Salonul Internațional al Cercetării Științifice, Inovării și Inventicii PRO INVENT 2025 Ediția a XXII-a

Universitatea Națională de Știință și Tehnologie POLITEHNICA BUCUREȘTI

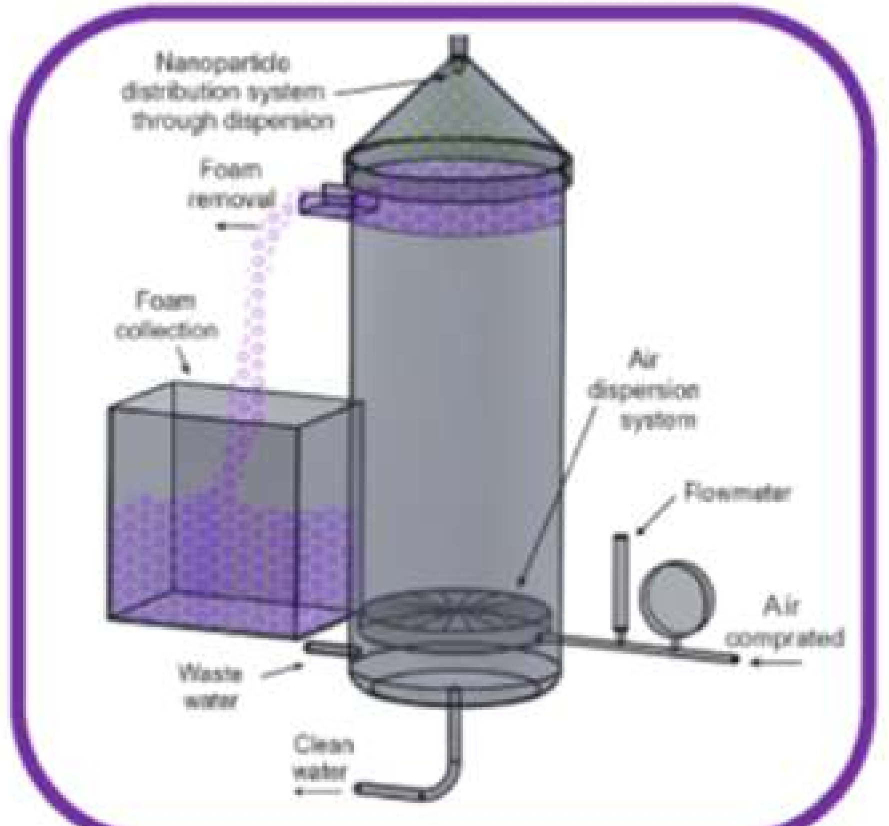
# INNOVATIVE FLOTATION INSTALLATION WITH HYBRID ECOLOGICAL NANOMATERIALS, USED IN WASTEWATER TREATMENT

Ioana Corina MOGA [1], Ileana Cristina COVALIU-MIERLA [2], Gigel PARASCHIV [2], Gabriel PETRESCU [1]

1 - DFR Systems SRL
2 – National University of Science and Technology POLITEHNICA Bucharest

**The *WaterFlo* project aims to develop an innovative technology for treating industrial wastewater heavily loaded with fats and colloidal particles, using a flotation process supported by hybrid eco-friendly nanomaterials. The proposed technology advances from experimental validation to the design and testing of a pilot installation capable of treating up to 50 m³/day of industrial wastewater.**

**The efficiency of wastewater treatment through flotation can be enhanced using nanoparticles by increasing foam generation and reducing bubble coalescence. Literature indicates two main approaches: adding nanoparticles as suspensions with flotation agents, or directly into the foam. Laboratory studies at NUSTPB (TRL 4) showed that introducing nanoparticles onto the foam surface after its formation is the most effective method, leading to stable foam and improved flotation. This method, integrated with an automated nanoparticle dispersion system and an advanced air distribution unit, is proposed to be scaled up to TRL 6 within the *WaterFlo* project.**




**For the pilot stage, the researchers plan to develop hybrid oxide nanoparticles ($Fe_3O_4$, $CuFe_2O_4$, $NiFe_2O_4$) coated with biopolymers such as chitosan or sodium alginate. These coatings will ensure steric stabilization at fluid interfaces, thereby improving foam stability and pollutant removal. The nanomaterials can later be recovered through their magnetic properties, regenerated, and reused, increasing both efficiency and sustainability of the process.**

**Key advantages include achieving a very high pollutant removal efficiency (96–100%), recovery and reuse of nanomaterials, reduced environmental impact, and the generation of patentable know-how that provides a competitive advantage in the wastewater treatment market.**

ACKNOWLEDGEMENT

**This work was funded by the Ministry of Research and Innovation, within National PN-IV-P7-7.1-PTE-2024-0200, contract 59PTE/2025 (*WaterFlo*).**

---

Salonul Internațional al Cercetării Științifice, Inovării și Inventicii PRO INVENT 2025 Ediția a XXII-a

# DEVELOPMENT AND VALIDATION OF A COMBINED TRI-COMPONENT INTEGRATED SYSTEM FOR WASTEWATER TREATMENT

Ioana Corina MOGA[1], Ovidiu IORDACHE[2], Bogdan CAZAN[2], Gabriel PETRESCU[1]

1 - DFR Systems SRL
2 – The National Research and Development Institute for Textiles and Leather

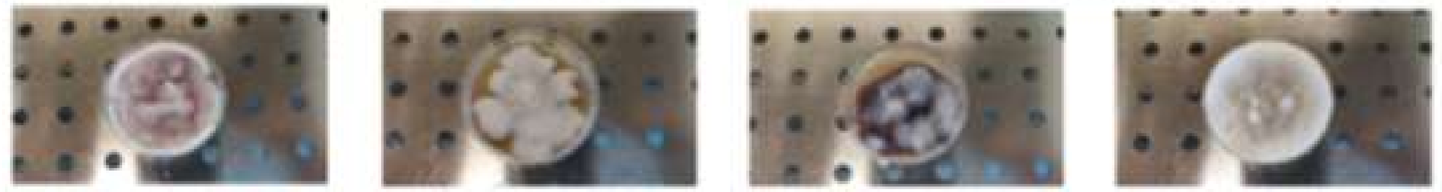
## CONTEXT

Textile and leather industrial activities are responsible for the generation of large quantities of process waters that are characterized by high industrial chemicals content, that when discharged into public waters or refluxed into environment components, lead to ecosystemic hazards. The treatment of tannins containing wastewater is difficult, due to their high solubility in water, which is a limiting factor in conventional biological treatment methods, as it inhibits microbial growth in activated sludge.

## PROJECT SCOPE

The development of a combined wastewater (specific to textile and leather industry) treatment method, coupled with the execution of a customized treatment installation, with high efficiency and versatility, overcoming the disadvantages of currently used physical-chemical treatment. The technology relies on complementarity between three key components for reduction and breaking down of main pollutants in the treated wastewater volume. The three components refer to macromycetes strains, MBBR specific HDPE carriers and sonication treatment.

**Macromycetes strains** will be immobilized on biofilm carriers, for mechanical biomass fixation. High yields of biomass will be targeted, by macronutrients enhancement of growth rates. Several strains will be taken into consideration, such as: *Trametes versicolor, Pleurotus pulmonarius, Pleurotus ostreatus, Morchella importuna, Pleurotus eryngii, Pleurotus djamor, Pholiota nameko, Pholiota adiposa, Lentinula edodes, Ganoderma lucidum,Ganoderma lingzhi, Flammulina velutipes, Fusarium oxysporum, Cerioporus squamosus.*



The **MBBR** technology utilizes free-moving biofilm carriers, which represents a future evolution of the activated sludge process that allows a greater pollutant removal degree in smaller systems (i.e., bioreactors). The biofilm grows protected within small plastic carriers, which are carefully designed with high internal surface area. These biofilm carriers are suspended and mixed throughout the water phase.

Biotreatment will be closely followed by **sonication process** that beside the effluent sterilization role (due to pressure variation and cavitation), will disrupt microbial cell walls, and release iso-enzymes, that will further act as biocatalysts, mediating hydrolytic reactions. Sonication treatment stage will be used for destruction of both microbial load in the treated wastewater, yielding a post-sterilizing effect after the first treatment stage, and disruption of organic matrixes that are difficult to degrade.

**Acknowledgement**

**This work was funded by the Ministry of Research and Innovation, within National Project PN-IV-P7-7.1-PED-2024-1337, contract 62PED/2025 (3treat).**