Improving the Efficiency of Soluble Coffee Manufacture via Membrane Systems

Rowan University

CURRENT PROCESS

Nestlé USA Freehold, NJ beverage factory, instant coffee production, involves thermal dewatering methods to produce soluble coffee powders. Coffee manufacture requires large amounts of energy and generates wastewater. Evaporation removes most of the water during production, and therefore is one of the most energy-intensive steps.

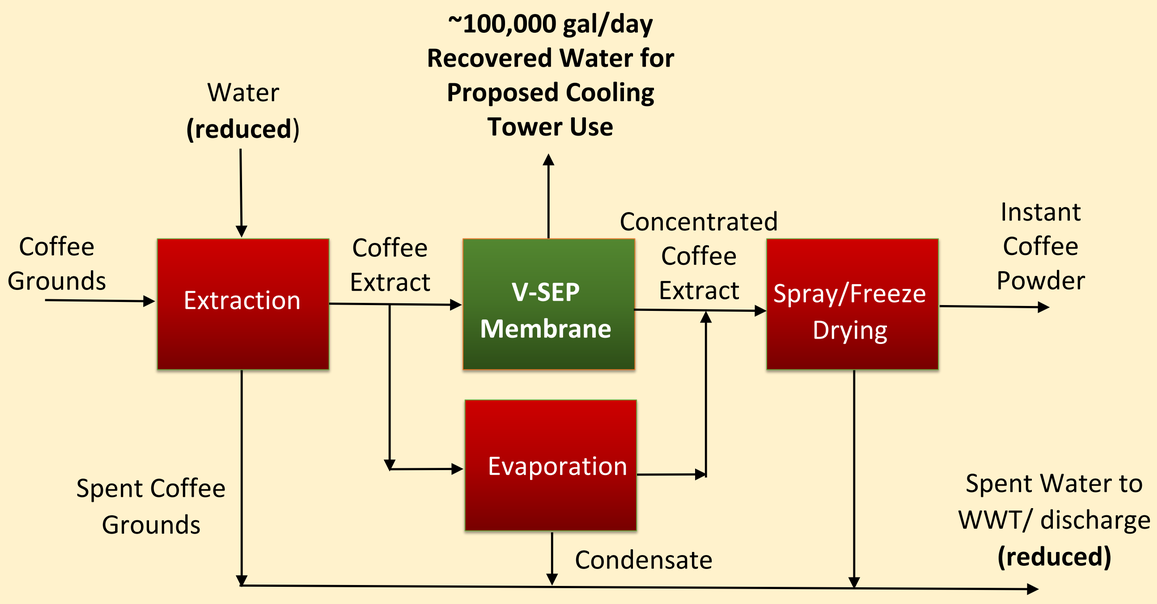
BACKGROUND

Using membranes as an alternative to, or in combination with evaporation, could address these problems of energy-usage while retaining coffee powder qualities such as aroma and taste. The added benefit is that membrane processes can recover water for reuse in factory operations, such as in cooling towers. Membranes have been used in previous food processing applications such as powdered milk production. One of the problems with membranes, however, is that the surface and pores foul after continuous use, reducing overall efficiency. Vibratory shear-enhanced processing (VSEP) membrane systems mitigate this problem by using oscillatory vibration to create high shear at the membrane's surface. This technology offers a promising area of research for more sustainable manufacturing.

ROWAN SOLUTION

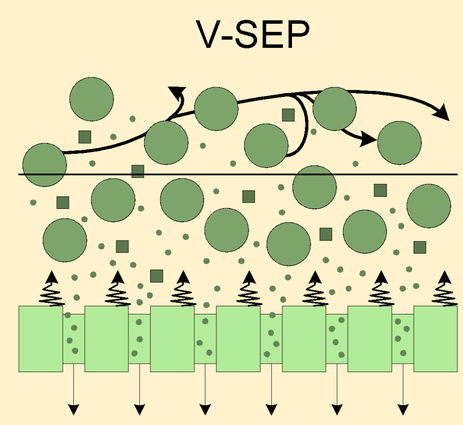
The feasibility of using VSEP membrane processes to pre-concentrate coffee extract was investigated, the proposed membrane process was compared to the existing evaporation process in costs and environmental impact.

- Preliminary testing shows process is more energy and cost efficient
- Process produces reusable water that can be utilized by plant



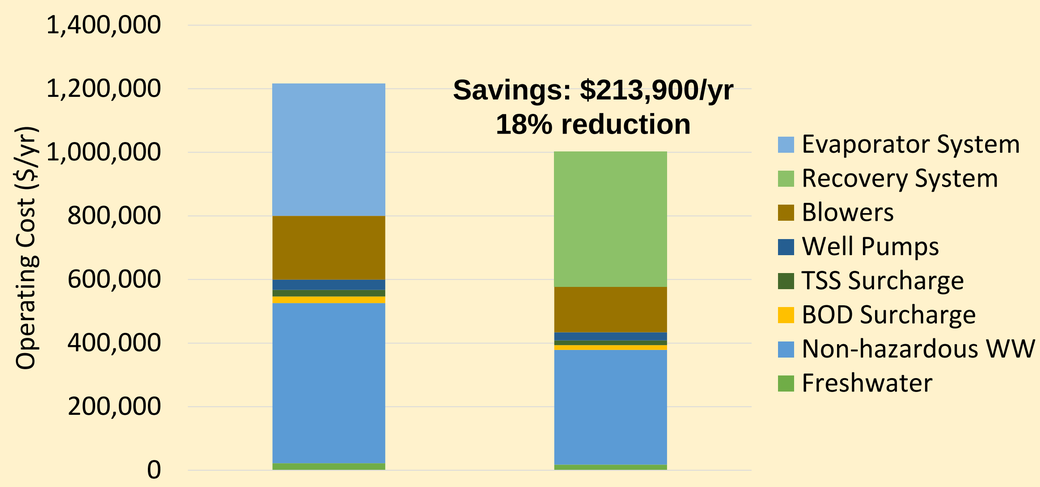
VIBRATORY SHEAR-ENHANCED PROCESSING (VSEP)†

- High shear rates (vibrational displacement) prevent surface and internal fouling
- Helps reduce and maintain constant permeate flux throughout separation

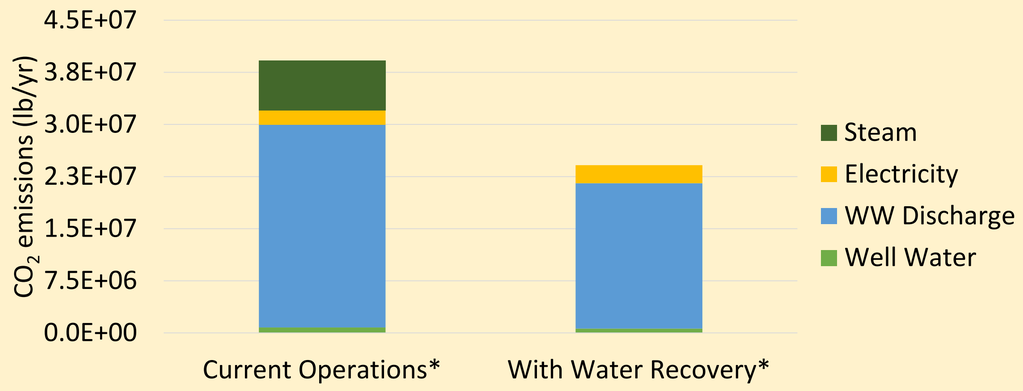


Design proposal using membrane system shows 100,000 gal/day freshwater can be saved in a projected overall operation

Preliminary Economic Assessment*



Preliminary Environmental Impact* (Life Cycle Emissions)



- CO_2 emission reduction: 15.1 MM lb/yr
- Total emission reduction: 15.1 MM lb/yr

*Based on a projected overall operation

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†Wisniewski, Slater, Savelski, *Clean Tech. Environ. Policy*, 20, 1791–1803, 2018. https://doi.org/10.1007/s10098-018-1569-4