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National Institute of Urban Affairs

FOCUS ON SDG 6.3

By 2030, improve water quality, wastewater treatment & safe reuse.

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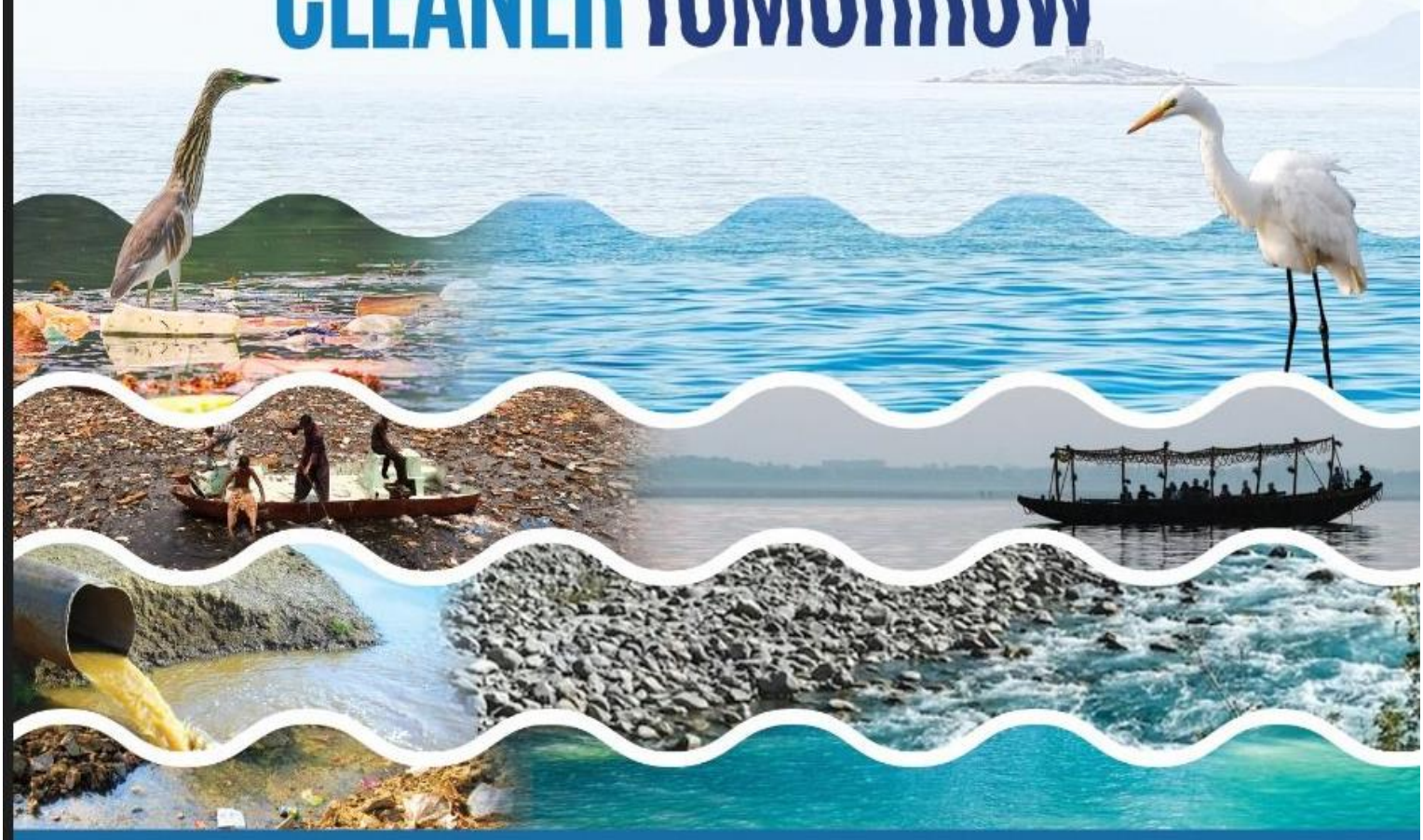
CLEANER WATER CLEANER TOMORROW



Breakthrough in industrial and municipal wastewater treatment

To achieve UN SDG 6.3 and make the National Missions truly successful, we have to make wastewater treatment and management highly resource and energy efficient, much more sustainable, affordable, robust and future ready with augmentation of capacities within existing infrastructure. Thus, it is required to integrate in current systems, novel approaches and advanced technologies which could help achieve these requirements, writes **Dr. Nupur Bahadur**, Senior Fellow & Head, NMCG-TERI Centre of Excellence on Water Reuse, Water Resources Division, TERI.

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Background

UN SDG Target 6.3 sets out to improve ambient water quality, which is essential to protecting both ecosystem health (target 6.6 and SDGs 14 and 15) and human health (recreational waters and drinking water sources, target 6.1), by eliminating, minimising and significantly reducing different streams of pollution into water bodies. The main sources of pollution include wastewater from households, commercial establishments and industries (point sources), as well as run-off from urban and agricultural land (nonpoint sources). Thus, it becomes imperative for Industries and Urban Local Bodies (ULBs) to adequately treat wastewater and reuse. However, the current wastewater treatment faces the following issues, gaps and challenges:

(i) use of a large amount and large number of chemicals, which leads to secondary problems associated with toxic sludge generation, disposal and management, (ii) almost all kinds of effluents are treated with a similar approach, without understanding the matrix, composition and requirement of treatment, (iii) high dependence on biological treatment systems, which involves large footprint, prone to shock loads and inadequate treatment especially in case of industrial effluent treatment, (iv) inadequately treated coloured water when goes as the feed to tertiary systems, involving RO/MEE/MVR etc. leads to choking and biofouling of membranes and create associated problems leading to higher CAPEX and OPEX and make the overall wastewater treatment and management highly unsustainable, unacceptable, unaffordable and non-compliant.

Further, in the National Missions like the 'Namami Gange', the primary requirement is to curb the point source pollution across the ETPs and STPs, so that the objectives of 'Nirmal Dhara' (unpolluted flow) is achieved. The missions like SBM 2.0 and AMRUT 2.0 require the stringent treated water quality for reuse to be having COD<30 mg/L and BOD<5 mg/L, which our existing wastewater treatment technologies fail to achieve. Large industrial houses could afford tertiary treatment systems to achieve Zero Liquid Discharge (ZLD) compliance from CPCB, Government of India, whereas the MSME sector is left with limited choice of discharging the inadequately treated coloured water to drains and to natural water bodies.

Thus, in order to support and make the UN SDG 6.3 and these National Missions truly successful, we have to help all sectors of industries to be water secure and compliant, and provide safe and secure water and sanitation to rural and urban areas. We have to make wastewater treatment and

management highly resource and energy efficient, much more sustainable, affordable, robust and future ready with augmentation of capacities within existing infrastructure. Thus, it is required to integrate in current systems, novel approaches and advanced technologies which could help in addressing these gaps and challenges.

TERI's TADOX® technology

It is in this pursuit, The Energy and Resources Institute (TERI), New Delhi, has developed a novel technology called TERI Advanced Oxidation Technology (TADOX®), which provides treatment of wastewater stream containing high colour, COD, BOD, TOC, dissolved organics, micropollutants, non-biodegradable and persistent organic pollutants (POPs) in effluents from grossly polluting industries and municipal wastewater. TADOX® is under TERI's Patent (grant awaited) and also under various categories of trademark with the Trademark Office, Government of India. TADOX® involves UV-Photocatalysis as

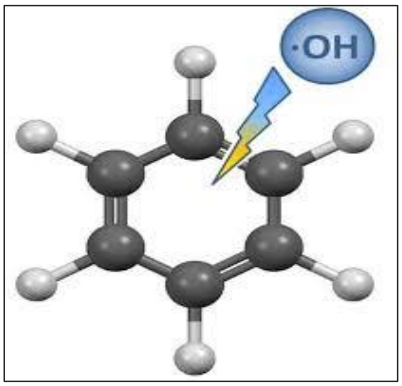


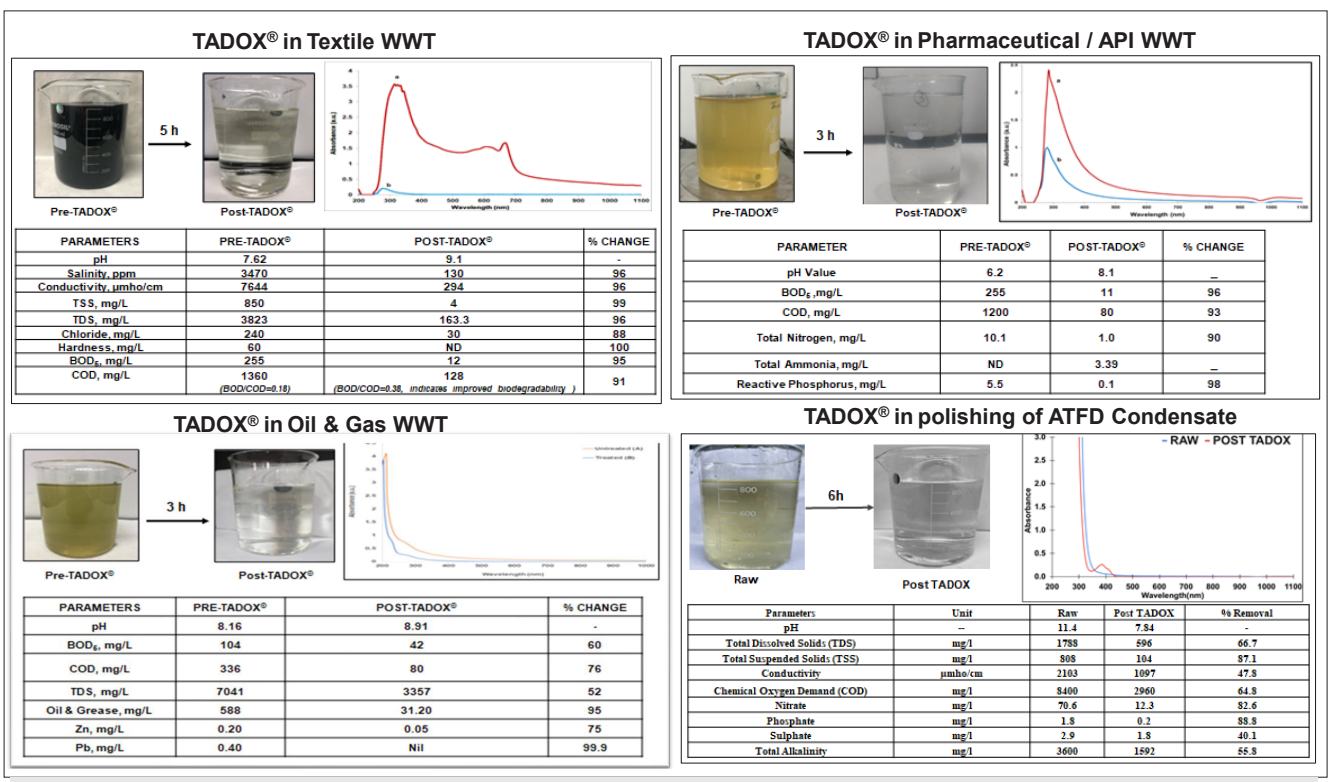
Fig. 1. Breaking of bonds of pollutant molecule by UV induced hydroxyl radicles

an Advanced Oxidation Nanotechnology (AON), leading to oxidative degradation and mineralisation of targeted pollutants. Also, it involves novel approaches which make very less use of chemicals in the overall treatment leading to much reduced quantum of sludge, preventing secondary pollution and providing highly resource and energy efficient treatment.

This technology has been developed under DST Water Mission, Water Technology Initiative (WTI), Program of Ministry of Science & Technology, Government of India, during July 2017-2020 and the outcomes have been announced through its press release on 25th August, 2021: https://pib.gov.in/PressReleasePage.aspx?PRID=1748888

TADOX® technology for industrial wastewater treatment

Figure 2 depicts successful case studies in Industrial Wastewater Treatment in different sectors and how it could be retrofitted at different stages of treatment as per the need. The TADOX® treated colourless and high-quality water going to subsequent tertiary system involving RO may prevent biofouling of membranes, enhance life span and efficiency of RO systems and reduce overall load on subsequent evaporators like MEE and MVR etc., enabling sustainable and affordable ZLD compliance with 85-90 per cent enhanced water reusability. Further, having small footprint, few hours treatment time and together with resource & energy efficiency, the overall treatment is



PARAMETERS	PRE-TADOX®	POST-TADOX®	% CHANGE
pH	7.62	9.1	-
Salinity, ppm	3470	130	96
Conductivity, µmho/cm	7644	294	96
TSS, mg/L	850	4	99
TDS, mg/L	3823	163.3	96
Chloride, mg/L	240	30	88
Hardness, mg/L	60	ND	100
BOD_6, mg/L	255	12	95
COD, mg/L	1360 (BOD/COD=0.18)	128 (BOD/COD=0.38, indicates improved biodegradability)	91

PARAMETER	PRE-TADOX®	POST-TADOX®	% CHANGE
pH Value	6.2	8.1	_
BOD_6, mg/L	255	11	96
COD, mg/L	1200	80	93
Total Nitrogen, mg/L	10.1	1.0	90
Total Ammonia, mg/L	ND	3.39	_
Reactive Phosphorus, mg/L	5.5	0.1	98

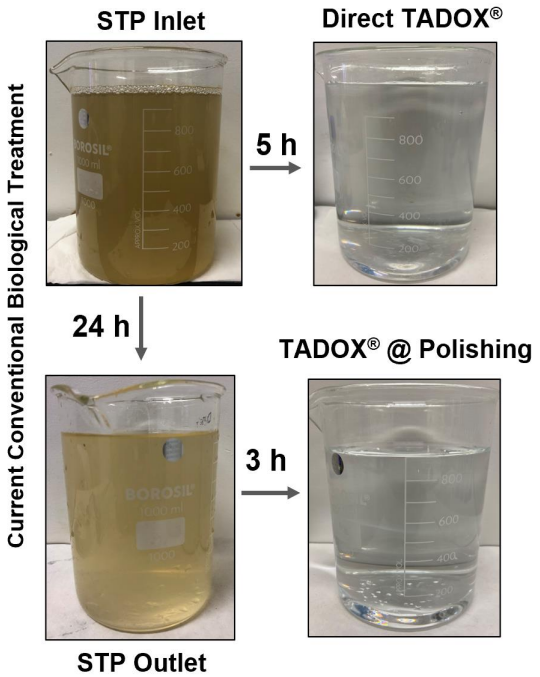
PARAMETERS	PRE-TADOX®	POST-TADOX®	% CHANGE
pH	8.16	8.91	-
BOD_6, mg/L	104	42	60
COD, mg/L	336	80	76
TDS, mg/L	7041	3357	52
Oil & Grease, mg/L	588	31.20	95
Zn, mg/L	0.20	0.05	75
Pb, mg/L	0.40	Nil	99.9

Parameters	Unit	Raw	Post TADOX	% Removal
pH	-	11.4	7.84	-
Total Dissolved Solids (TDS)	mg/l	1788	596	66.7
Total Suspended Solids (TSS)	mg/l	808	104	87.1
Conductivity	µmho/cm	2103	1097	47.8
Chemical Oxygen Demand (COD)	mg/l	8400	2960	64.8
Nitrate	mg/l	70.6	12.3	82.6
Phosphate	mg/l	1.8	0.2	88.8
Sulphate	mg/l	2.9	1.8	40.1
Total Alkalinity	mg/l	3600	1592	55.8

Fig. 2. TADOX® Treatment of Industrial Wastewater

STP INLET	
pH	7.9
Colour, (Pt- Co) (CU)	185
COD, mg/L	650
BOD, mg/L	261
TSS, mg/L	380
Total N, mg/L	32.0
Total P, mg/L	81.2
E. coli, MPN/100 ml	1.02 x 10^5
Total Coliform bacteria, MPN/100 ml	6.12 x 10^6
Total count, CFU/100 ml	5.24 x 10^5

STP OUTLET	
pH	8.2
Colour, (Pt- Co) (CU)	125
COD, mg/L	400
BOD, mg/L	78
TSS, mg/L	110
Total N, mg/L	30
Total P, mg/L	13
E. coli, MPN/100 ml	1.21 x 10^4
Total Coliform bacteria, MPN/100 ml	1.13 x 10^5
Total count, CFU/100 ml	1.84 x 10^4



DIRECT END-TO-END TADOX®	
pH	8.0
Colour, (Pt- Co) (CU)	8
COD, mg/L	64
BOD, mg/L	7
TSS, mg/L	<5
Total N, mg/L	1.9
Total P, mg/L	<1
E. coli, MPN/100 ml	16
Total Coliform bacteria, MPN/100 ml	1.16 x 10^2
Total count, CFU/100 ml	28

TADOX® AT POLISHING STAGE	
pH	8.1
Colour, (Pt- Co) (CU)	5
COD, mg/L	46
BOD, mg/L	<3
TSS, mg/L	<5
Total N, mg/L	1.7
Total P, mg/L	<1
E. coli, MPN/100 ml	<8
Total Coliform bacteria, MPN/100 ml	3.13x 10^2
Total count, CFU/100 ml	11

Fig. 3 - TADOX® Treatment of Sewage

expected to bring down OPEX by 30-40 per cent than current values. Further, TADOX® could be integrated and retrofittable in existing treatment systems depending on the nature and constitution of the matrix; e.g. for streams having high COD, it could be integrated at pre-biological stage to enhance biodegradability; for streams having high BOD, at post-biological or polishing stage to remove recalcitrant and dissolved organics.

TADOX® technology in sewage and municipal wastewater treatment

Case study

Following is the case study of treatment of raw STP Wastewater from the 10 KLD TADOX® WWT Plant, operational in TERI Gurugram campus. This plant is treating wastewater coming directly from a collection sump, having wastewater from various research laboratories, hostels, canteens, laundry, toilets, etc. No stream segregation of any kind is required and two approaches could be there (i) directly treating the Inlet water and (ii) further treating or polishing the currently treated outlet. Since in both cases, the quality of treated water is the same, therefore, direct treatment is best as it saves the time, resources and footprint as compared to existing treatment technologies.

Way forward

In case of Sewage and Municipal wastewater treatment, TADOX® having Advanced Oxidation is sufficient for direct treatment, without any kind of biological treatment or additional disinfection technology, not even requiring any kind of grey and black water stream segregation. With total treatment time of 4-5 h, together with point of use water quality, which makes it an excellent choice in improving current efficiencies in wastewater treatment together offering augmentation of capacity within existing infrastructure. Also it could serve as Decentralized Wastewater Treatment system and micro-STP in upcoming and existing infrastructural projects, townships, commercial complexes, Green Buildings, AMRUT and Smart Cities Project. Also under SBM 2.0, where the requirement is to enhance treated water reuse, this technology could be used at the polishing stage of the current STPs.

Currently the technology is at TRL-7 and ready for commercialization and invites participation of Industry and Governmentto adopt and deploy technology at field scale. It holds great potential for point source pollution abatement across ETP and STPs and thus preventing Industrial effluent and sewage being discharged to open drains and pollute riverine ecosystem.

Innovation is the key to achieving SDGs and the technological interventions like TADOX®isparticularly required to meet the SDG 6.3.

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