Main Organiser

Outreach Partners

Problem Statement Call
Next Generation Sustainable Water Technologies (Phase 1)
Launch Date: 24 January 2024

Problem Statement 4 : Automated Sampling and Quality Checking of treated waste water
Statement Owner : Private

Background of Current Process & Challenge Statement
Oil processing, e.g. oil refining, consumes much water for operations and produces large volumes of wastewater. The wastewater contains oil in the form of suspended particles and dissolved organic substances. Improperly treated wastewater can result in pollution if it is discharged into the environment.

As more than 90% of the wastewater is water[1], technologies that can treat wastewater efficiently will facilitate sustainability of the limited water resources. Water treatment plants are thus important in the separation[2] and recovery[3]of water. The techniques deployed include distillation, evaporation, active carbon filtration and chemical oxidation. [4] A common method used is Dissolved Air Flotation (DAF). DAF separates waste in wastewaters by dissolving pressurized air and releasing the air at atmospheric pressure in a flotation tank basin[5]. Tiny bubbles are formed which then stick to the suspended waste particles which float to the surface of the water and are skimmed off. The remaining water are then considered as effluent.

Before discharging, the effluent water has to be tested. We are now seeking appropriate technologies that can perform quantitative and qualitative measurement of various toxic substances and be compared with required governmental standards.

Desired Outcomes
As required by the Singapore Environmental Protection and Management Act 1999, any discharge of effluent water has to comply with the Environmental Protection and Management (Trade Effluent) Regulations.

The effluent has to be free of these substances:

- radioactive material;
- pesticide, fungicide, herbicide, insecticide, rodenticide or fumigant;
- refuse, garbage, sawdust, timber, human or animal waste or solid matter;
- petroleum or other inflammable solvent; or
- a substance that either by itself, or in combination or by reaction with other waste or refuse, may give rise to any gas, fume, odour, or substance which is or is likely to be a hazard to human life, a public nuisance, injurious or otherwise objectionable.

[1] . Domingues E, Fernandes E, Gomes J, Castro-Silva S, Martins RC. Advanced oxidation processes at ambient conditions for olive oil extraction industry wastewater degradation. Chemical Engineering Science. 2022;263:118076. DOI: 10.1016/j.ces.2022.118076
[2] Nidheesh PV, Behera B, Babu DS, Scaria J, Kumar MS. Mixed industrial wastewater treatment by the combination of heterogeneous electro-Fenton and electrocoagulation processes. Chemosphere. 2022;290:133348. DOI: 10.1016/j.chemosphere.2021.133348
[3] Ziembowicz S, Kida M. Limitations and future directions of application of the Fenton-like process in micropollutants degradation in water and wastewater treatment: A critical review. Chemosphere. 2022;296:2-8. DOI: 10.1016/j.chemosphere.2022.134041
[4] Sutrisna PD, Kurnia KA, Siagian UWR, Ismadji S, Wenten IG. Membrane fouling and fouling mitigation in oil–water separation: A review. Journal of Environmental Chemical Engineering. 2022;10:107532. DOI: 10.1016/j.jece.2022.107532
[5] https://en.wikipedia.org/wiki/Dissolved_air_flotation

The Allowable limits for trade effluent discharge are as follows:

	Items of Analysis	Watercourse	Controlled Watercourse
	(Units in milligram per litre or otherwise stated)		
1	Temperature of discharge	45°C	45°C
2	Colour	7 Lovibond Units	7 Lovibond Units
3	pH Value	6- 9	6- 9
4	BOD (5 days at 20°C)	50	20
5	COD	100	60
6	Total Suspended Solids	50	30
7	Total Dissolved Solids	-	1000
8	Chloride (as chloride ion)	-	250
9	Sulphate (as SO_4)	-	200
10	Sulphide (as sulphur)	0.2	0.2
11	Cyanide (as CN)	0.1	0.1
12	Detergents (linear alkylate sulphonate as methylene blue active substances)	15	5
13	Grease and Oil	10 (Total) 10 (Hydrocarbons)	1 (Total)
14	Arsenic	0.1	0.01
15	Barium	2	1
16	Tin	-	5
17	Iron (as Fe)	10	1
18	Beryllium	-	0.5
19	Boron	5	0.5
20	Manganese	5	0.5
21	Phenolic Compounds (expressed as phenol)	0.2	Nil
22	*Cadmium	0.1	0.003
23	*Chromium (trivalent and hexavalent)	1	0.05
24	*Copper	0.1	0.1
25	*Lead	0.1	0.1
26	*Mercury	0.05	0.001
27	*Nickel	1	0.1
28	*Selenium	0.5	0.01
29	*Silver	0.1	0.1
30	*Zinc	1	0.5
31	*Metals in Total	1	0.5
32	Chlorine (Free)	1	1
33	Phosphates (as PO_4)	5	2
34	Calcium (as Ca)	-	150
35	Magnesium (as Mg)	-	150
36	Nitrate (as NO_3)	-	20

Main Organiser

Outreach Partners

Problem Statement Call
Next Generation Sustainable Water Technologies (Phase 1)
Launch Date: 24 January 2024

Requirements

1. The system is to be automated.
2. The system is to meet governmental requirements.
3. The system should be cost effective.
4. The system is to consume minimum energy.
5. The system should be at Technology Readiness Level of 6 or higher, that is, the solution has already been tested and verified in a relevant operational environment.

Solution proposal to include

- Process design, technologies and technology providers.
- Detailed scientific principles of the proposed technologies, including detailed comparison with current global state-of-the-art and a brief technology review.
- Detailed consideration of how the unit processes would work together and the impact on individual unit processes when one (or more) of them is (are) optimised for energy.
- Technical details on the methodology, equipment specification, etc.
- Energy consumption details.
- Project team member's expertise, previous related work and experience.
- Timeline for the project, showing intermediate milestones to be achieved.
- Expected research outcomes, and proposed KPIs for the project, including energy consumption and other aspects.
- General business plan: how the Intellectual Property (IP) created will be owned and commercialised, and how this will benefit Singapore.
- Detailed budget required for the project (broken down into individual categories of manpower, equipment, consumables, travel, consultancy services, others).

Pilot scope

- Pilot will be hosted by a major oil storage terminal.
- User is ready to allocate manpower resources, equipment and space for selected provider(s) to pilot and demonstrate technological and business viability.
- Successfully selected technology provider(s) are to install and test systems at the facility.
- Pilot will be over a period of 3 months.

Main Organiser

Outreach Partners

Problem Statement Call

Next Generation Sustainable Water Technologies (Phase 1)

Launch Date: 24 January 2024

Timeline

R2Wi first Water Challenge Call (Closed Door)	NOV 6 13 20 27	DEC 3 10 17 24 31	JAN 7 14 21 28	FEB 4 11 18 25	MAR 3 10 17 24 31	APR 7 14 21 28	MAY 5 12 19 26	JUN 2 9 16 23 30
Preparation for launch of call - Confirmation of statements by users - Sourcing of sponsors - Partner listing - Technology sourcing - emailing of contacts	PREPARATION							
Launch - Online + OnPremise **Submission** - 2.5 months for receipt of proposals **Selection Committee** - Recruit committee members - Announcement of award to be in SIWW			LAUNCH / SUBMISSION					
Selection of technology providers - Joint selection sessions - Negotiation between PS owners and Tech providers					SELECTION			
Award - press release send to SIWW social media - press release send w R2Wi Social media								AWARD