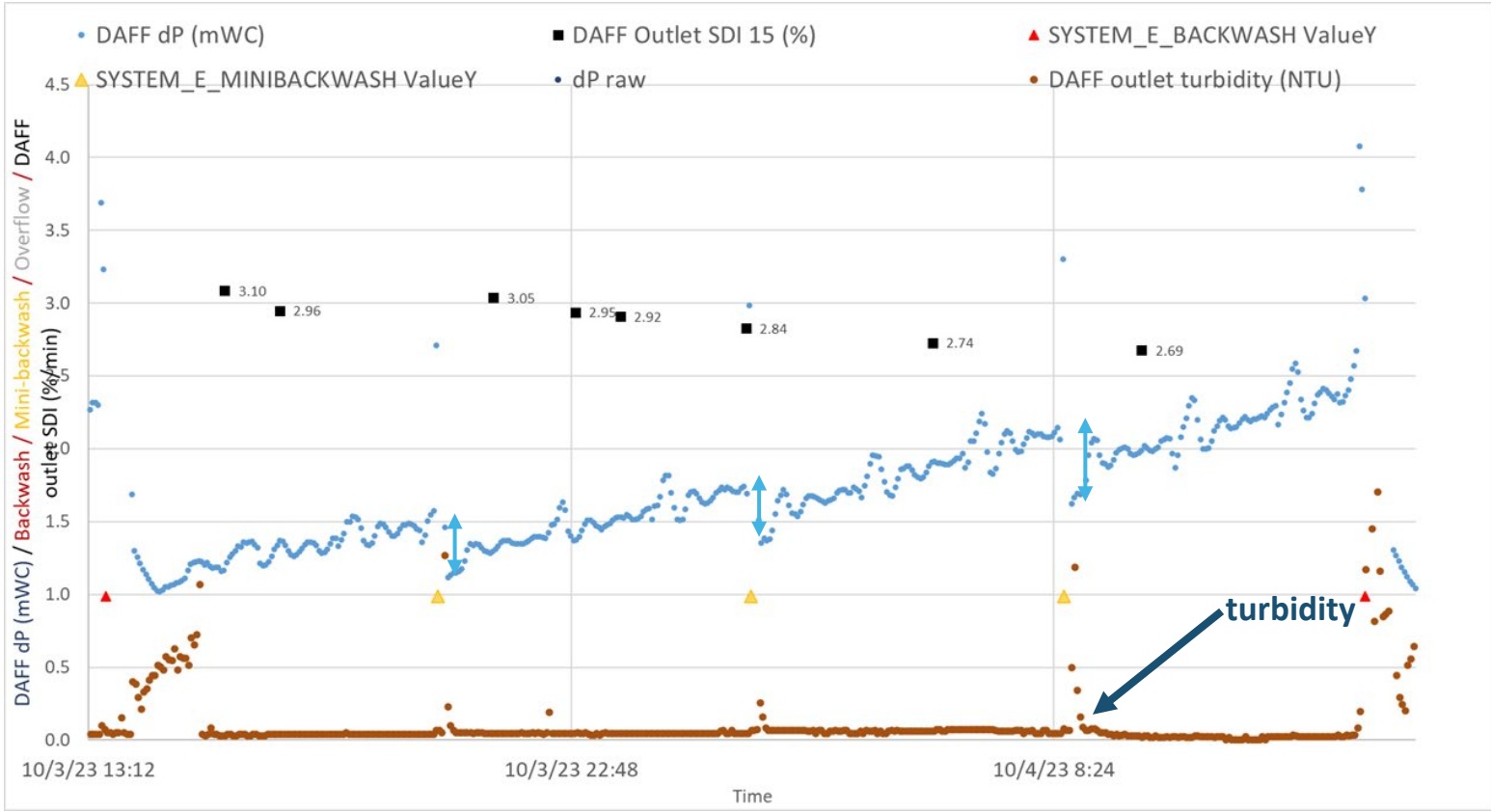
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Representation of worst seawater in Iloilo: High Total Suspended Solids Trials 50 ppm



20 m/h & 50 mg/L TSS
No breakthrough,
24h of successful operation

SDI_{15min} still compliant with RO membranes requirement (< 5 %/min)



SeaDAF® Filter solution validated

SEADAF FILTER PERFORMANCE

Determination of product performance during high TSS events

Demo plant used to provide precise operating conditions for Ilollo project

1. Characterisation of removal through the sludge blanket



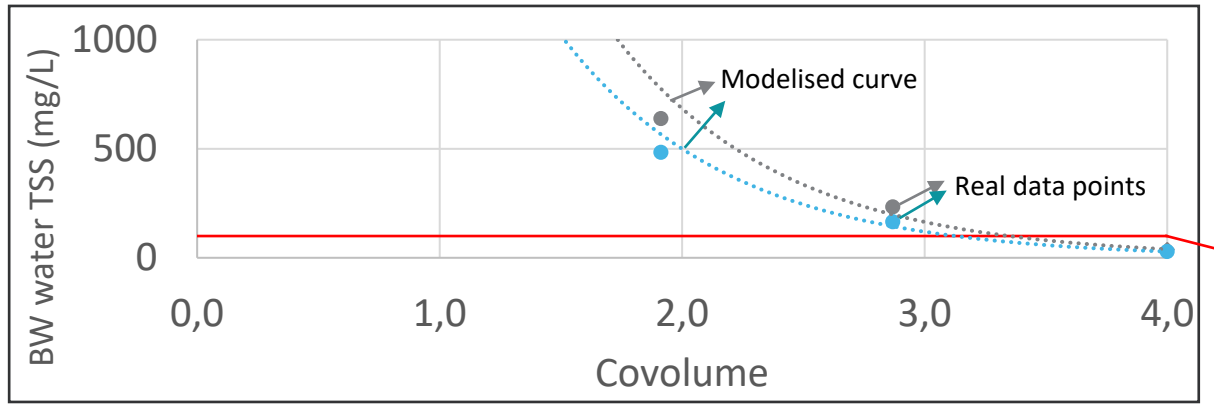
→ > 50% of solids caught by sludge blanket

2. Characterisation of maximum quantity of solids accepted by the SeaDAF Filter media

→ **25 kg for a full cycle at 20 m/h**

3. Characterisation of backwash requirement for loaded seawater (for 2 cycles)

→



Backwash sequence adjusted to **3.5 covolume** to clean media correctly

SEADAF FILTER FIRST REFERENCE

Feedback on technology scale-up

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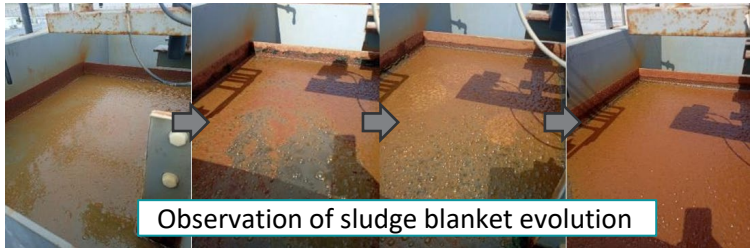
Possibility to adjust product to individual contexts requirement

First semi-industrial scale reference for product

Early confidence from SUEZ through extensive pilot testing & already pre-determined operating condition

Smooth adoption of new technology

Possibility for client to visit demo plant & see the product in operation



Observation of sludge blanket evolution



SEADAF FILTER FIRST REFERENCE

Zoom on SeaDAF Filter installation on Ilollo

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Information will be added later this year

CONCLUSION

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SeaDAF®Filter is a new approach for RO pre-treatment focused on reduction of footprint & reduction of carbon footprint

It ensures similar RO feed quality than conventional pre-treatment with a combined structure at higher filtration velocity

Technology development included a demo plant phase to bridge the gap between piloting and first industrial scale unit

SeaDAF®Filter first reference is planned to be in operation in Ilollo from 2026

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Thank you!

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General