

# Catalysis and Sustainability: A Technological Breakthrough for Optimized Water Management in Cooling Towers

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## Summary

For several years now, water management in cooling towers has been revolutionized through the introduction of catalytic water management. This concept, which has proven its effectiveness in the market, has enabled numerous industries to significantly improve their operational efficiency, strengthen their sustainability, and meet increasingly stringent environmental standards. While conventional water treatment technologies have been useful for decades, they are now showing their limitations in the face of growing demands for performance and sustainability. In this context, our innovative catalytic enhanced water management continues to establish itself as a groundbreaking solution that is transforming water management in cooling towers. By reducing maintenance costs, increasing energy efficiency, and minimizing the use of biocides, this technology provides tangible benefits to operators while ensuring exemplary compliance with environmental regulations, particularly those outlined in the 2015 Water Framework Directive (WFD).

## 1. THE CURRENT CHALLENGES OF CONVENTIONAL TECHNOLOGIES

Cooling towers are essential in many sectors, including energy production, chemicals, metallurgy, and food processing. They play a crucial role in dissipating the heat generated by industrial processes by using water as a cooling fluid. However, this water management presents significant challenges that affect operational efficiency, system sustainability, and regulatory compliance.

### 1.1. Fouling and Corrosion: Persistent Technical Obstacles

Fouling of heat exchangers and other key components in cooling towers remains a recurring and costly problem. This fouling, caused by mineral and organic deposits, can reduce heat transfer efficiency by up to 90% with just a 1 mm thick deposit (*Kern, 1950*). This loss in efficiency results in increased energy consumption and higher maintenance costs. Corrosion is another major challenge. The harsh conditions to which water is subjected in these systems promote corrosion, which reduces equipment lifespan, leads to leaks, unexpected breakdowns, and high maintenance costs. This corrosion can also cause production interruptions, directly impacting operational profitability.

### 1.2. Reliance on Biocides: A Necessary but Problematic Solution

To combat the issues of fouling, corrosion, and microbial growth, operators have traditionally relied on chemical products, particularly biocides. While effective, these products come with significant drawbacks: they are expensive, can lead to microbial resistance over time, and pose risks to human health and the environment. Moreover, their use complicates compliance with increasingly stringent environmental regulations.

## 2. CATALYTIC WATER MANAGEMENT: AN INNOVATIVE & EFFECTIVE RESPONSE

In response to the limitations of traditional methods, catalytic technology is positioned as a cutting-edge solution to tackle the complex challenges of water management in cooling towers. Since its introduction to the market, it has demonstrated its ability to transform the way industries manage water, providing sustainable and cost-effective solutions. This technology uses heterogeneous catalysts to improve water treatment processes, including dissolution, filtration, and evaporation. Catalysts accelerate chemical reactions without being consumed, which effectively prevents fouling, corrosion, and deposit formation, while reducing or eliminating the need for harmful chemicals.

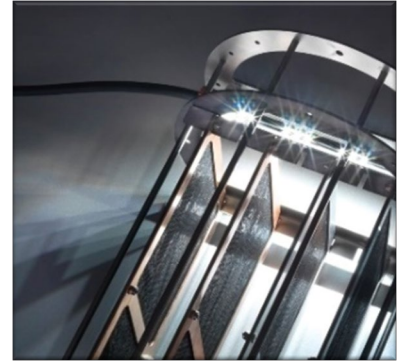


Figure 1: Catalytic module for a flow rate of 25 m<sup>3</sup>/h

### 2.1. The Operation of Catalytic Water Management

Catalytic water management is based on the use of advanced materials, special treated metal alloys, that induce specific chemical reactions to prevent the formation of deposits and reduce corrosion. These long-lasting catalysts are integrated into the cooling system, where they alter the water's chemistry to create conditions unfavorable for mineral precipitation and microbial growth. One of the most remarkable advantages of this technology is its ability to keep internal surfaces clean.

By reducing fouling and deposits, the catalysts allow heat exchangers and pipes to operate optimally, thus decreasing maintenance and cleaning needs. Additionally, by reducing corrosion, this technology extends the lifespan of equipment, lowering replacement costs and enhancing system reliability. Catalytic water management has been successfully implemented across various industrial sectors for many years, demonstrating its effectiveness in improving water management and reducing operational risks.

## 3. ENVIRONMENTAL IMPACT AND COMPLIANCE: THE ROLE OF THE 2015 WATER FRAMEWORK DIRECTIVE

The 2015 European Union Water Framework Directive (WFD) imposes strict requirements for water quality, prohibiting the deterioration of water bodies. This directive aims to ensure that all surface waters in Europe reach "good status" by 2027. For industries using cooling towers, this means that any activity likely to degrade water quality must be strictly controlled.

### 3.1. Reducing the reliance on Chemicals through Catalysis

One of the direct consequences of the WFD for operators is the need to reduce their reliance on chemicals, particularly biocides, which can affect the quality of water discharged into the environment. Catalytic water management provides an effective response to this challenge by reducing or eliminating the need for such products. By minimizing the use of biocides, this technology contributes to the protection of water resources while helping industries comply with the requirements of the WFD.

### 3.2. Compliance with the WFD and Benefits of Catalytic Water Management

Catalytic water management also enables operators to meet other aspects of the WFD, particularly by maintaining good water quality throughout the cooling process. By reducing fouling, corrosion, and microbial growth, this strategy improves the quality of the water circulating within the systems, thereby minimizing the risks of contamination and non-compliance. Additionally, by extending the lifespan of equipment and reducing maintenance needs, this technology contributes to more sustainable and environmentally friendly operations.

## 4. CASE STUDIES: SUCCESS OF CATALYTIC WATER MANAGEMENT

Catalytic water management has proven its effectiveness in various sectors over several years. These success stories demonstrate how this technology can transform industrial operations, providing a sustainable and cost-effective solution for water management.

For example, at an iron foundry in Ypres, the application of this strategy led to a dramatic increase in productivity. Before adopting this solution, the foundry's annual production ranged between 20,000 and 25,000 tons of cast iron. Since the implementation of catalytic water management, production has nearly doubled, reaching between 40,000 and 45,000 tons per year, without any modification to the melting furnace. This increase in production is directly linked to the improved efficiency of the cooling system, thanks to the reduction in deposits and corrosion.

Additionally, the use of biocides was reduced by more than 50%, resulting in substantial savings while improving employee safety by reducing their exposure to chemicals.

### 4.1. Optimization of Power Plant Performance

Another significant example is the application of catalytic water management in the power plants of Schkopau and Rostock. In these facilities, this strategy completely eliminated the use of biocides during normal operations while keeping the systems compliant with strict microbiological control standards, including those related to Legionella. At the Rostock plant, the technology also eliminated the need for annual manual cleaning of the 8 km of cooling water pipelines, thanks to its effect on stabilizing limestone particles, thereby solving a chronic fouling issue caused by zebra mussels.

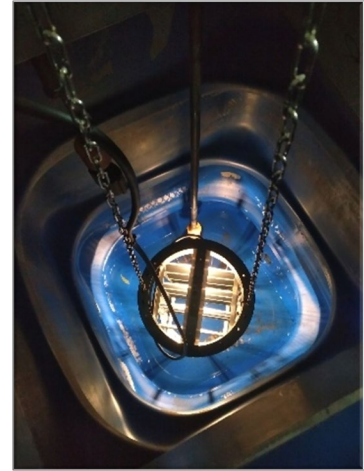


Figure 2: Catalyst module in the feed tank of an RO installation



Figure 3: Catalytic module in the treatment of fresh water at the Schkopau power station

## 5. LASTING AND ECONOMIC BENEFITS OF CATALYTIC WATER MANAGEMENT

The adoption of catalytic water management offers significant advantages in terms of operational performance, sustainability, and profitability. These benefits are particularly important in a context where environmental regulations are becoming increasingly strict and where there is constant pressure to reduce operational costs.

### 5.1. Reduction of Maintenance and Operating Costs

One of the key advantages of catalytic water management is the reduction of maintenance and operating costs. By minimizing fouling and corrosion, the technology reduces the need for maintenance interventions, cleaning, and equipment replacement. This results in substantial savings for companies while improving the energy efficiency of cooling systems.

## **5.2. Increased Equipment Durability**

By extending the lifespan of equipment, catalytic water management enables companies to maximize the use of their capital investments. Equipment operates longer and more reliably, reducing costs associated with service interruptions and frequent replacements. Additionally, the reduction in corrosion means that equipment retains its structural integrity for longer, contributing to safer and more sustainable operations.

## **5.3. Environmental Compliance and Reduced Health Risks**

The ability of catalytic water management to reduce or eliminate the use of hazardous chemicals, such as biocides, not only enhances worker safety but also contributes to environmental protection. By aligning industrial operations with sustainability goals and regulatory requirements, this technology helps companies reduce their environmental impact while minimizing the risks of non-compliance and penalties.

## **6. A NEW ERA FOR INDUSTRIAL WATER MANAGEMENT**

Catalytic water management represents a major breakthrough for industries seeking to optimize their operations while adhering to environmental and safety standards. By offering an effective solution to reduce fouling, corrosion, and the use of biocides, this technology enables companies to achieve significant cost savings, improve operational performance, and reduce their environmental impact.

Adopting this strategy is not only a strategic choice to enhance the profitability of industrial operations but also a commitment to a more sustainable and responsible industry. By drastically reducing maintenance costs, improving energy efficiency, and minimizing the use of biocides, our solution provides measurable benefits for operators. Easy to install and designed to last, it ensures exemplary environmental compliance while extending the lifespan of equipment.

In conclusion, catalytic water management offers industries a unique opportunity to transform their water management systems. By improving efficiency, reducing costs, and ensuring strict compliance with environmental standards, this strategy represents the future of water management in industrial systems. Industries that adopt this technology today will be better prepared to meet the challenges of tomorrow, while contributing to a cleaner and more sustainable future for all.