



Innovative process design for energy efficient milk powder production

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Background

Sustainability is a major topic in the food industry nowadays. Products have to be produced in an energy and water efficient way. The dairy industry is one of the most energy intensive sectors in food processing; mainly concentration and drying are responsible for high energy consumption. The way milk powder is produced has not changed radically over 50 years. While in the last decades innovative processing methodologies have been introduced, which can lead to breakthroughs in energy and water efficient processing.

Objective

The objective of this work is to optimize and redesign the milk powder production chain; making efficient use of energy and water, and increasing the use of renewable resources.

What is the potential of emerging technologies to improve the energy efficiency of milk powder production?

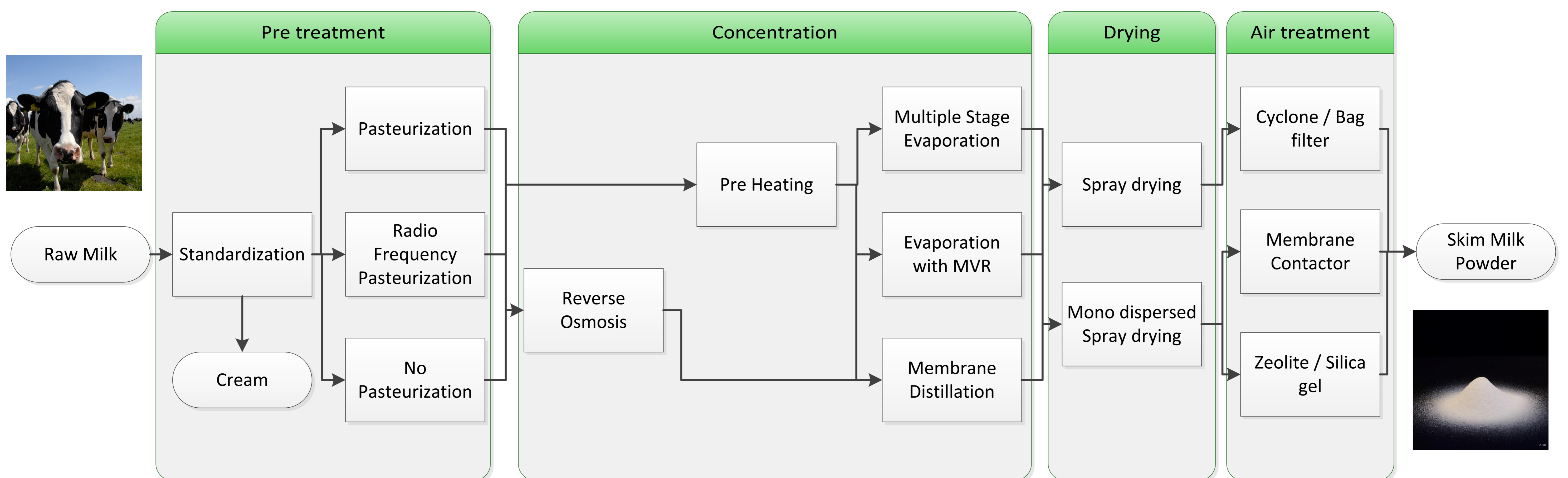


Figure 1. Superstructure of the different production processes of skim milk powder.

Approach

Introducing new technologies at different stages of the production chain will have an influence on the whole chain performance, both up and downstream. Simulation and optimization are needed to model these interactions. By representing the different unit operations in a superstructure, see Figure 1, and applying multi-objective optimization, trade-offs between costs, energy and water consumption are generated. These trade-off results will lead to optimal process configurations.

Preliminary results

Figure 2 shows the benchmark made for the current energy consumption of skim milk powder production. The new situation consists of the optimal combination of emerging technologies with the current ones. First estimates result in a **63% energy reduction** by introducing new technologies to the current way of milk powder production. Especially the implementation of mono dispersed drying, and thus air recycling, and membrane distillation will lead to high energy reduction.

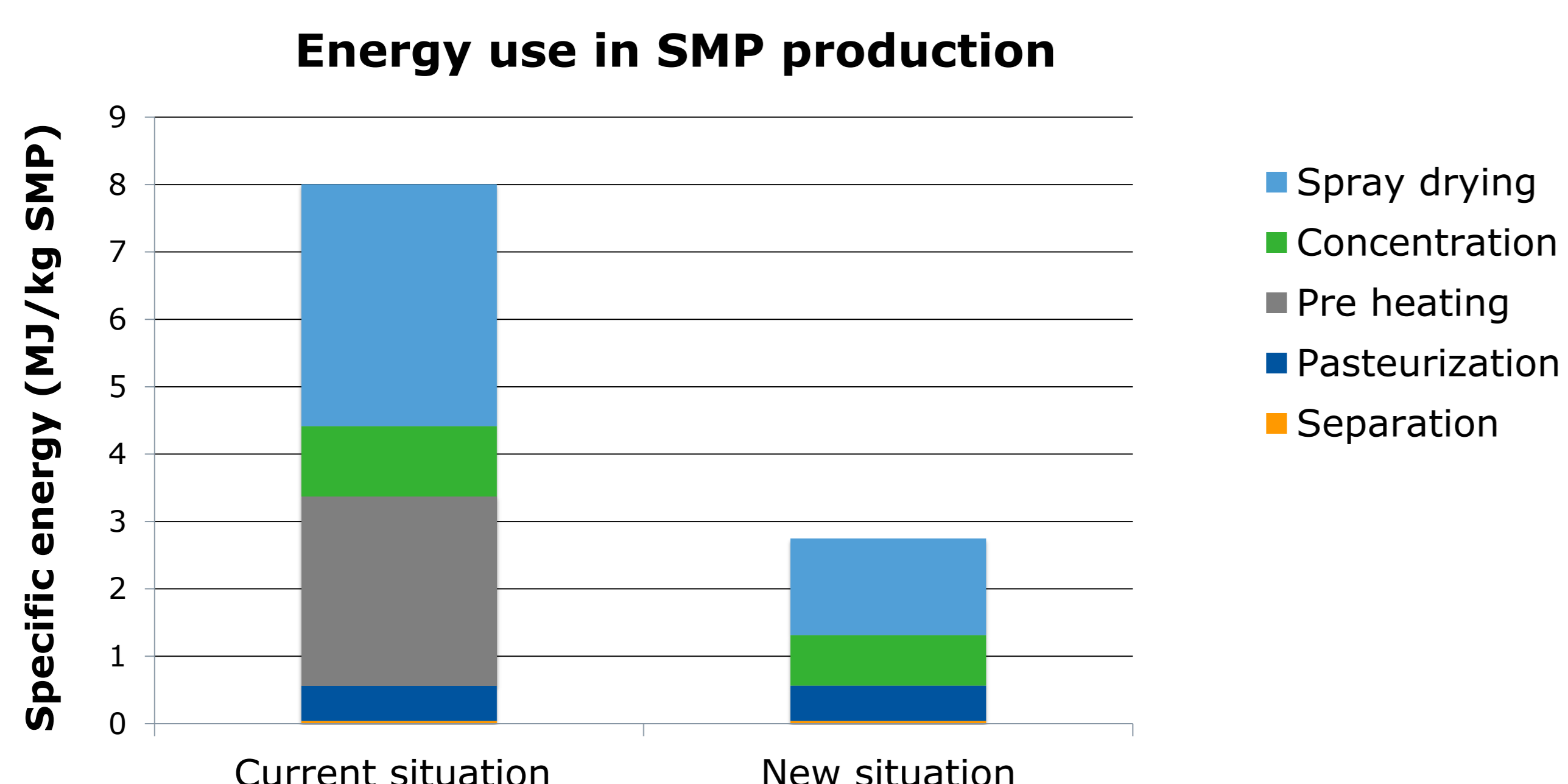


Figure 2. Comparison of the energy use for the production of skim milk powder (SMP) between the current situation and the situation with the best combination of innovations.

Future work

- Single unit optimization
- Whole chain optimization
- Reduce energy and water consumption
- Make use of renewable energy sources
- Enlarge energy and water recovery
- Pilot plant validation of new chain

