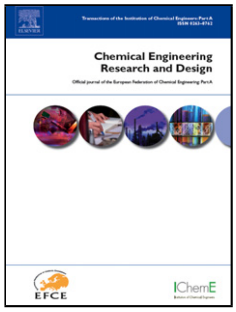

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Study of Water Reuse Opportunities in a Large-Scale Milk Processing Plant through Process Integration

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Highlights

Cleaning-in-place (CIP) requires large quantities of water in the dairy industry

Optimization for minimizing water usage during CIP is studied in this work

Opportunities for water recycle/reuse together with reverse osmosis based regeneration has been explored in a large diary

Solution of the resulting MINLP model results in significant reduction in freshwater consumption and wastewater generation

Abstract

The dairy sector in India, being the largest milk producer in the world, consumes substantial amounts of water annually. This industry is, therefore, likely to affect water sustainability in India in the near future. Amul Dairy, is the largest food brand in India and as such consumes large amounts of water annually. The cleaning-in-place (CIP) processes at Amul Diary account for nearly 75% of the total water consumption. The raw milk receiving and processing department (RMRD) requires nearly 90% of the total water used in CIP. This work, therefore, investigates the water usage in Amul Dairy and identifies the prospects of water reuse by using optimization techniques for minimizing water usage in the RMRD. This was achieved by treating the wastewater from the RMRD plant by means of a reverse osmosis (RO) membrane in order to allow opportunities for regeneration-reuse/recycling in the CIP process. An overall mixed-integer nonlinear programming (MINLP) framework was developed that simultaneously evaluates both water recycle/reuse and regeneration reuse/recycle opportunities. The model applied to the CIP process in the RMRD plant resulted in 33% reduction of freshwater consumption and 85% reduction of wastewater generation.

Keywords: Diary Industry, Optimization, Water Reuse, Process Integration, Sustainability