VA TECH WABAG

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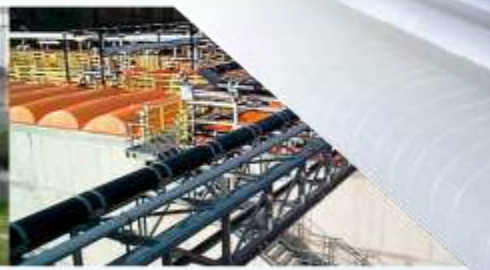
CONFERENCE • EXPO • AWARDS
SOx NOx
22 & 23 December 2016
2016

WATER REUSE AND RECYCLE IN POWER SECTOR



Manjay Kumar Verma
Manager- Global Business Development

History of WABAG

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PROUD OF
OUR 90 YEARS HISTORY

The water technology sectors of
VA TECH (Austria),
SULZER (Switzerland) and
BABCOCK (Germany)

were combined to form one group of companies:

2010	VA TECH WABAG Ltd. **goes public** (NSE, Mumbai)
2007	Reunification: WABAG India takes over WABAG Austria Group from SIEMENS
09/2005	Sale of WABAG India: Management buyout backed by ICICI Venture
07/2005	Acquisition of VA TECH by Siemens - WABAG becomes part of the Siemens Group
1999	Acquisition of WABAG from Deutsche Babcock by VA TECH, Austria
1996	**Foundation** of VA TECH WABAG Ltd., Chennai, India
1986	Completion of the **3-stage acquisition** of WABAG by Deutsche Babcock
1930	Initiation of water technology activities by J. **Overhoff**, Austria
1924	Foundation of WABAG Wasserfilterbau in Wroclaw
1868	Foundation of J. Overhoff, Austria

Global Presence

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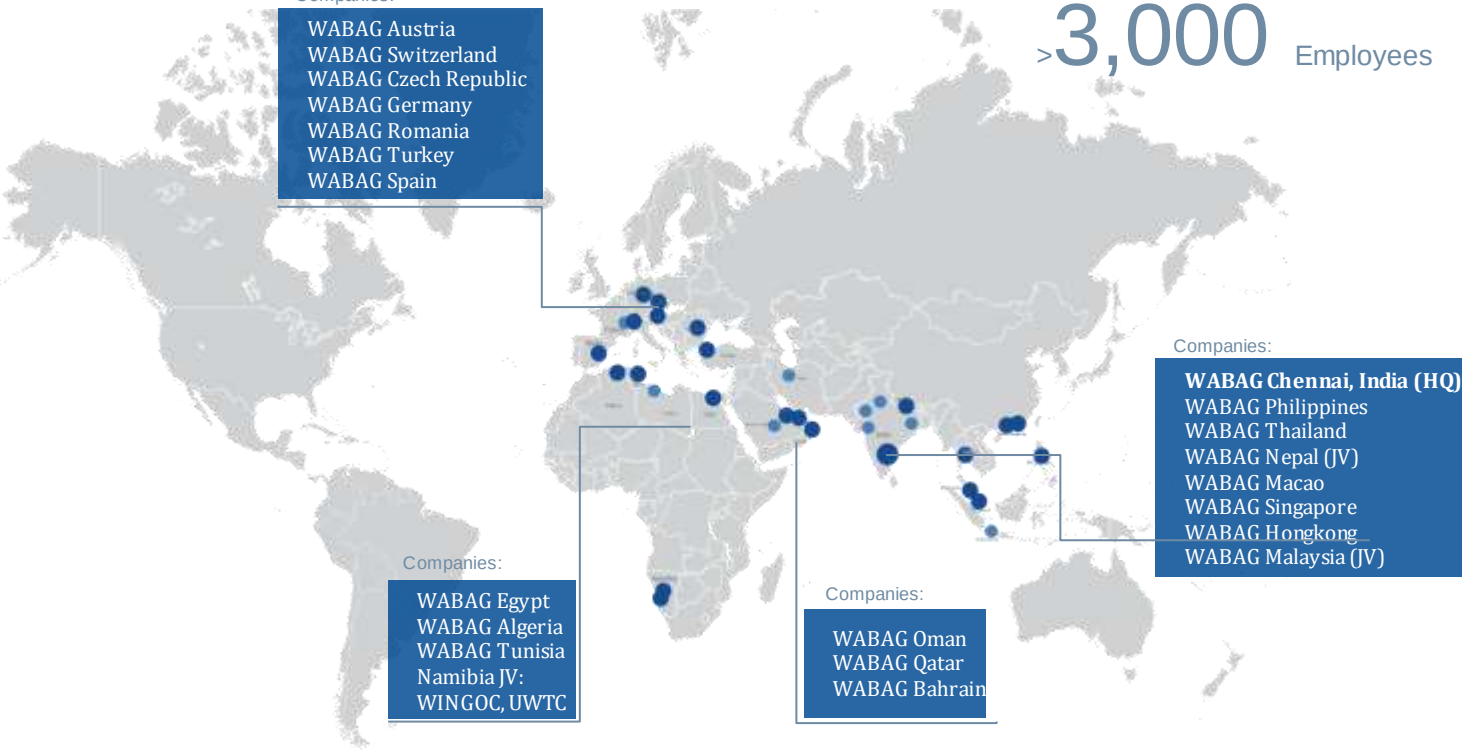
4 Continents

30 Countries

>22 Companies & Offices

>3,000 Employees



Complete Water Treatment Solution Provider

- ✓ Provides a complete range of Water and Waste Water Treatment solutions – **90+ years**
- ✓ R&D centers located in India, Austria and Switzerland - **Technology focused company** — **100+ Patents**
- ✓ More than 2300 projects in last 3 decades – **Municipal & Industrial Clients** — **Strong Execution Record**
- ✓ Promoted by Professionals & Four out of Five Directors are Independent - **Corporate Governance** — **Professional**
- ✓ Globally operating & maintaining around 100 Water, Wastewater & Desal plants – **Project Lifecycle Partner** — **Asset light**

Prevailing Water Crisis

THE ECONOMIC TIMES

By *Debjoy Sengupta*, ET Bureau | Updated: Jun 09, 2016, 03.26 PM IST

Water scarcity cost power firms Rs 2,400 crore revenue loss

Water shortages have led to coal power plant shut downs in West Bengal, Karnataka and Maharashtra. NTPC, Adani Power, GMR, Mahagenco and Karnataka Power Corporation are among the companies affected.

Most of the losses have occurred between March and May, when plants have been unable to run due to a lack of water for cooling.

Repeated shutdowns at NTPC's Farakka plant between February and April resulted in lost generation of over 1 billion units of electricity, translating into lost revenue of Rs. 390 crore claimed Greenpeace.

The CEA's April quarterly report shows 72GW of thermal power projects are under construction India's energy projections made in advance of the Paris climate summit in December 2015 indicate another 300 GW of thermal power proposed by 2030.

The Greenpeace analysis is based on daily outage reports from the Central Electricity Authority (CEA), and Right to Information replies from National Thermal Power Corporation (NTPC).

Government Notification for Recycle

रजिस्ट्री सं० डी० एल०-33004/99 REGD. NO. D. L.-33004/99

भारत का राजपत्र
The Gazette of India

Sr. No.	Industry	Parameter	Standards
1	2	3	4
"5A.	Thermal Power Plant (Water consumption limit)	Water consumption	I. All plants with Once Through Cooling (OTC) shall install Cooling Tower (CT) and achieve specific water consumption upto maximum of 3.5m^3/MWh within a period of two years from the date of publication of this notification. II. All existing CT-based plants reduce specific water consumption upto maximum of 3.5m^3/MWh within a period of two years from the date of publication of this notification. III. New plants to be installed after 1st January, 2017 shall have to meet specific water consumption upto maximum of 2.5 m^3/MWh and achieve zero waste water discharged";

WATER CONSUMPTION IN POWER PLANT

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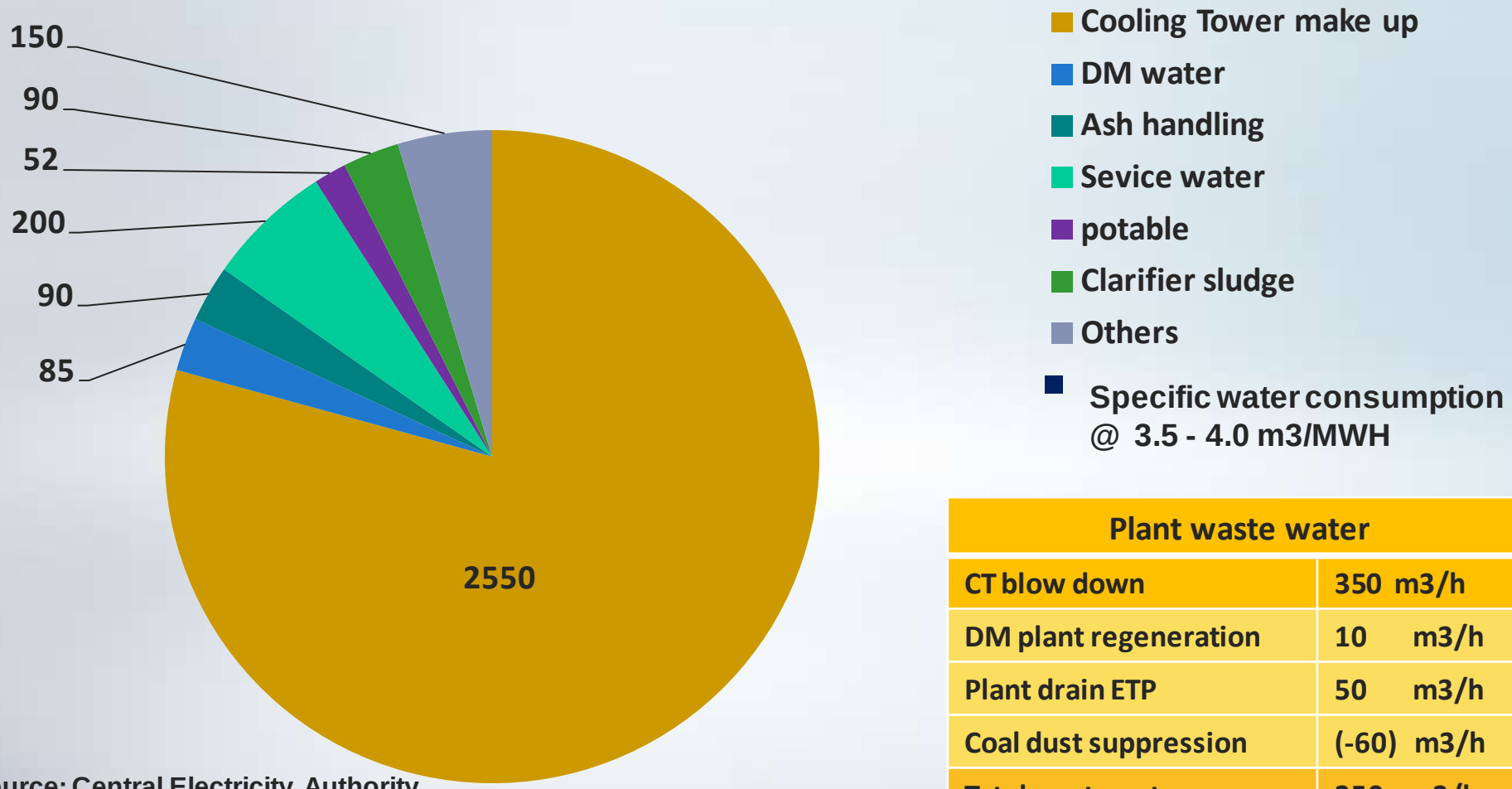
Water Consumption m3/h in 2x500 MW Thermal Power Plant

Total water average requirement: 3000-3500 m3/h



Source: Central Electricity Authority

Plant waste water	
CT blow down	350 m3/h
DM plant regeneration	10 m3/h
Plant drain ETP	50 m3/h
Coal dust suppression	(-60) m3/h
Total wastewater	350 m3/h

Water recycle in power plant

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We turn industrial and/or municipal wastewater into:

Industrial water

- Cooling water
- Boiler feed water
- Process water
- Firefighting water
- Utility water

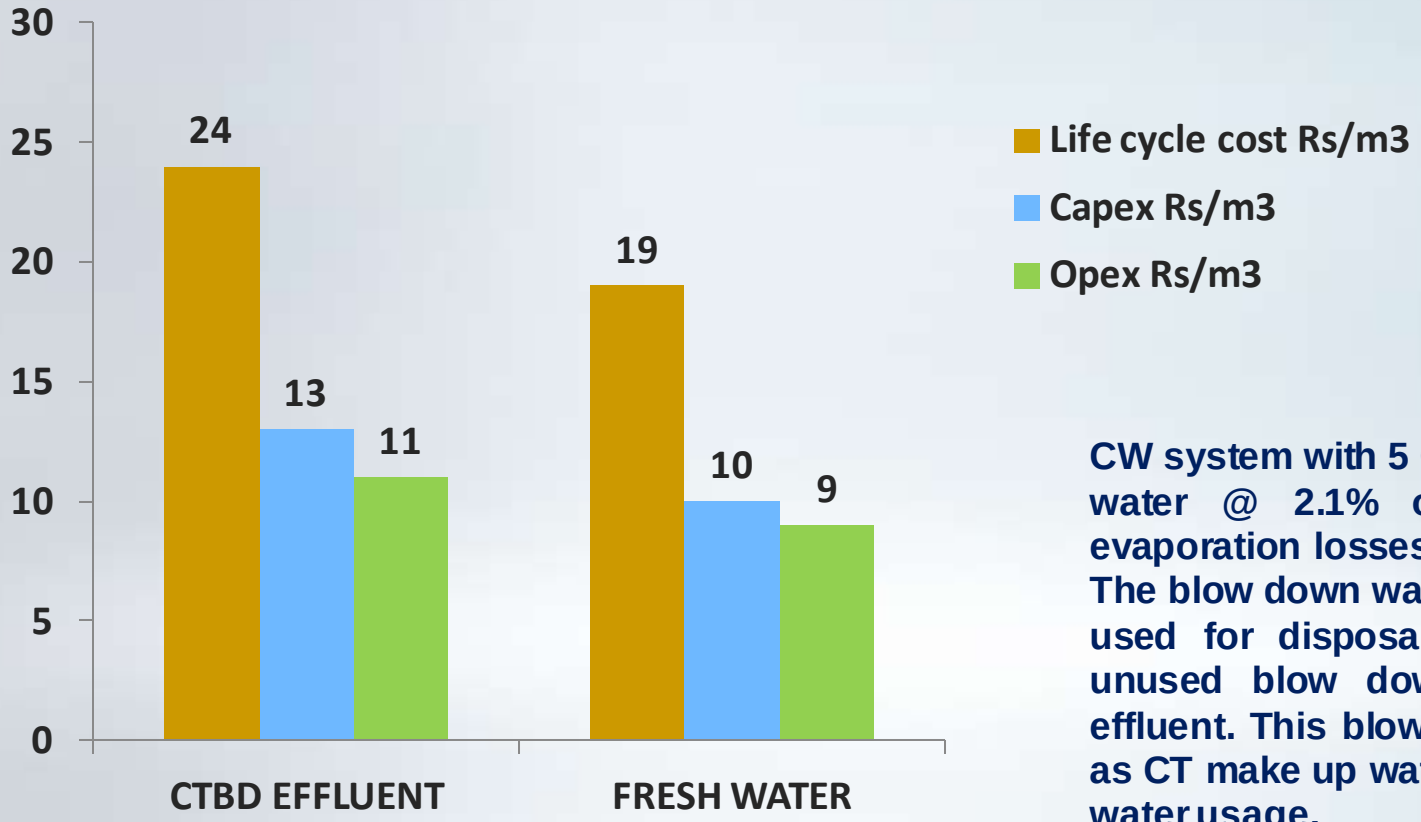
Benefits

for industry and environment

- Independent & secure water supply
- Consistent water quality
- Reduced fresh water consumption
- Fast Return on Investment
- Cut in used water volumes and charges
- Sustainability by employment of green technologies
- A contribution to socio-economic development
- Protecting natural fresh water resources.

Water recycle economics for power plant

Cooling Tower Blow Down Effluent Reuse



CW system with 5 COC requires make up water @ 2.1% of CW flow due to evaporation losses, drift and blow down. The blow down water is considered to be used for disposal of bottom ash and unused blow down is discharged as effluent. This blow down may be reused as CT make up water as it will save fresh water usage.

The fresh water which comes from public water supply source requires treatment. The cost of CT make up water produced from fresh raw water excludes the cost incurred for fresh water.

INDUSTRIAL WATER TREATMENT
Tailor made solutions

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Cooling water

- Depending on the raw water source – surface or ground water or treated wastewater – employment of one- or multi-stage systems:
- e.g. Screening and Filtration up to Reverse Osmosis.

Boiler feed water

- **Demineralisation** plants using various raw water sources for industrial companies (refineries, paper industry, power plants, etc.)
- Technologies employed:
  Reverse Osmosis,
  Ion Exchange,
  Electrochlorination,
  Cartridge filter,
  Activated Carbon Filter, etc.

Process and ultrapure water

- According to high quality requirements, multi-stage and high-performance technologies are employed as a rule:
- Membrane processes
  (UF, MF, NF, RO, EDR),
  Distillation,
  Ion Exchange
  Disinfection

Closing of water cycles

- **Water recycling and reuse** with conventional and advanced treatment processes. Reclamation of treated industrial and municipal wastewater. Providing up to 100% water recovery.
- Tailor made solutions for the production of service water, cooling water, boiler feed or process water.

Aerobic & Anaerobic treatment

- Aerobic treatment: Activated sludge process or the FLUOPUR®-system.
- Anaerobic treatment with conventional treatment systems or space-saving high performance reactors.

MICROPUR® Advanced mechanical pre-treatment

Fine sieving process for conventional WWTPs:
MICROPUR-CAS®

MBR plants:
MICROPUR-MBR®

MARAPUR® Membrane bioreactor

Membrane filtration (UF, MF, RO)

- For strict treatment requirements, e.g. water recycling and reuse.

BIOZONE® Advanced biological treatment using ozone

The BIOZONE® process for advanced treatment of used water with high percentage of persistent organic compounds.

Comprehensive Water and Wastewater treatment for a RINL Power Plant in Vizag

- Turnkey contract for Plant Water System and Balance of Plant including a wastewater treatment plant as part of the expansion of the Rashtriya Ispat Nigam Limited power plant in Vizag, India.
- The Project consists of cooling towers, a pumping station, ultrafiltration, reverse osmosis, demineralisation and a wastewater treatment plant.
- Highlight being the downstream ultrafiltration and reverse osmosis systems, facilitates efficient water recycling.
- The **reclaimed water** is to be **re-used** as **make-up water** for **cooling tower**.

Key Data

Location: Vizag Steel Plant Vishakhapatnam, A.P. **Capacity:** 4,900 m^3/d **Start-up:** 2012

CASE STUDY 2:
Industrial Wastewater Recycling

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IOCL Panipat Refinery - Recycling

Membrane Filtration

First Indian refinery wastewater recycling system based on membrane technology: Clarification, Filtration, Ultrafiltration, Reverse Osmosis and Demineralisation. Recycling for reuse as boiler feed water.

Key Data

Location: Panipat, Haryana, India

Capacity: 21,600 m^3/d

Start-up: 2006

IOCL Panipat Outlet Parameters

Parameter	Input to TTP	Outlet of TTP
pH	6.0-8.5	7-7.6
Turbidity in NTU	50	NIL
TDS in ppm	1786	0.4
TSS in mg/l	30	NA
B.O.D	<10	NIL
C.O.D	<150	NIL
Oil & Grease	10	NIL

Source: IOCL Panipat TTP/RO

WATER RECLAMATION
Reference examples - Industry

27 water reclamation plants completed since 1995.
For various industrial applications.

>400,000 m^3 water/day

Windhoek, Namibia, Industrial Park, 5,175 m^3/d

- Water Reclamation Plant for the Industrial Park Ujams
- MICROPUR®-Fine sieving process & MARAPUR® – Membrane Bioreactor technology and disinfection
- BOOT, Start-up: 2014

Dahej, Gujarat, India 36,000 m^3/d

- Effluent treatment and recycling plant for Dahej Manufacturing Division – treating PTA wastewater
- UASB, MBR, UF & RO.
- Reuse as utility water
- Start-up: 2014

WABAG's
Proven Track Record

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PLANT WATER SYSTEM
1 x 300 MW Durgapur Projects Limited, WB

- Intake Water Pumping
- Raw Water Piping
- Raw Water Treatment
- Cooling Water Make-up
- CTBD system
- DM Plant
- Waste Water Recycle Plant

PLANT WATER SYSTEM
600 MW Rayalseema & 600 MW Kakatiya TPP,AP

- Clarification & Filtration
- DM-UF with Mixed Bed Polisher
- CW & ACW System
- Circulating Water System
- Condensate Polishhing Unit
- Wastewate recycle plant

IOCL, India
DM plant for refinery
21,600 m³/d

500 MW Chhatissgarh Power Generation Company Ltd., Korba, Chattisgarh

DM & High Pressure CPU
2X800 MW Krishnapatnam TPP, AP

Adani , India
RO process water 20,000 m³/d

Government Notification for Reuse

sustainable solutions. for a better life. WABAG

रजिस्ट्री सं० डी० एल०-33004/99 REGD. NO. D. L.-33004/99

भारत का राजपत्र
The Gazette of India

असाधारण
EXTRAORDINARY
भाग I—खण्ड 1
PART I—Section 1
प्राधिकार से प्रकाशित
PUBLISHED BY AUTHORITY

सं. 39] नई दिल्ली, बृहस्पतिवार, जनवरी 28, 2016/माघ 8, 1937
No. 39] NEW DELHI, THURSDAY, JANUARY 28, 2016/MAGHA 8, 1937

The thermal power plant(s) including the existing plants located within 50 km radius of sewage treatment plant of Municipality/local bodies/similar organization shall in the order of their closeness to the sewage treatment plant, mandatorily use treated sewage water produced by these bodies and the associated cost on this account be allowed as a pass through in the tariff. Such thermal plants may also ensure back-up source of water to meet their requirement in the event of shortage of supply by the sewage treatment plant. The associated cost on this account shall be factored into the fixed cost so as not to disturb the merit order of such thermal plant. The shutdown of the sewage treatment plant will be taken in consultation with the developer of the power plant.

Present Scenario: NTPC's Stand

THE ECONOMIC TIMES

Companies opt for conservation, buy treated water from municipal corporations

By *Madhvi Sally* & *Rachita Prasad*, ET Bureau | Updated: Aug 19, 2016, 01.55 AM IST

"Indian Oil Corporation will be buying treated water from Mathura's sewage treatment plant," said Uma Bharti, minister of water resources, river development and Ganga rejuvenation. "Further, along the Ganga river, a number of NTPC power plants will also be using treated water," she said.

"Private companies say there is a market for treated water and they are ready to use it. To begin with we are working with public sector undertaking and simultaneously others will join," she said. Power minister Piyush Goyal has been actively promoting reuse of treated water in power plants, she added. Company officials of NTPC said the company was in talks with the respective municipal bodies regarding use of treated sewage for its stations in Maharashtra (Solapur and Mouda), Uttar Pradesh (Meja and Dadri), Gujarat (Kawas), Haryana (Faridabad), and Jharkhand (Patratu).

RENOVATION & MODERNIZATION OF SEWAGE TREATMENT PLANT & REVERSE OSMOSIS PLANT

Client : NTPC
Location: NTPC Badarpur Thermal Power Station (3x95 MW + 2x210 MW)
Start Up: 2014
Capacity: 2500 m3/d.

Description:

- Process water for power plant
- Feeding existing DM plant for the production of boiler feed water.
- River water polluted with municipal and industrial wastewater.
- Membrane bioreactor (MBR) & Reverse Osmosis Technology

Chennai Petroleum Corporation Limited

Project Brief

Sewage Recycle plant , Chennai, India

Transforming wastewater into a valuable production factor.

Capacity : 11,400 m3/d

Contract model: DBO

Plant commissioned: 2007

Treated sewage from Kodungaiyur WWTP is used as raw water in reclamation plant which employs advance technologies including membrane processes for converting treated sewage into high quality industrial water for use in CPCL refinery process.

Earlier Challenges:

- Water scarcity
- High water cost
- Pollution and environmental issues.

Solutions offered

The treated sewage from Kodungaiyur (Chennai) sewage treatment plant is used as raw water and is further treated in tertiary treatment units employing advanced membrane technologies to convert it into high quality industrial water.

This has provided the industry an alternative source of water ensuring secured water supply.

This project provides unique features in terms of maintaining ecological balance, and reuse of wastewater.

Chennai Petroleum Corporation Limited

Benefits:

- Recycle and reuse provide alternative source of water and Increases security of water supply in water scarce cities.
- Independence from rainfall and droughts.
- Keeping cities clean and green.
- Significant reduction in life cycle cost of product water
- Maintain *ecological balance*
- Revenue generation out of sale of water.

Delivery Model:

WABAG was responsible for turnkey execution of project on Design, Build, Operate (DBO) model including long term operation and maintenance contract.

CAPEX / OPEX

Life cycle cost

Cost of product water: Rs 25/m3

The life cycle cost of industrial water produced from treated sewage is cheaper than the cost of water produced from sea water desalination. Therefore, sewage reclamation project implementation was a commercial decision for CPCL. This reference shall provide encouragement to many such water scarce cities.

Financing / Funding mechanism:

The project is funded by Chennai Petroleum Coprporation Limited as a part of their expansion plan.

Waste to Energy – Step towards Power Neutrality

How do we get from…

TO

WASTE to ENERGY

Usage & Drivers of Alternate source of Energy

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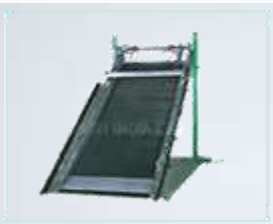
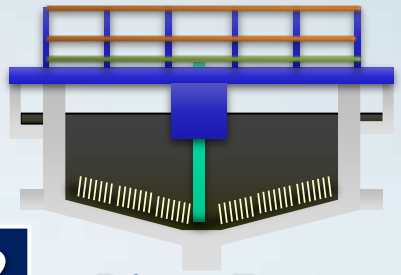
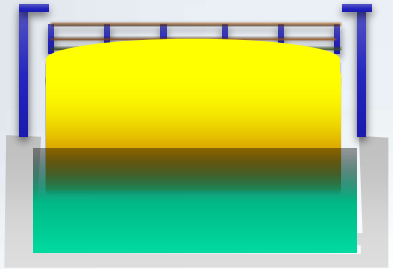


1 Collection & Preliminary

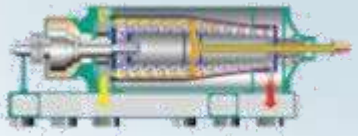


2 Primary Treatment

A Secondary and Disposal



3 Anaerobic Sludge Digestion & Gas Generation

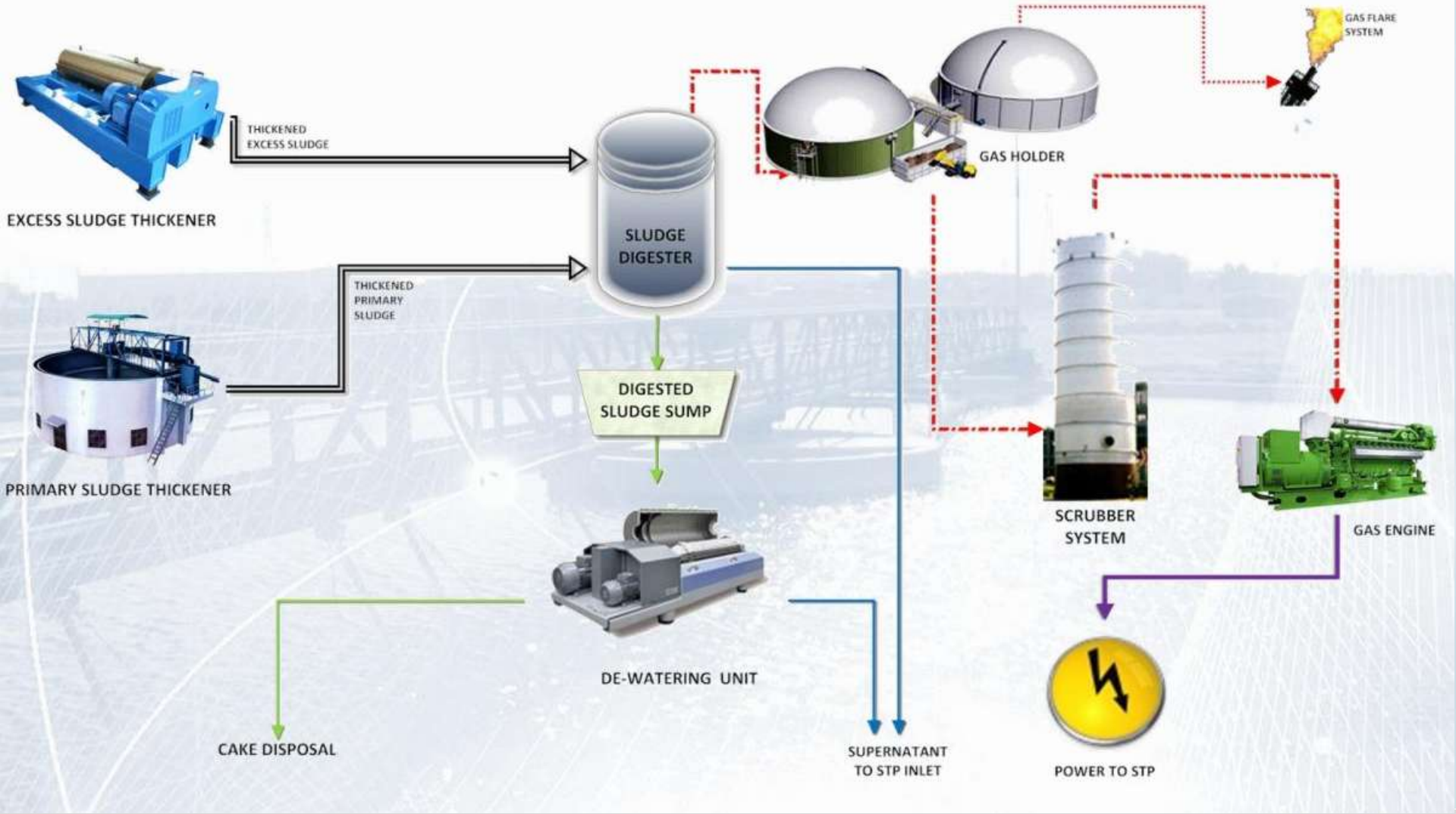


B Dewatering

4 H_2S Scrubber

5 Power Generation by Gas Engine

Bio-Gas Handling System



Consistently Self Sustainable Assets

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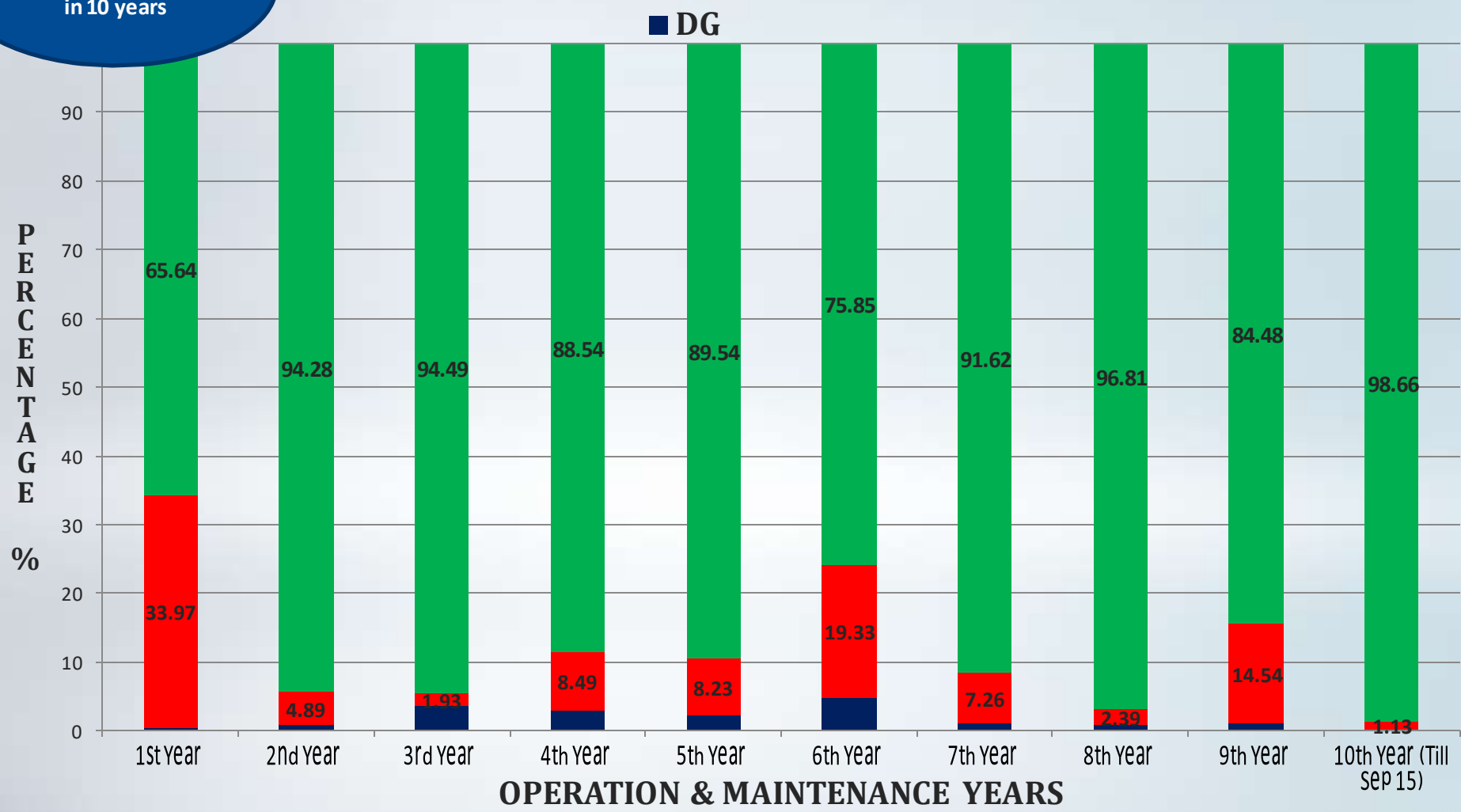
88% Average Green Energy contribution in 10 years



Some of Wabag's REFERENCES

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Comprehensive technical and economic know-how of WABAG guarantee efficient project realisation.

Project	Capacity	Power Capacity Installed	Start-up
K& C Valley, Bangalore	60 MLD	1063 kVA	2016
Pappankalan, Delhi	91 MLD	1063 kVA	2015
Kondli, Delhi	204 MGD	2126 kVA	2014
Tehran, Iran	450 MLD	5000 kVA	2009
Delawas, Jaipur, Phase I / II	60 MLD	625 kVA	2008 / 2010
Xiaohongmen, Beijing, China	600 MLD	2000 kVA	2008
Perungudi, Chennai	54 MLD	1063 kVA	2006
Kodungaiyur, Chennai	110 MLD	1063 kVA	2006
Adana East & West, Turkey	400 MLD	1500 kVA	2003 / 2006
Kayseri, Turkey	110 MLD	2000 kVA	2004

XIAOHONGMEN, CHINA

KAYSERI, Turkey, 110 MLD

KODUNGAIYUR, Chennai, 110 MLD

ADANA, Turkey, 355 MLD

DELAWAS, Jaipur, 62.5 MLD

Successful Installations in India

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Kondli STP

- The plant, situated in Delhi, is based on Activated sludge process with a treatment capacity of 205 MLD.
- Installed Bio-Gas Engine capacity of 1064 kVA
- Power generated from Bio-Gas Engine : 23.925 MW/day

Kodungaiyur STP

- The plant, situated in Chennai, is based on Activated sludge process with a treatment capacity of 110 MLD.
- Installed Bio-Gas Engine capacity of 1064 kVA
- Actual Power Generated: 13 MW/day
- The O & M cost is reduced by 80% due to savings in electricity cost

Perungudi STP

- The plant, situated in Chennai, is based on Activated sludge process with a treatment capacity of 54 MLD.
- Installed power generation capacity of gas engine is 1064 kVA
- Actual Power Generated : 9 MW/day

Successful Installations in India (Contd…)

Tehran STP, Iran

- Largest such installation in Iran with capacity of 450 MLD Plant based on Activated Sludge Process with BNR removal
- Plant has 4 Co-generation units each of capacity 1.25MW
- Around 80% of the plant's electricity needs is met through the use of biogas, which is produced in 6 digester towers (each of 9,000 m^3)

62.5 MLD Jaipur Delawas Unit II STP

- The plant is based on Activated sludge process
- Digested Sludge is used in production of Compressed Natural Gas
- Bio-Gas generation rate : 2,747 m^3/day
- Digested Sludge is Dewatered with centrifuges and finally used as organic manure

Keshopur STP

- The plant, situated in Delhi, is based on Activated sludge process with treatment capacities of 54.48 MLD
- Average Bio-Gas generated – 986.42 Kg/day

Successful Installations in India (Contd…)

90 MLD Pappankalan STP, Delhi

- Activated Sludge process based treatment; includes primary and secondary treatment along with BNR removal
- Sludge treatment facility includes Anaerobic Sludge Digesters and Bio-Gas Engine
- Digested Sludge is fed in composting plant; end product from which is organic manure

600 MLD Xiaohongmen WWTP, Beijing

- Main process includes primary and secondary treatment of sewage along with power generation.
- Energy Production from plant : 67,000 Kwh/day
- Around 10% of the total energy produced is required for anaerobic sludge stabilization, hence approx. 60,000 kWh/d is used for sewage treatment plant operation

XIAOHONGMEN, CHINA

Similar Projects (presently under construction)

PETRONAS RAPID Project, Malaysia

- Total 9 Effluent treatment units with combined treated marine outfall of 5050 m^3/hr located in Malaysia
- Plant is presently under construction and is scheduled to be commissioned by 2018
- Mainly three sludge treatment units
  - Oily Sludge Treatment Unit
  - Bio Sludge Treatment Unit
  - Sanitary Sludge Treatment Unit
- Activated Sludge Process based thickeners receive 16.2 m^3/hr of sludge
- 90% sludge dewatering is proposed with centrifuges and low temperature belt type dryers
- Resulting dry solids are proposed to be 90% dry with 10% moisture content.

Al Madina Al Shamaliya STP

- 40 MLD plant located in Bahrain, currently under construction
- Activated Sludge Process based treatment system
- Includes extended aeration along with BNR removal
- Sludge Management facility includes
  - Aerobic Sludge Digesters
  - Sludge Dewatering System comprising of Belt Thickener, Belt Filter Press and Belt Type Thermal Dryer
- 90% dewatering is proposed and dry solids bagging will take place.

ISTANBUL CIty – Used Water Management, Turkey

O&M for 16 million population Mega-City on two continents.

- Used water management of the **Asian and European** districts of Istanbul. In total 124 units, managing more than 5,000,000 m³ used water every day.
- WABAG Turkey has been operating the plants with a local O&M team of around 700 since September 1, 2014.
- 3 large-scale mechanical/biological WWTPs equipped with anaerobic sludge digestion and power generation treat the bulk of the used water:

Tuzla WWTP:	250,000 m³/d, Co-Generation: 2 x 4,600 kW
Paşaköy WWTP:	200,000 m³/d, Co-Generation: 4,600 kW
Ataköy WWTP:	400,000 m³/d, Co-Generation: 9,200 kW

Key Data

Location:	Istanbul,Turkey
Start O&M:	September 2014
O&M:	2014-2016

Capacities:

9 Pre-Treatment Plants:4,200,000 m³/d
51 WWTPs:880,000 m³/d
64 Pumping Stations:2,300,000 m³/d

Two Fold benefits - Cash & Kind

COST FACTOR

- Power cost is the major part of operating cost… since this is saved, operating cost gets reduced by over 50%, depending upon the process selection. This is a good benefit for municipalities, since they are funding the entire operation cost.

ECO - IMPACT

- Reduces the emission of green house gases like CO2, CH4 etc.
- The remaining substrate from the digester can be used as high quality, agricultural fertilizer, keeping nutrients retained and being nearly odorless.

GREEN RETURNS

- Brings in Certified Emission Reduction (Carbon Credits) through Clean Development Mechanism (CDM) as the GHG emissions are controlled.
- Revenue generated from savings in Energy and Additional revenue from Carbon credits can be utilized to fund tertiary treatment plants for reuse.

Sustainability…

Reuse and Recycle Drivers

- WABAG offers the know-how and competence based on the completion of over 50 municipal and industrial water reclamation plants – *including the first* ***Direct Potable Reuse plant in Windhoek, Namibia.***

- Major trend in Water Management for Conservation of Water is Reuse & Recycle of wastewater in Municipal as well as Industrial sector to reduce dependency on freshwater supplies

- The drivers are:
  - **Population Growth**
  - **Urbanization & Industrialization**
  - **Pollution/depletion of raw water resources**
  - **Climatic changes**

Water – Too precious to use once

WATER NEUTRALITY

110 MLD Sewage Treatment Plant - Kodungaiyur

2.5 MGD Sewage Reclamation Plant at Manali

A drop “recycled” is a drop earned

- India’s first refinery wastewater recycling system based on membrane technology.
- The 21.6 MLD Effluent recycling plant started in operations in 2006 is one of the world’s largest with over 90% water recovery
- Boiler feed quality water is obtained from the recycled effluent

- The multistage recycling system includes Clarification, Filtration, Ultrafiltration, Reverse Osmosis and Demineralisation by mixed bed ion-exchange filters.

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