

PROBLEMS IN THE USE OF WATER RESOURCES IN INDUSTRY AND THEIR SOLUTIONS

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Abstract: Water is a critical resource in industrial operations, essential for various processes ranging from manufacturing to power generation. However, unsustainable water use by industries poses significant challenges, including water scarcity, pollution, and increased operational costs. This article explores the current state of water management in industry, identifies key issues, and proposes solutions for improving efficiency and sustainability. The methodology includes a comprehensive literature review of water management practices, analysis of successful case studies, and synthesis of recommendations from industry experts. Data on water consumption, pollution levels, and industry practices are sourced from authoritative publications, academic journals, industry reports, and government sources. Key findings reveal critical shortcomings in industrial water use, notably water scarcity, environmental pollution, energy intensity, and economic costs. Industry practices often strain local water supplies, leading to competition with agriculture and domestic needs. Environmental pollution from untreated wastewater jeopardizes aquatic ecosystems and community health. Energy-intensive water treatment processes exacerbate climate change impacts. To address these issues, strategies such as water-saving technologies (closed systems, recycling), conservation practices (leak detection, process optimization), and advanced treatment technologies (pollutant removal) are recommended. Integrating water management into broader sustainability initiatives is crucial, necessitating collaboration with stakeholders and participation in collective industry initiatives.

Key words: Water resources, industry, sustainability, efficiency, environment, problems, solutions, closed system.

Introduction: Water is indispensable for industrial operations and serves as a crucial component in manufacturing, power generation and various processes in various industries. However, the unsustainable use of water resources by industries has created several problems such as water scarcity, pollution and increased operational costs [1-3]. Eliminating these shortcomings is necessary to ensure the long-term viability of industrial activity and environmental sustainability. This article examines the current state of water management in industry, identifies key challenges, and proposes solutions to improve efficiency and sustainability [4-7].

Water is used for a wide range of applications in many process industries. Industrial processes and systems that use water are subject to strict environmental regulations related to the discharge of wastewater [8-12]. The demand for fresh water is increasing, making it a

very valuable commodity in more and more countries and a crucial commodity in some parts of the world. Changes, and the pace of these changes, have increased the need to improve water resources management and minimize runoff [13-15]. Applying water minimization techniques can effectively reduce the total freshwater demand for water used by processes and subsequently reduce the amount of wastewater generated. This can lead to lower costs of purchasing clean water and wastewater treatment [16-18].

Digitization and the integration of various aspects of value chains represent a significant shift in industrial development. By incorporating digital technologies into products, services and business models, companies can improve efficiency and open new avenues for growth. Horizontal integration fosters cooperation and synergy between different entities in an industry, leading to the creation of interconnected ecosystems that can adapt and evolve autonomously [7,21-24]. At the same time, vertical integration simplifies processes by combining different levels of the organization, smoother coordination and optimization of resources. Together, these strategies pave the way for an interconnected, agile and innovative industrial landscape [7,19-20].

Metod: The methodological approach of this article includes a literature review of water management practices in industry, analysis of case studies of successful initiatives, and synthesis of recommendations from industry experts. Data on water consumption, pollution levels and industry practices are collected from authoritative sources, including academic journals, industry reports and government publications. The findings are then compiled to provide insight into water resource use gaps and potential solutions.

Results and discussion: Water is an indispensable resource for industrial processes, essential for activities ranging from manufacturing and power generation to cooling and cleaning. However, the indiscriminate use of water in industry creates many disadvantages that can have serious consequences for both the environment and the economy. Understanding these deficiencies is critical to developing strategies to mitigate their impacts and promote sustainable water management practices. The main shortcomings related to the use of water resources in the industry were studied and the analysis of the main ones was carried out.

Water scarcity in the use of water resources in industry. One of the most important disadvantages of industrial water use is the increased water scarcity, especially in already water-stressed areas. Industry often draws water from local sources, putting pressure on freshwater supplies and competing with agricultural and domestic uses. As the demand for water increases due to population growth and economic development, the depletion of freshwater resources can lead to conflict and environmental degradation.

The problem of environmental pollution. Industrial activities contribute to water pollution by discharging untreated or inadequately treated wastewater containing pollutants such as heavy metals, chemicals, and pathogens. This pollution can contaminate water bodies, disrupt aquatic ecosystems, and harm human health through consumption of contaminated water or aquatic organisms. In addition, industrial pollution can compromise the quality of water for agricultural and recreational purposes, which can harm the overall well-being of communities. Energy intensity problem. Treating and transporting water for industry requires large amounts of energy that contribute to greenhouse gas emissions and climate change. Energy-intensive processes such as desalination and wastewater treatment can

further strain limited energy resources and exacerbate environmental impacts. In addition, industries that rely on water-intensive cooling systems or hydroelectric power generation may experience operational problems during periods of water scarcity or drought. Economic cost problems. Inefficient use of water in industry can result in economic losses from increased water procurement and treatment costs, as well as potential fines for non-compliance with environmental regulations. Water shortages or supply interruptions can disrupt production processes, leading to downtime and reduced productivity. In addition, industries that rely heavily on water resources may face reputational risks and market uncertainties as consumers and investors increasingly prioritize sustainability.

Effects on society. Excessive use of water resources by industries can have negative effects on local communities, especially in areas where water scarcity is a pressing issue. Competition for water resources between industry, agriculture and municipalities can lead to social tensions and conflicts over water use. In addition, pollution from industrial activities can disproportionately affect vulnerable communities, heighten environmental justice concerns, and violate human rights to clean water and a healthy environment. **Excessive water consumption:** Many industries use large amounts of water, often inefficiently, affecting local water resources and ecosystems. **Solutions to this problem include:** Implementing water-saving technologies such as closed systems, water recycling and reuse. Adopting water conservation practices including leak detection, process optimization and staff training. Integrating water management strategies into overall sustainability initiatives, prioritizing water conservation and efficiency.

Water Pollution: Industrial activities contribute to water pollution by discharging pollutants such as chemicals, heavy metals and sewage. **To reduce pollution:**

Installation of advanced treatment technologies to remove pollutants before discharge.

Implement pollution prevention measures such as source control, waste minimization and green chemistry practices.

Compliance with regulatory standards and voluntary certification programs to ensure responsible waste management and environmental protection.

Lack of water management: Many industries lack comprehensive water management programs without considering the long-term impacts of water use on local communities and ecosystems. **To promote sustainable water resources management:**

Collaborate with stakeholders, including communities, government agencies, to understand local water challenges and develop collaborative solutions. Integrating water risk assessment and management into corporate decision-making processes, taking into account factors such as climate change, population growth and regulatory changes. Participate in industry initiatives and partnerships to promote collective action on water management and water-related issues.

Conclusion: Efficient and sustainable management of water resources is essential for the future of industry and the environment. By addressing water gaps through innovative technologies, best practices, and collaborative efforts, industries can minimize their environmental impact, reduce costs, and increase resilience to water-related risks. It is important that stakeholders from different sectors prioritize water management and work together towards a more sustainable and water-resilient future. Although water is necessary for industrial processes, its indiscriminate use can cause serious disadvantages for the

environment, economy and society. Addressing these gaps requires a concerted effort to promote sustainable water management practices, improve water efficiency, and reduce pollution from industrial activities. By prioritizing water management and adopting innovative technologies and policies, industries can mitigate their negative impacts on water resources and contribute to a more sustainable and equitable future.

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