System of the Particle-Permeation Controllable Soap Membrane Filter With High Self-Recovering Property as Multiscale Particle "Switches"

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Microplastics are exponentially increasing worldwide, causing destructive impacts on marine life and humans. The existing approaches to overcome this crisis may involve using natural or artificial filters, which are highly inefficient because they only filter out macroscopic objects, have limitations in manipulating the size of holes, and require multiple layers, proving the need for development. This project directly enhances the filtration rate of microscopic particles by proposing a system of particle-permeation controllable soap membrane filter, a binary layer of soap membrane forms which represent reverse filters. Ahead of investigating the compatibility as micro-scale filters, the maximization of self-recovery characteristics was proceeded by changing the ratio between three parameters through two different tests. Then, five parameters related to the performance of the single membrane layer were experimented followed by the physical model involving energy analysis. Also, a secondary soap foam layer was experimented with three parameters for each phase to dampen the descending velocity of large particles, decreasing the occurrence of non-filtration due to film rupture. Based on experimental verification, the membrane filter system was constructed using a film generator and the foam regulator to vary the characteristics of the membrane, optimizing the best state of filtration. By creating various filter prototypes of conventional methods, the models' performances were tested by continuous trials of particle group penetration. As a result, the system filtered the target particles with 138.9% average retention accuracy compared with current traditional models, significantly improving the overall filtration performance along with increased accessibility.

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