Novel coatings for prevention of biofilm formation in drinking water distribution systems

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Background and motivation

Drinking water can get **contaminated by biofilms** formed in distribution systems[1]. Bacterial adhesion to surfaces is an energy driven process and is the first event for biofilm formation. The **modification of the surface** of the polymeric pipes, and thus their energy state, could be a possible strategy to avoid bacterial adhesion and prevent biofilm formation[2]. In our previous work, two hydrogel coatings, synthetized from **poly(sulfobetaine methacrylate)** (P(SBMA)) and **N-isopropylmethacrylamide** on real grade polymeric pipes materials, have been successfully tested against the adhesion of four drinking water bacterial strains. These coatings **increase the surface energy** and thus **repel** bacteria via electrostatic interactions.

In light of a future possible application of the coatings in real-case scenarios (Fig.1), further testing, development and optimization of the synthesis/coating process needs to be performed.

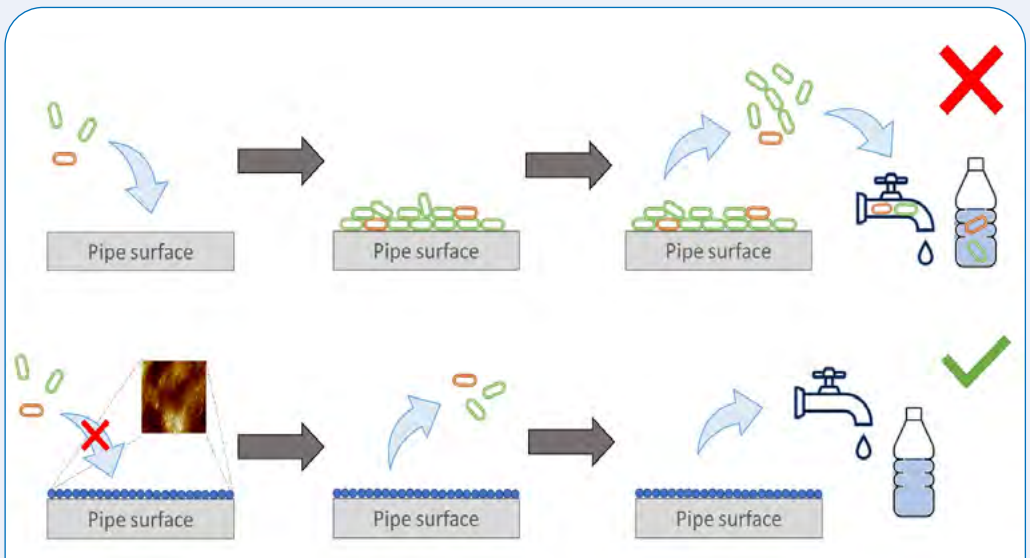

Fig.1. Graphical abstract of the proposed project

Technological challenges

- The coatings **stability** and **durability** has to be tested in time, and in response of varying turbulence and other influencing factors.
- The synthesis method needs to be adapted and modified for application at a **higher scale** and to keep the **costs low**.
- The formation of a **conditioning film** of organics and inorganics on top of the coatings can **compromise** the coating functioning after a certain period.

To address most of the research questions still open, one of the strategies will be to apply these coatings in a real-case scenario, utilizing an experimental setup in line with the water distribution, which can be monitored in time (Fig. 2).

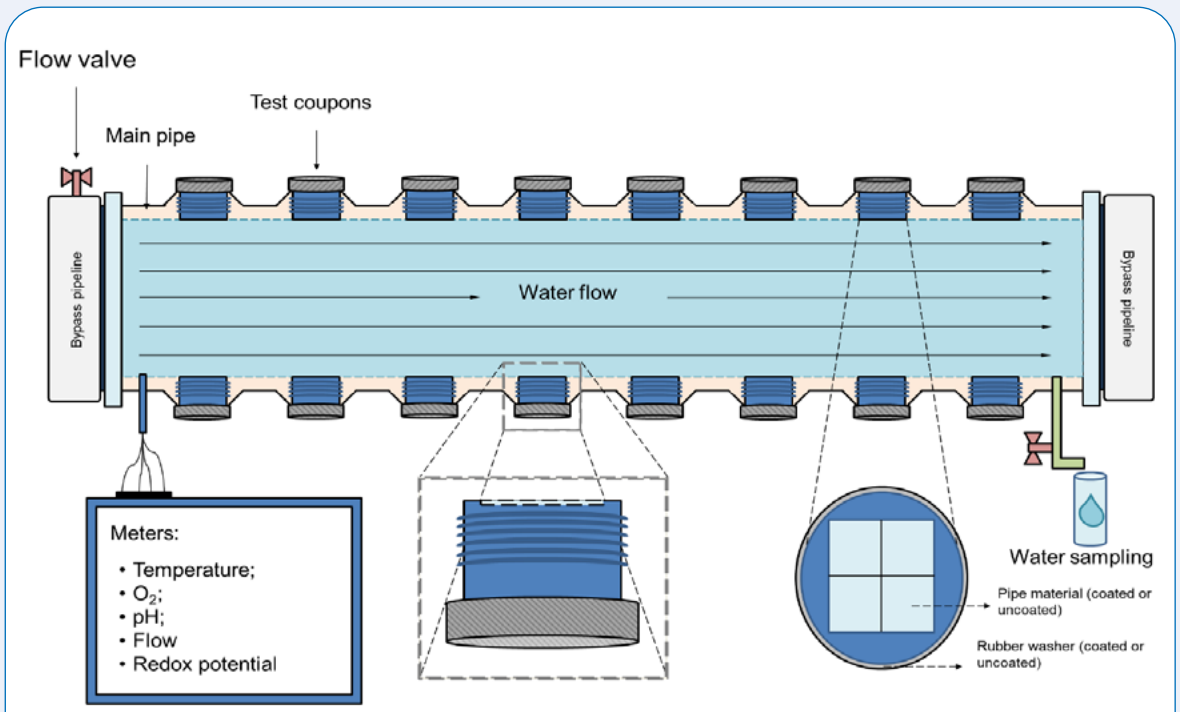

Fig.2. A modified Robbins device setup which bypass the water flow, to test coatings on real scale flow conditions

Research goals

- Development of new coatings synthesis protocols for future applications.
- Long-term testing of the coating stability and efficiency in bacterial adhesion prevention.
- Studying the possible influence of conditioning film deposition in time on coatings efficiency
- Improve the chemical composition of the coatings even further on the basis of the results collected.
- Investigate possible applications in other water facilities/ technologies

The final objective is to further boost the application of these thin layer coatings as an **easy** and **effective** strategy to extend the life of those materials in contact with drinking water which usually favours biofilm formation.

References

[1] Wingender, J. & Flemming, H.-C. Biofilms in drinking water and their role as reservoir for path-ogens. Int. J. Hyg. Environ. Health 214, 417–423 (2011).

[2] 2. Carniello, V., Peterson, B. W., van der Mei, H. C. & Busscher, H. J. Physico-chemistry from initial bacterial adhesion to surface-programmed biofilm growth. Adv. Colloid Interface Sci. 261, 1–14 (2018).

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