Filtered Milk for Cheese and Ingredient Production
International Developments

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Background

- Study commissioned by the US Dairy Export Council concerning microfiltered milk ingredients (MMI). This was recently published by USDEC and provides a strategic assessment of the international production, technology and market development situation for MMI products for cheese and ingredient applications.

- Research for the study was carried out by DH Business Consulting over the period November 2015 - February 2016.
Overview – Ultrafiltration and Microfiltration

- Ultrafiltration first introduced commercially in the 1970’s and now extensively used for protein standardization of cheese milk.
- Widely adopted on a global basis – UF operations used for cheese production throughout Europe, North and South America, Oceania.
- Ultrafiltration can be readily integrated into cheese plants and complements conventional whey protein processing.
- Microfiltration first used for the production of cheese in the early 1990’s.
- Adoption of MF for casein enrichment of cheese milk has been largely confined to the European Union.
- Compared with UF, significantly greater challenges may arise when attempting to integrate MF capabilities with cheese and whey processing operations.
Milk Microfiltration – origins and development track

- Microfiltration – the oldest of the semi permeable membrane technologies with origins dating to 1920’s Germany
- Industrial applications for MF advanced in the 1960’s and 1970’s with the development of ceramic membranes – at the time primarily used by the nuclear energy industry in France and the United States
- Technology was subsequently transferred to the dairy industry in France leading to the first research on dairy applications starting in the late 1970’s
- Substantial basic development conducted during the 1980’s leading to roll out in the dairy industry by the latter part of the decade and increasing processor adoption of the technology from the 1990’s
- This work was carried out using ceramic membranes as the platform. Development of polymeric spiral wound membranes came later
Process flow basics – milk protein fractionation

Source GEA Process Engineering
European Union – Current production situation for protein fractionation

- 40 - 50 process installations with capability to fractionate milk proteins via microfiltration technology

- First commercial adoption dates from the early 1990’s

- Two categories of operation
  1. Facilities using MF for solely for cheese milk enrichment (the majority)
  2. Companies engaged in the production of microfiltered milk ingredients (MMI) including use in cheese

- Nine companies currently involved in the manufacture and marketing of ingredient products from microfiltered milk. Three additional processors considering investment
**EU – Manufacturer Profile – milk protein fractionation**

### Commercial Use of Microfiltration Technology in the European Union

#### For Cheese Production

- **40+ installations**
- **France, Germany, Netherlands, United Kingdom, Italy, Austria, Poland**

#### For Ingredient Manufacturing (including use in cheese)

<table>
<thead>
<tr>
<th>CLHN</th>
<th>Cremo SA</th>
<th><strong>Potential Manufacturers</strong></th>
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<tr>
<td>Ingredia</td>
<td>FrieslandCampina</td>
<td>Arla Foods Ingredients</td>
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<tr>
<td>Lactalis</td>
<td>Muller-Sachsenmilch</td>
<td>Bayerische Milchindustrie</td>
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<td>Milei</td>
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<td>Laita-EPI</td>
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<td>Sodiaal</td>
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<td>Valorlait</td>
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Progressive commercial development

- First wave of development in the 1990’s with use of MF for cheese

- Starting in the 2000’s a few early adopter companies commenced ingredient production
  - By 2010 6 companies involved
  - By 2015 9 companies involved
  - By 2018 12 companies ??

- Pickup in investment activity over 2014-2016 with at least seven new projects announced comprising new operations or expansion of existing facilities scheduled for completion by 2018

- Use in cheese was the original investment driver. A wider range of factors involved with more recent development and investment
## Business development drivers for investment in microfiltration and milk protein fractionation

**Source:** DH Business Consulting

<table>
<thead>
<tr>
<th>Business Development Drivers</th>
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<tbody>
<tr>
<td>➢ Removal of EU milk quotas</td>
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<td>➢ Interest in milk as a raw material</td>
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<td>➢ Diversification in raw milk utilization</td>
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<td>➢ Sustainability</td>
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<td>➢ Cheese milk enrichment</td>
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<td>➢ Derivatives Demand</td>
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<td>➢ Food ingredient demand</td>
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<td>➢ Facilitates production of organic dairy products</td>
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<td>➢ Milk permeate utilization</td>
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Business Examples – Valorlait

- Valorlait – a joint venture company established by a raw milk cooperative (Union Laitière de la Meuse) in northern France and a nearby cheese company (Fromage Ermitage)

- Starting in 2010 the partnership invested in a basic milk separation and microfiltration facility in a central location within the milk pool

- Fluid microfiltered milk is sold by the JV and shipped to the cheese company for casein enrichment of cheese milk

- From treating an initial milk volume of 500,000 pounds operations have grown with three stages of investment to a current capacity of 2 million pounds per day including sales to third parties
Business Examples – Muller Sachsenmilch

- Muller Sachsenmilch – a subsidiary of the large family owned dairy company Molkerei Alois Muller

- Microfiltration operations are carried on at the company's Sachsenmilch plant in eastern German. The plant has total daily milk capacity of over 11 million pounds

- The facility comprises an extensive set of processing operations – fluid milk, dairy beverages, cultured products, fresh and hard cheeses, whey products and milk protein ingredients

- Microfiltered milk retentate is used internally for the production of consumer dairy products. MF operations also used to manufacture dry micellar casein and serum protein ingredients for external sale
Sodiaal

• Sodiaal – French cooperative with diversified operations including cultured dairy, cheese, whey processing and nutritional products

• Utilizes internal MF installations in line for cheese milk enrichment

• Contract purchases external MF retentate for use in in-house production of cheese

• Investing in new facility to manufacture organic infant formula containing serum protein from microfiltered organic milk. Retentate will be shipped from a central microfiltration facility to local cheese operations
Process Technology Adoption and Implications

- Manufacturing capacity for milk microfiltration and cheese milk enrichment initially relied on ceramic membrane filtration technology (CMF)

- Around 2005 polymeric spiral wound membranes were introduced commercially for the first time (PMF)

- Both technologies have been adopted for cheese milk standardization and ingredient manufacturing applications. Manufacturing capacity in the dairy industry is currently divided between the two equipment systems

- CMF has proven to be a reliable if costly technology. Involves larger capital investment and operating cost compared to PMF. The systems differ in terms of key process conditions and outcomes such as product compositions and operating efficiency
Summary

- Microfiltration has been used for cheese milk standardization for nearly 25 years
- Most widely adopted in France followed by other EU countries
- Pickup in investment activity 2014-2016 with at least seven new projects announced comprising new operations or expansion of existing facilities for completion by 2018
- Adoption of MF technology was originally driven by cheese milk standardization benefits. While this remains a significant factor, recent investment activity is also the result of additional drivers
- MF has had a lower level uptake compared to UF. Rate of MF adoption have been influenced by multiple interacting factors including challenges with operating complexity, technology selection, investment cost and regulatory considerations
Acknowledgments

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Thank you

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