Case study factsheet

Agricola (CS5)

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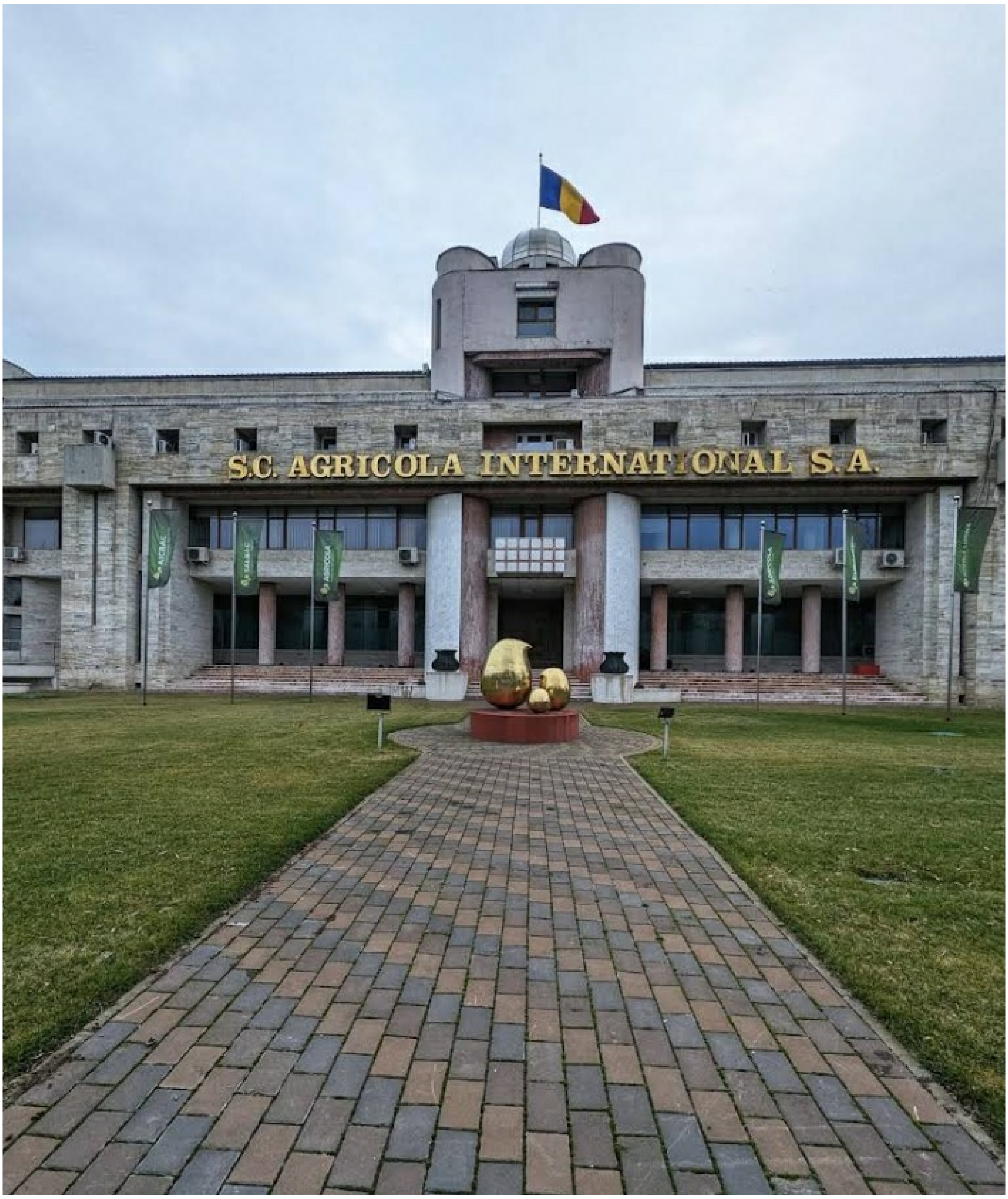
Project AquaSPICE

Bacau , **Romania**


S.C. AGRICOLA INTERNATIONAL S.A.

Description

AGRICOLA International S.A. in Bacau, Romania, seeks to implement an innovative solution for water management and recycling at its poultry slaughterhouse to reduce its environmental footprint. The pilot project will focus on producing bacteria-free water that meets European standards for meat industry. The project aims to contribute to the circular economy by reusing water in the meat-hanging and cooling areas, collaborating with local industries and institutions for potential reuse opportunities.

Best practices

- Design for Influent Variability:
  Treatment systems should be designed to accommodate highly variable organic and nutrient loads, which are typical in agro-industrial wastewater streams. Buffer tanks and adaptable flow regimes help mitigate load shocks.

- Implement Multi-Barrier Treatment Trains:
  A combination of biological treatment, membrane filtration, and disinfection should be used to ensure reclaimed water meets irrigation standards, especially under Regulation (EU) 2020/741.

- Prioritize Modular and Scalable Infrastructure:
  Modular construction allows flexibility in capacity expansion and easy maintenance. It also facilitates replication across other agro-food contexts with varying production volumes.

- Integrate Real-Time Monitoring Tools:
  Incorporate sensors and monitoring systems to continuously track water quality parameters such as TSS, COD, TOC, and microbial loads. These tools support proactive control and early anomaly detection.

- Establish Clear Maintenance Protocols:
  Routine cleaning and inspection schedules, especially for membrane and disinfection units, are essential to ensure system longevity and avoid biofouling or blockages.

- Ensure Operator Training and Support:
  Local staff must be trained to operate both the biological and filtration systems. Simplified user interfaces and remote technical support improve reliability in low-resource settings.

- Engage End Users in Planning and Operation:
  Water users should be involved in the early design and feedback loop to ensure reclaimed water characteristics meet their needs and foster long-term acceptance.

- Account for Local Environmental Conditions:
  Systems should be protected against temperature extremes, humidity, and dust, which may affect equipment like sensors or open-air basins, especially in Mediterranean climates.

Technology performance and best practices

The final system implementation is comprised of a screening and sedimentation system for solids removal (primary treatment), a biological reactor to reduce organic matter and nutrients (secondary treatment), an MBR and a UV lamp for further removal of organics, solids and pathogens (advanced treatment) and an automation & real-time monitoring system. The results achieved from this configuration were:

1. Water Quality Achieved for Reuse:
   - Total Suspended Solids (TSS): < 10 mg/L
   - Biological Oxygen Demand (BOD): < 10 mg/L
   - Chemical Oxygen Demand (COD): ~30 mg/L
   - Total Nitrogen (TN): < 15 mg/L
   - Total Phosphorus (TP): < 2 mg/L
   - Turbidity: < 2 NTU
   - E. coli: < 10 CFU/100 mL (compliant with Category A of EU Regulation 2020/741)
2. Treatment Efficiency:
   - COD removal: > 85%
   - BOD removal: > 90%
   - Nutrient (N & P) removal: > 80%
3. Water Recovery:
   - Overall recovery rate: Approximately 85–90% of treated water reused for agricultural irrigation.

Synergistic benefits

- Enhanced Water Reuse Quality and Safety:
  The integration of biological treatment, membrane filtration, and disinfection technologies (e.g. UV or chlorination) ensured the production of high-quality reclaimed water suitable for reuse, aligning with EU reuse regulations.
- Decision Support via Real-Time Monitoring:
  The use of real-time monitoring systems (sensors and dashboards) in conjunction with treatment processes allowed dynamic control and early anomaly detection, improving operational stability and optimizing chemical/energy usage.
- Stakeholder Engagement Enabled by Transparent Data:
  The transparent flow of operational data through digital tools enhanced trust for the end-users, supporting the approval for reuse of the reclaimed water and facilitating cooperative management.
- Compliance and Replicability through Tool Integration:
  The coordinated use of monitoring, treatment, and validation tools helped meet legal and quality standards, improving the replicability potential in other cases within and outside the company.

Requirements and conditions

1. High Nutrient Content Handling:
   The treated wastewater originated from the agro-food industry and contained high concentrations of organic matter and nutrients (notably nitrogen and phosphorus), requiring robust biological and membrane-based treatment systems.

2. Water Quality for Irrigation:
   The reclaimed water needed to meet strict quality standards suitable for reuse, particularly regarding salinity, microbiological safety, and nutrient levels.

3. Compliance with EU Regulations:
   Technologies had to align with Regulation (EU) 2020/741 on minimum requirements for water reuse, necessitating comprehensive monitoring and validation processes.

4. Variability in Wastewater Composition:
   Influent wastewater quality varied significantly, impacting process stability and requiring adaptable system configurations.

5. Integration into Existing Infrastructure:
   New treatment units had to be retrofitted into existing WWTP infrastructure, imposing space and hydraulic constraints.

6. Energy Consumption and Operational Costs:
   There was a strong emphasis on maintaining low energy consumption to ensure economic feasibility, especially given the agricultural end use of the treated water.

7. Climatic Conditions:
   High ambient temperatures in the region affected process kinetics (positively for biological systems, but possibly leading to increased evaporation and energy loss in open systems).

8. Local Acceptance and Stakeholder Involvement:
   Engagement of local farmers and water users was necessary to ensure acceptance of reclaimed water for irrigation, influencing system design and outreach efforts.

9. Scalability and Replicability:
   The solution had to demonstrate potential for scaling across other agro-industrial contexts in southern Europe, affecting the selection of modular and cost-efficient technologies.

Key lessons

- Adaptability to Influent Variability:
  The technologies applied must be adaptable to fluctuations in wastewater composition, which is typical in agro-industrial operations. Systems that can dynamically respond to these variations showed better operational stability and treatment efficiency.

- Importance of Modular Design:
  Modular and flexible system design was key for managing diverse flow rates and treatment needs. This facilitated testing of different configurations and simplified future scalability.

- Integrated Monitoring Supports Operational Control:
  The combination of sensor-based monitoring with real-time data processing significantly

improved operational responsiveness, allowing proactive adjustment of treatment conditions to maintain compliance and efficiency.

- Holistic System Integration Enhances Efficiency:
The integrated use of biological, membrane, and disinfection units allowed for more effective treatment than individual technologies alone, demonstrating the benefit of synergistic combinations in achieving up-to-standards effluent.

- Regulatory and End-User Alignment is Crucial:
Ensuring alignment with regulatory standards and engaging end users early in the process enhanced acceptance of the treated water and helped tailor system outputs to practical reuse needs.

- Operational Simplicity Favours Replicability:
Technologies that are easy to operate and maintain were found to be more viable for replication. Complex or highly technical systems risk being underutilized without proper training and support.

Lessons learned from technology operation

- Need for Skilled Technical Staff:
Operation of advanced treatment units, especially membrane systems, requires personnel with a basic level of technical training. In contexts where local capacity is limited, operator support and training become critical to ensure effective performance.

- Maintenance-Intensive Components:
Membrane-based processes were identified as maintenance-sensitive, particularly prone to fouling and requiring regular cleaning protocols (CIP) to avoid performance loss and unplanned shutdowns.

- Technological Risks from Process Instability:
Biological treatment units showed sensitivity to fluctuations in influent composition, which could lead to microbial imbalances or reduced removal efficiency if not properly monitored and controlled.

- Downtime Linked to Equipment Sensitivity:
Temporary downtimes were occasionally reported due to sensor or instrumentation malfunctions, especially in outdoor or high-humidity environments. Weather protection and redundancy were noted as useful design strategies.

- Importance of Remote Monitoring Systems:
Real-time monitoring and remote alerts helped mitigate downtime risks by enabling quick identification and resolution of anomalies, thereby enhancing system resilience.

- Operational Simplicity Favours Continuity:
Technologies requiring minimal manual intervention and having automated process control exhibited higher operational uptime and were more suitable for agro-industrial environments.

Applied technology

- **Membrane Bioreactor (MBR)**

Publications and references

- Life cycle environmental impact assessment of slaughterhouse wastewater treatment

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Scale

Operational scale of this case study related to the application of tools and technologyies

- Local scale

Challenge

Challenge that is addressed through the application of tools and/or technologies to the case study

- Water Scarcity

Related tags

water management | Water Recycling | Poultry Industry | Smart Water Solutions | Meat Production | Food Processing Water Management | Circular Economy

Contact data

Involved organisation

1. Agricola International SA