Industrial Water Management Strategies for Compliance, Sustainability and Cost Efficiency

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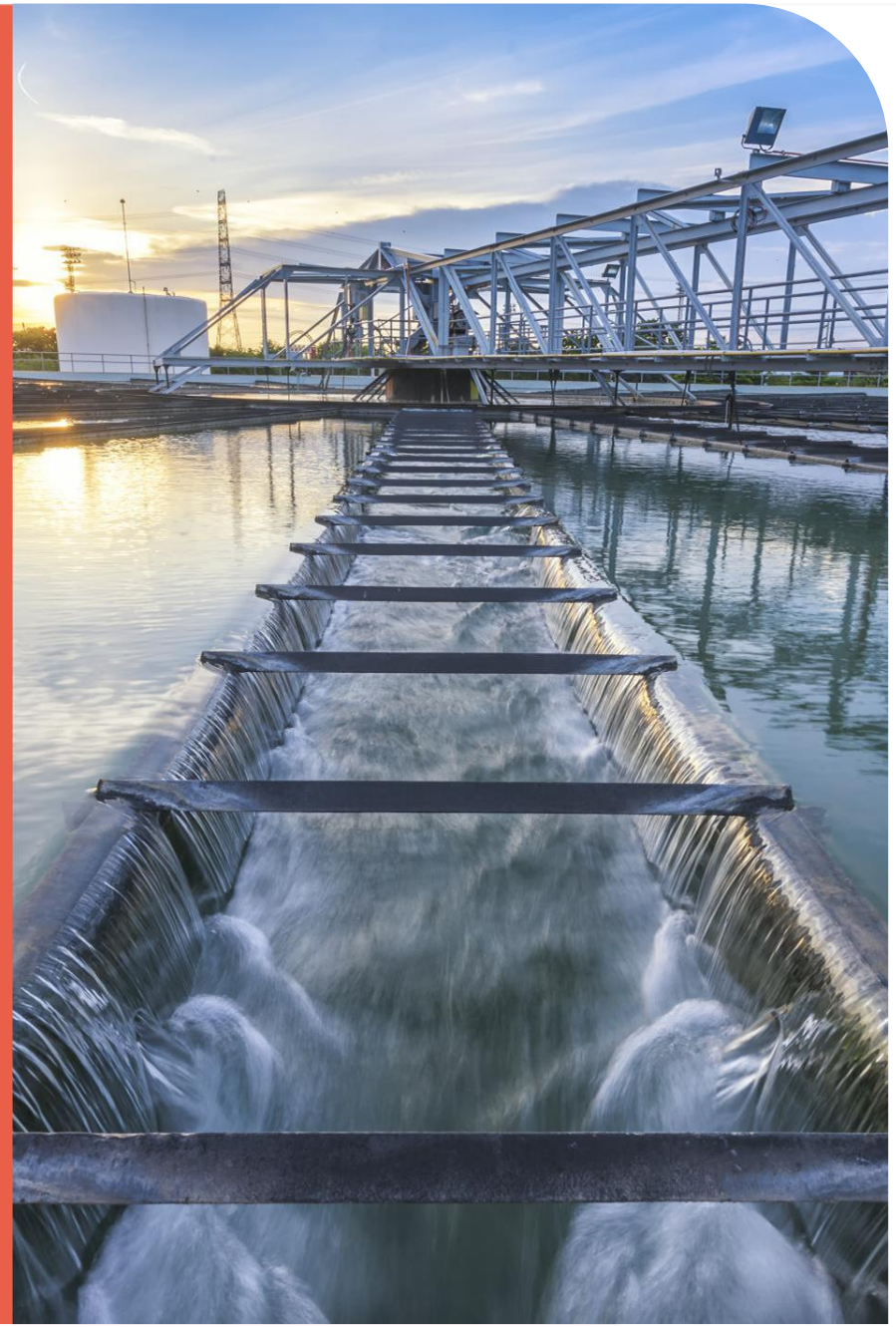
2024 TIEEP Water Forum
Theme: Water: The Big Picture



AGENDA

01
Water Management Introduction

02
Heightened Regulatory Compliance

03
Sustainability Goals

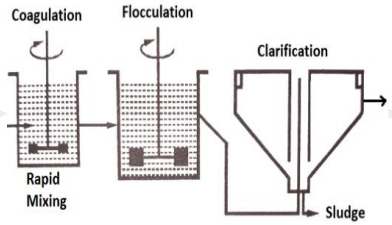
04
Efficiency Up, Costs Down

05
Process Monitoring

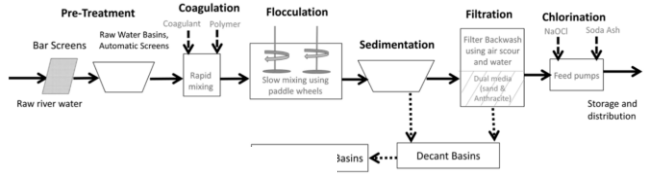
06
Summary, Q&A

WATER MANAGEMENT

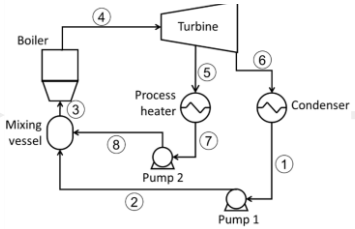
Source water



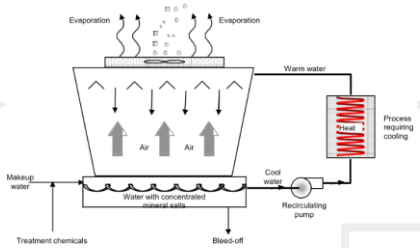
Drinking water



Utility water

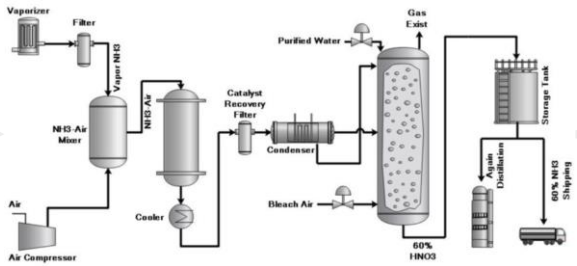


Cooling

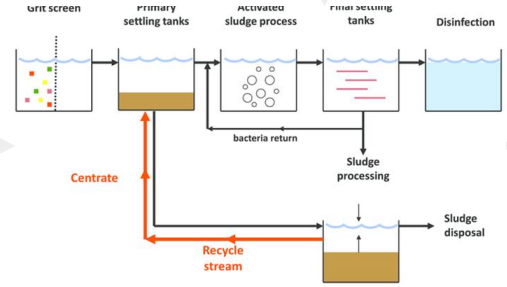


Distribution

Process Water



Wastewater



The water we drink is the same molecule as the water we see in oceans and rivers, the water discharged back to the environment, and the water used throughout manufacturing processes

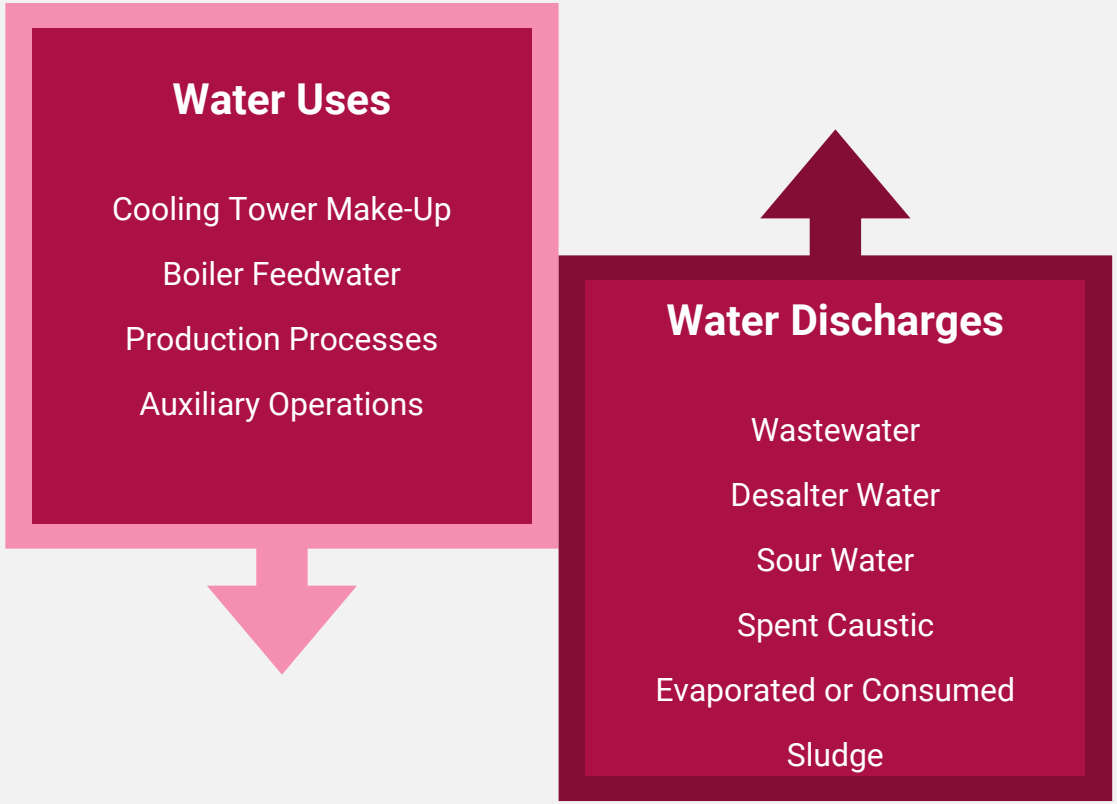
CHALLENGES & OPPORTUNITIES

OVERVIEW

- Water must be fit for purpose across a facility for product and process and environmental discharge
- Monitoring tools allow industries to set and achieve KPIs for efficiency, compliance, & quality

Climate Pressures	Market Shifts	Corporate Sustainability
•Environmental regulations •Emerging contaminants •Reclaim and reuse •Desalination •Wastewater discharge	•Shifting workforce •Supply chain constraints •Aging infrastructure •Security and data utilization •Artificial Intelligence	•Risk avoidance •Proactive preventative measures •Brand reputation •Quality control •Reducing chemical and energy consumption

REFINERY WATER BALANCE



65-95 gallons of water/ barrel of processed crude	10-50 gallons of wastewater/ barrel of processed crude

Bluefield Research

SOURCE

- Of the active refineries in the U.S.
  - majority are surface water
  - remainder are groundwater or municipal water

USE

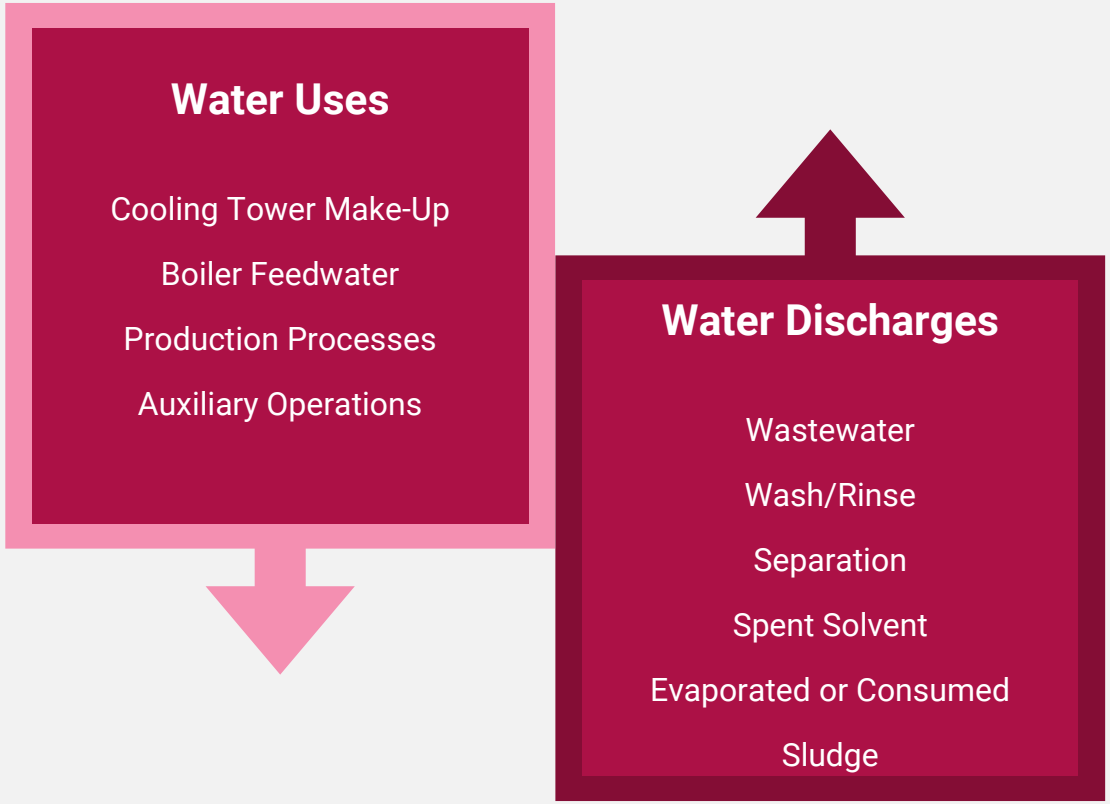
- Typically, 0.74 to 1.41 gallons of water/refined product.
- Process water, boiler feed water, and cooling water.

REUSE

- Return condensate
- Wastewater reuse
- Stormwater reuse

Bluefield Research

CHEMICAL WATER BALANCE



- Organic chemicals are most water intensive, agricultural chemicals are least
- Water spend includes recirculation, discharge, acquisition, and intake
- Water recycling and reducing water usage are secondary concerns at top chemical companies
- Cost savings and process improvements can be gained using available treatment technologies

6.7-11.1m^3 of water/ ton chemical produced	5% of water consumed 95% discharged as WW

Bluefield Research

REGULATORY COMPLIANCE

Ohio Explosives Manufacturing Operator to Pay $2.3 Million Over Clear Water Act Violations

"Pepco will pay over $57 million to resolve allegations that it discharged toxic chemicals into the District's land and waterways"

"Forever chemicals" flowing from Suncor into Sand Creek spike as Colorado weighs renewal of key water-quality permit

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Report Exposes Vast Amounts of Unregulated Water Pollution from Oil Refineries

EPA sued for 'lax standards' at BP refinery

Regulators fail for 43 years to stop BASF from 'staggering' daily toxic waste spill into Detroit River

REGULATORY COMPLIANCE

WASTEWATER DISCHARGE

- toxic pollutants
- nutrients that cause algal blooms
- affect drinking water sources
- strict discharge limits
- expensive treatment needs

https://phys.org/news/2023-04-environmental-groups-accuse-epa-pollution.html

OPPORTUNITIES

- Wastewater often considered afterthought cost center
  - Production is where profits arise → gets funding
- Waste minimization leads to lower treatment needs
- Water intake can be expensive and variable in quality
- Water reuse can generate new water sources at desired quality and lower water needs in water scarce areas
- Public pushing for environmental protection, accountability, and sustainability
  - Affects brand reputation and competitive advantage

SUSTAINABILITY GOALS

- B2C industries publish water use & plans more often than B2B
  - More food & beverage, personal care, pharmaceutical, automotive, oil & gas
  - Less power, mining, chemicals

- Corporate Sustainability Reporting Directive (CSRD) French requirement
  - report social and environmental risks
  - could impact over 50,000 companies including non-EU

- Chemical industry more concerned with emissions and plastic release

SUSTAINABILITY GOALS

Company	Sustainability Target
Air Liquide	100% implementation of water plan for high water use in high water stress areas by 2025
DOW	20% reduction freshwater intake at water stressed sites 2015-2025
Linde	water management plans by 2028
DuPont	water management strategy all sites by 2030
BASF	water management strategy at water stressed sites by 2030

EFFICIENCY VS COSTS

Ways to Increase Efficiency	Resulting Reduction in Costs
Return condensate	Minimize wastewater Decrease freshwater intake
Wastewater reuse	Depending on wastewater contaminant loading can
Reused based on quality needs	More treatment for boiler feedwater Less treatment for cooling water or rinse water
Improve effluent discharge quality	Avoid regulatory fines Minimize environmental degradation Improve corporate sustainability and brand reputation

- Industrial Emissions Directive for European Union members suggests Best Available Technologies (BAT) and associated emissions levels (AEL) to guide on compliance and efficiency and sustainability
- US Clean Water Act drives wastewater treatment improvements

EFFICIENCY VS COSTS

EMERGING OPPORTUNITIES

WASTEWATER → RECOVERY OF PRODUCTS

- phosphorus for fertilizer
- CO_2 for cement, fuel
- Onsite heat from biogas
- Renewable natural gas
- Biopolymers

ENERGY SOURCE SHIFTS

- EVs - lithium extraction is water intensive
- Hydrogen - requires ultrapure water

Waste Mitigation Strategies from Best to Worst

Prevent less waste
Prepare for reuse
Recycling
Other recovery
Dispose

PROCESS MONITORING

- How do you know when to reuse and what to reuse for?
  - How do you know if your wastewater system is overloaded?
- How do you know if you aren't meeting discharge requirements?
  - How do you know if your treatment is effective?
- How do you know if your assets are healthy and performing?
  - How do you avoid corrosion, scaling, deposition, microbial growth?

Process monitoring is key to achieving efficiency and cost savings

- Previously, **point of exit** was checked via **grab samples** sent to an off-site lab
- Identifying what contributes to **wastewater loading** and from where is critical for achieving discharge compliance
- Opportunities for water reuse rely on knowing the desired **purpose** and the required quality
- Create a water footprint map to identify areas for contamination and optimization

PROCESS MONITORING

Establish a baseline

- Normal operating conditions
- Manage treatment and find opportunities to improve

Detect a change

- Quickly measure deviation from norm
- Evaluate severity of change

Take corrective action

- Divert, continue, or stop
- Confidently make decisions

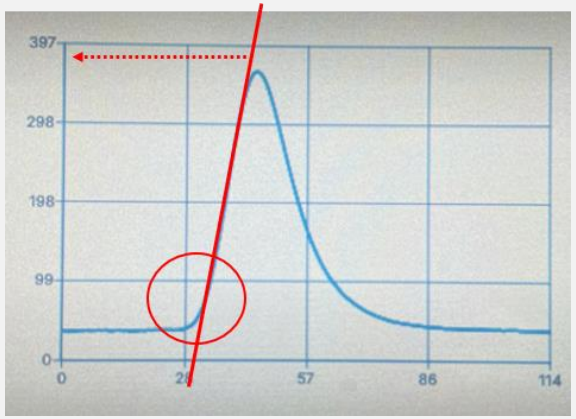
PROCESS MONITORING
CONSEQUENCES OF POOR WATER QUALITY

- Premature replacement of equipment e.g. RO, heat exchanger
- Poor heat transfer from scaling
- Higher operating cost e.g. fouled resin requiring frequent regeneration
- Higher blow-downs rates i.e. increase use of make-up water, lost productivity
- Catastrophic boiler explosion

RAW WATER SUPPLY: Ensure that any source of water is treated to deliver a consistent quality to boilers, cooling and process steps

PROCESS MONITORING

- Map out water quality across facility
- Determine which contaminants are critical based on production and discharge history
  - metals
  - organics
  - nutrients
  - emerging contaminants (PFAS)
- Identify locations of variability or critical to quality or safety
- Identify appropriate tool
  - lab vs online
  - speed, safety, range, sensitivity
  - maintenance and support



PROCESS MONITORING OPPORTUNITIES

- **Improve discharge compliance, achieve sustainability goals, enable reuse, minimize waste, lessen freshwater intake AND**

- Prevent product contamination and bad batches
- Reduce cleaning cycles
- Protect equipment assets
- Optimize treatment - reduce chemical use, membrane fouling…
- Avoid downtime, shutdown, and unnecessary repairs

SUMMARY

1. Industrial manufacturing face many challenges with regulations, sustainability pushes, and cost management to stay competitive and profitable
2. Water management offers opportunities to improve efficiency and save costs
3. Industrial Process Monitoring is critical to quality, control, and compliance providing awareness to make data drive profitable decisions

Questions & Discussion

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TEXAS INDUSTRIAL ENERGY EFFICIENCY PROGRAM