

## **Abstract**

As part of the doctoral thesis, all intended research and application goals were achieved, and the scope of activities was expanded to include additional experiments. The research focused on developing a method for collecting and transporting biological samples in recirculating aquaculture systems (RAS), which represent a future direction in aquaculture due to climatic and infrastructure constraints.

The first stage involved a literature review of aquaculture trends and disinfection methods. Of the four methods tested (UV-C, ozonation, hydrogen peroxide, peracetic acid), disinfection using hydrogen peroxide proved to be the most effective and also safe for engineering plastics. Based on this, suitable materials (PET-G, PE, PVC) were selected, demonstrating resistance to long-term exposure under process conditions.

Further research optimized the water flow regulation process by partially throttling the valve, using a guillotine valve as the solution ensuring the lowest energy loss. A prototype sampling system was also developed, in which a polypropylene membrane with a filtration degree of 1  $\mu\text{m}$  was the key element. Experiments demonstrated that the method allowed for sample concentration by at least 4 orders of magnitude.

A parallel sample transport system was developed, eliminating the risk of contamination and ensuring temperature stability. Tests confirmed its safety and compliance with the design assumptions.

Ultimately, a simplified biological sampling system was also created, which allowed for increasing the material concentration by 4–5 orders of magnitude without affecting the life or metabolic processes of microorganisms.

The completed work led to the development of a comprehensive, innovative method for pathogen detection in aquaculture. The solution is characterized by effectiveness, low implementation cost, and easy adaptation to RAS standards. The results achieved indicate the significant industrial potential of this method, which can improve sanitary supervision and the efficiency of aquaculture production on a global scale.