Foam flow cleaning of surfaces contaminated by Bacillus spores: impact of complex geometries mimicking food equipment

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The use of foam flow could represent an interesting alternative to conventional cleaning procedures in place for the cleaning of equipment surfaces contaminated by bacterial deposits, as equipment hygiene remains a major concern for the food industry. In this context, cleaning with wet foam (0.5 air/water fraction) has been proposed as an innovative method for cleaning closed equipment generating mechanical actions comparable to conventional procedures with a better efficiency in removing Bacillus spores.
A comparison between foam flow cleaning and standard cleaning-in-place (at the same shear stress 10 Pa, and using the same SDS surfactant (Sodium Dodecyl Sulfate 0.15% w/w)) was performed to test the potential of this novel approach to improve the cleaning efficiency of 2B stainless steel surface soiled by Bacillus subtilis PY79 spores. In the case of a straight pipe, the detachment of spores using foam flow resulted in about 3.6 log CFU reduction after 20 min cleaning compared to around 2 log CFU with CIP. In addition, a Life Cycle Assessment study shows that foam flow cleaning has significant benefits on the environmental impacts (around 90% less than CIP) with a drastic reduction in water and energy consumption.
In order to investigate the feasibility of using this method to clean actual food equipment, the first step was to assess how the effectiveness of cleaning by foam flow could be affected as a result of passing through various geometries. Various singularities widely encountered in food equipment design, such as the elbow, sudden expansion-contraction and check valve, were chosen. Compared to a straight pipe, the cleaning efficiency could be reduced by more than 1 log. However, it seems that depending on the singularity, this reduction in cleaning efficiency is more or less important. Indeed, these differences seem to be linked to the induced modifications of the size and organisation of the bubbles and on the stability of the foam itself.