



# FIET

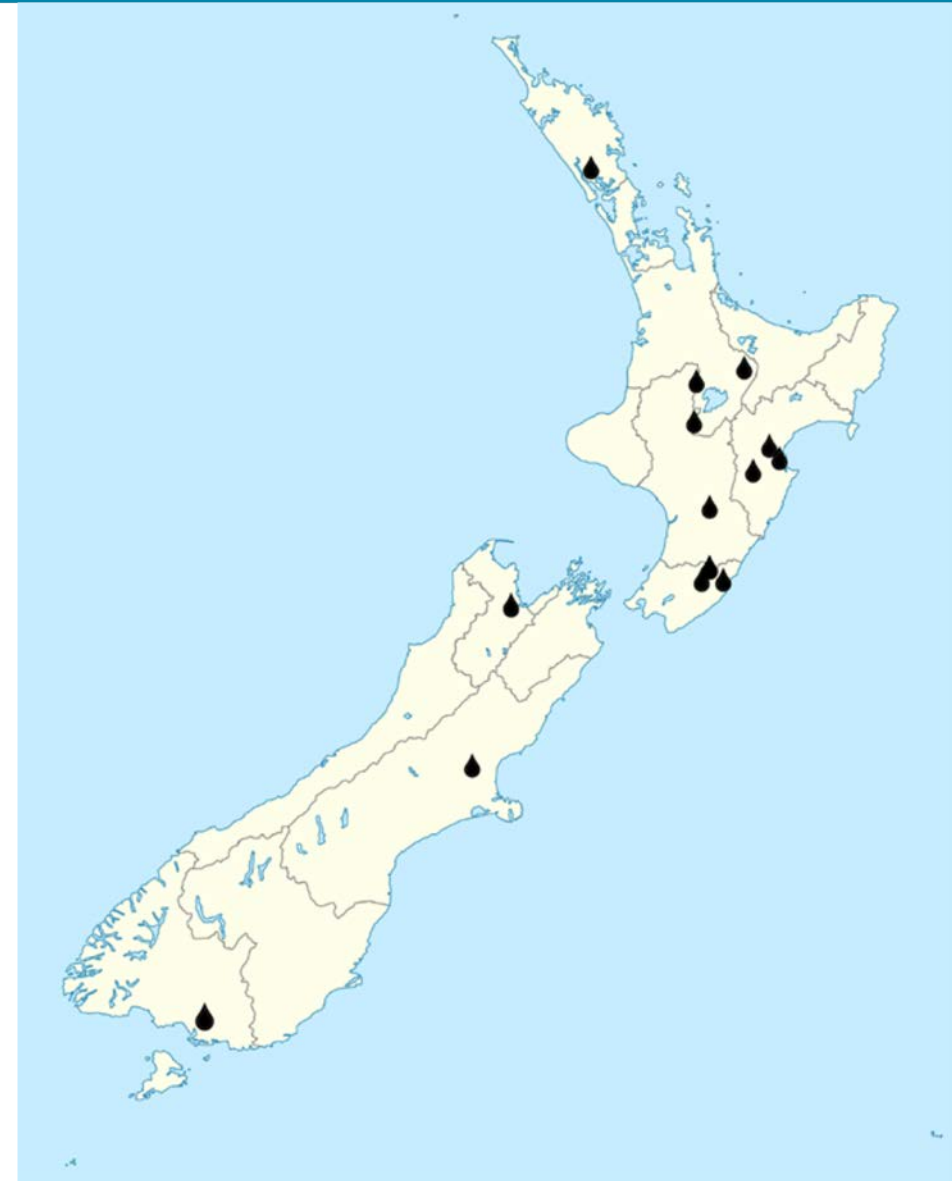
Food Industry Enabling Technologies

## Rapid Milk Freezer

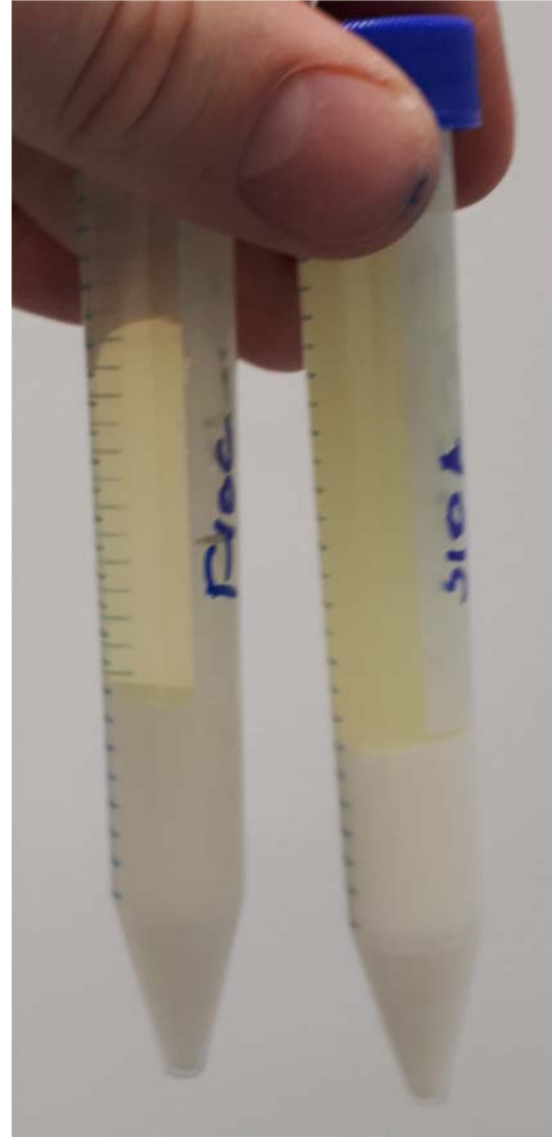


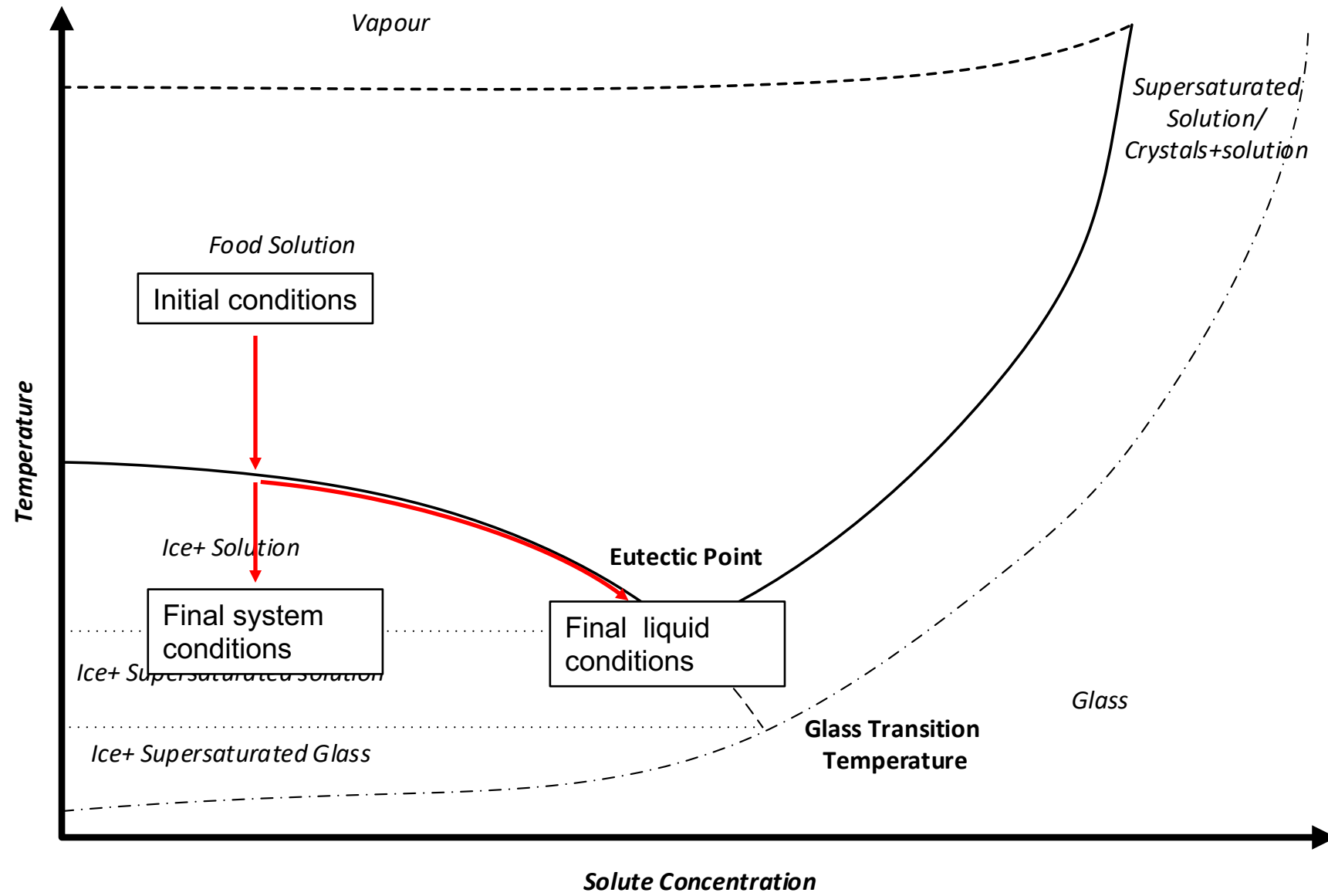
- **FIET**
  - Food Industry Enabling Technologies.
  - Community working on increasing NZ's export earnings through novel technologies.
  - MBIE-funded
- **Massey University PN**
  - Two Academic staff, one Post-Doc/ Research Officer and One PhD student (me).

- Small, far flung producers.
- Limited number of processors.
- Large processors want suppliers.
- Uneconomical to pick up milk regularly.
- Need to aggregate and store several collections of milk before transport.
- Freezing is sometimes used.

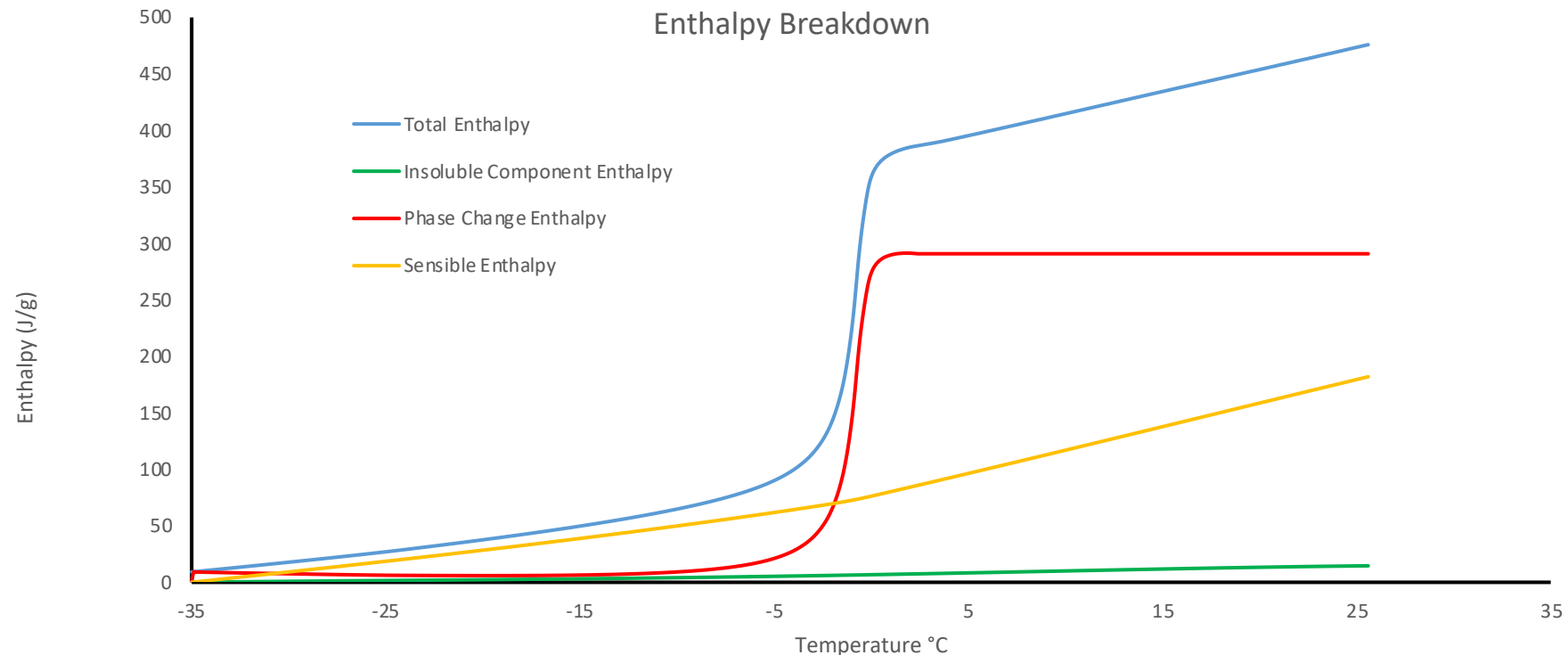


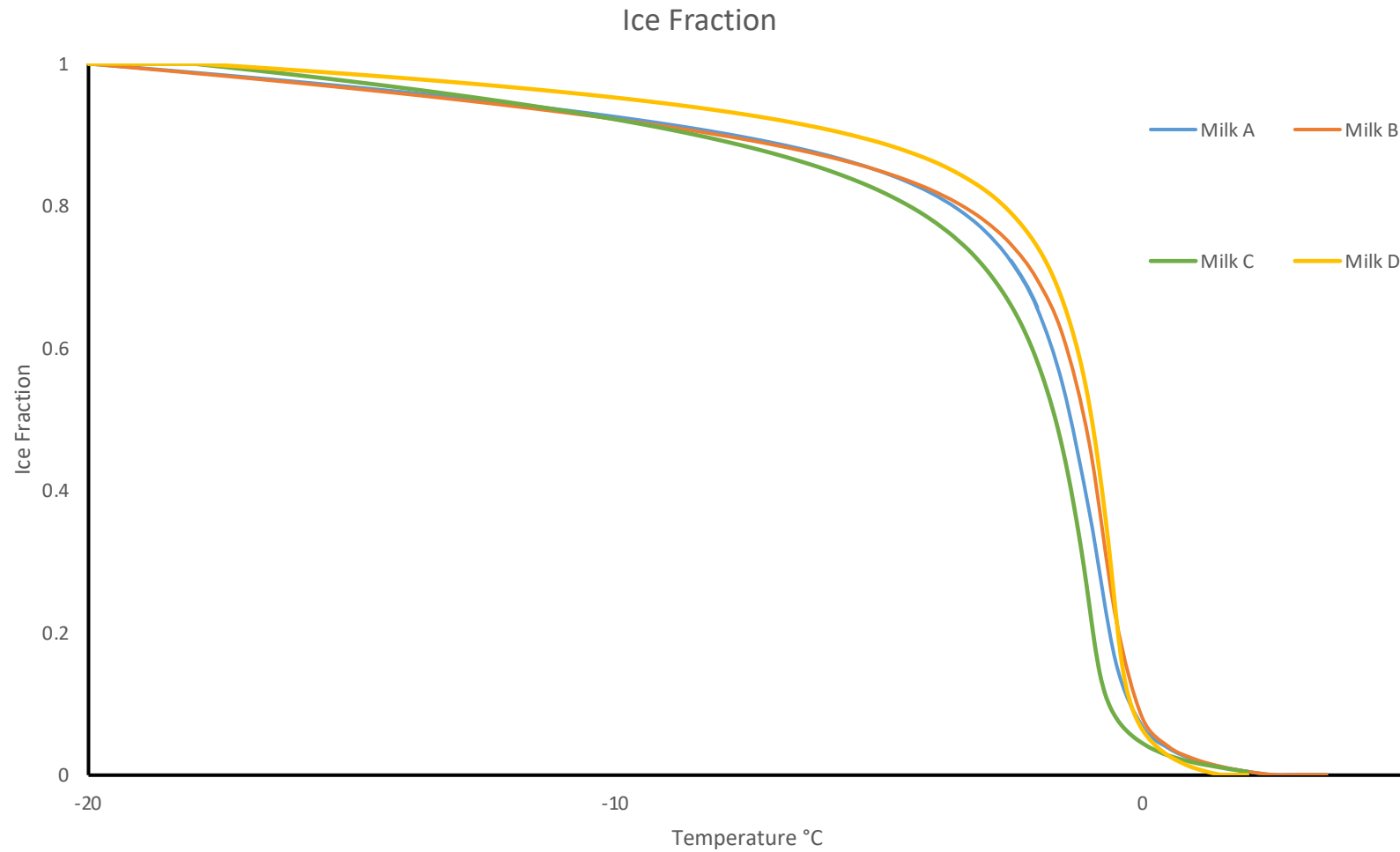
- Avoid damaging milk during freezing and frozen storage.
- Develop a reliable, affordable on-farm freezer.





- DSC tracks heat flows during heating and cooling of a sample
- We can break down the heat flow between two temperatures, and use this to work out how much water is frozen in the sample.





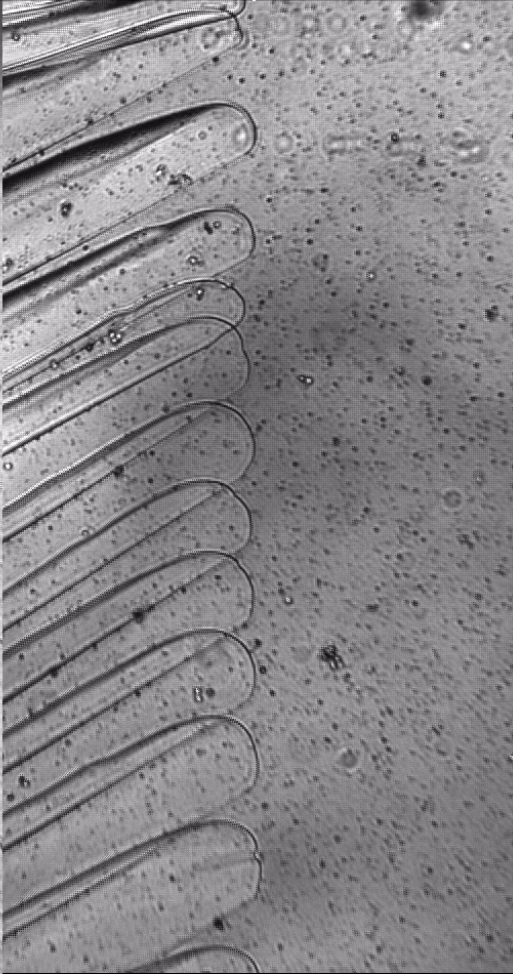


# Ice Morphology

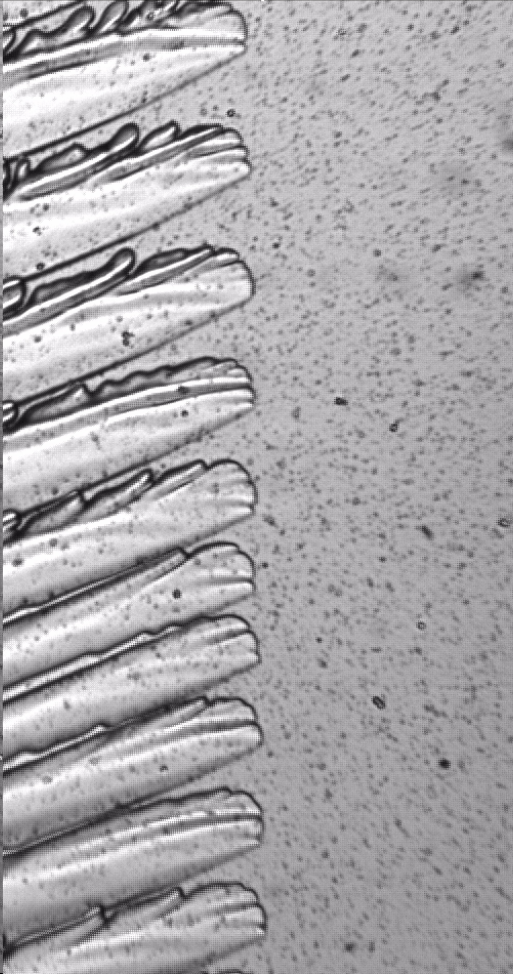
$<0.5\mu\text{ms}^{-1}$



$2.0\mu\text{ms}^{-1}$



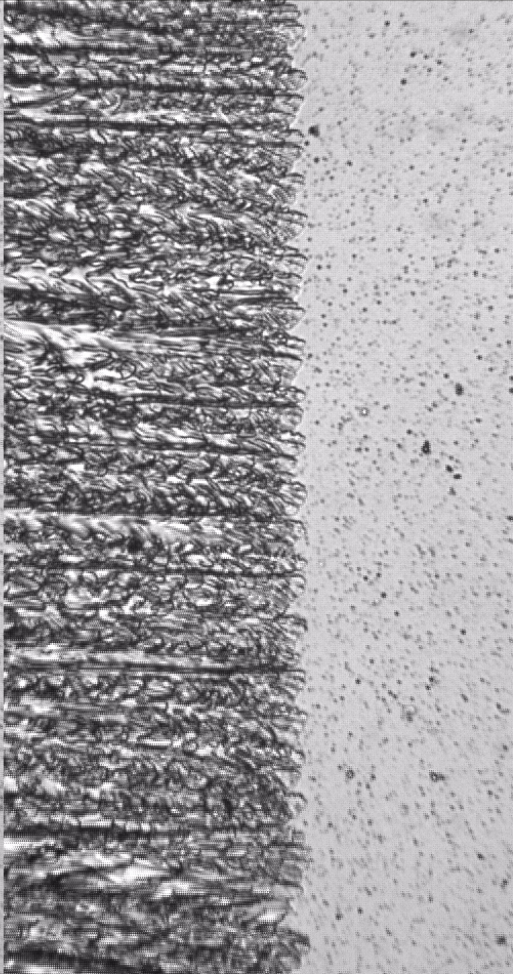
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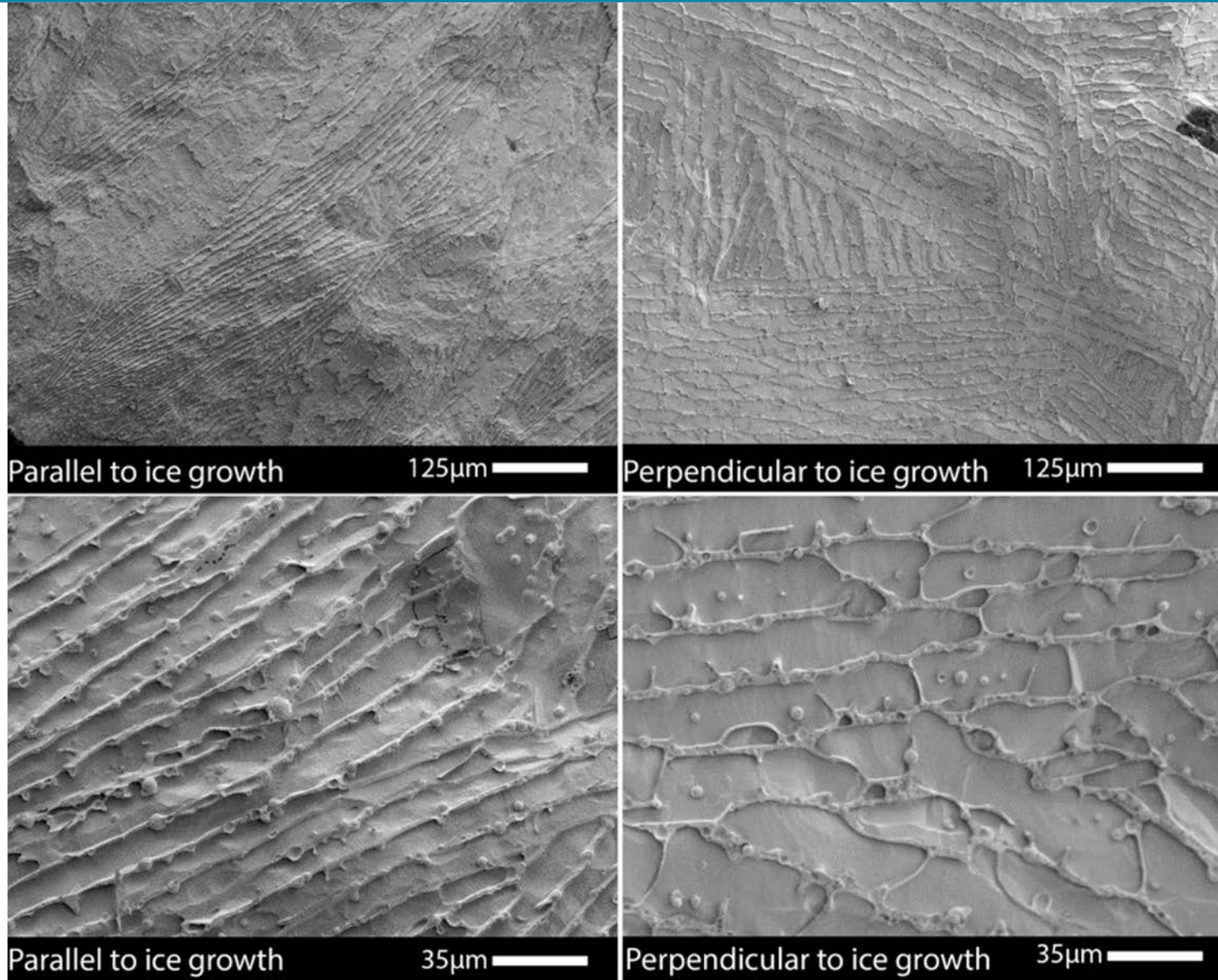
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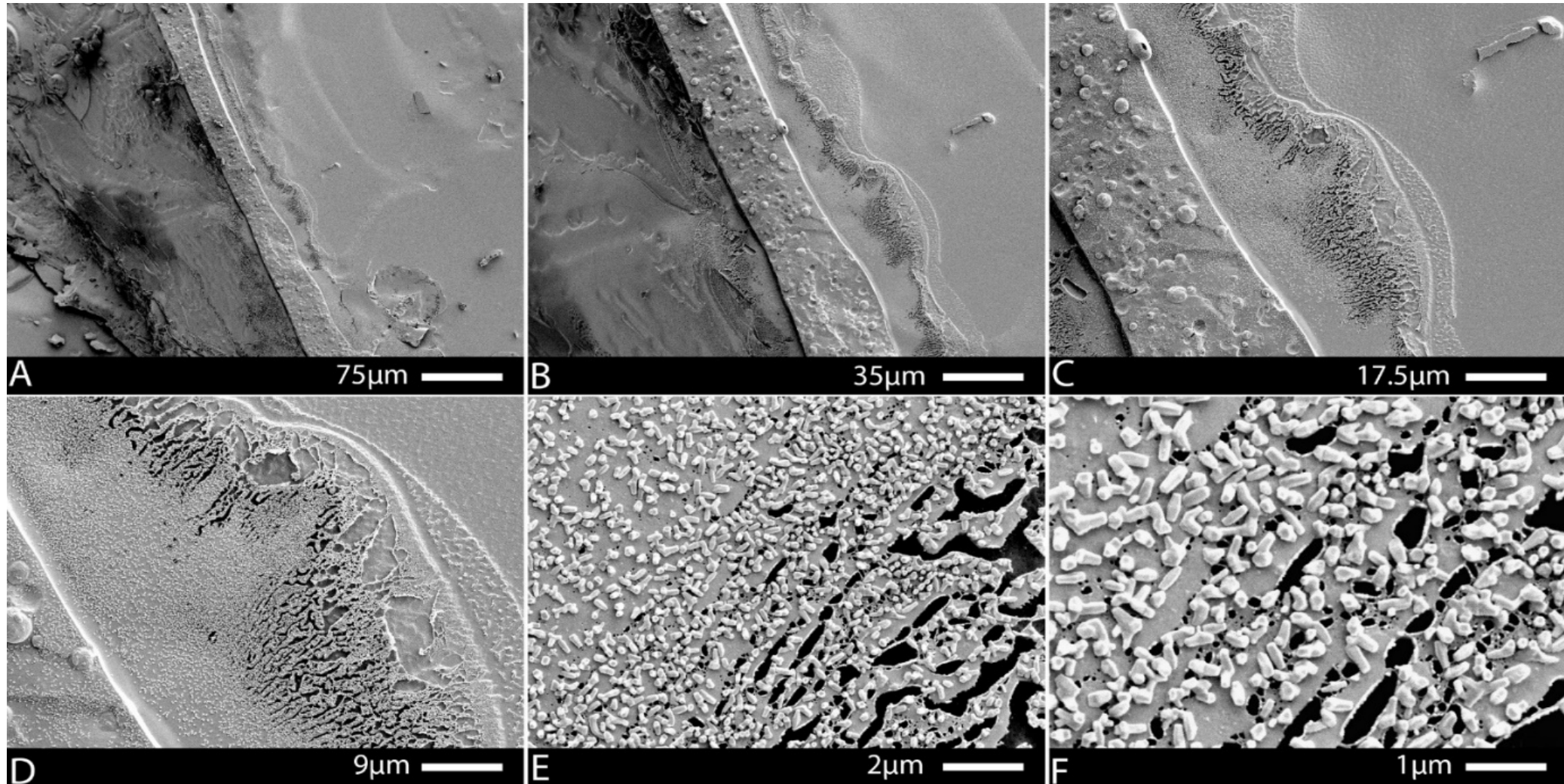
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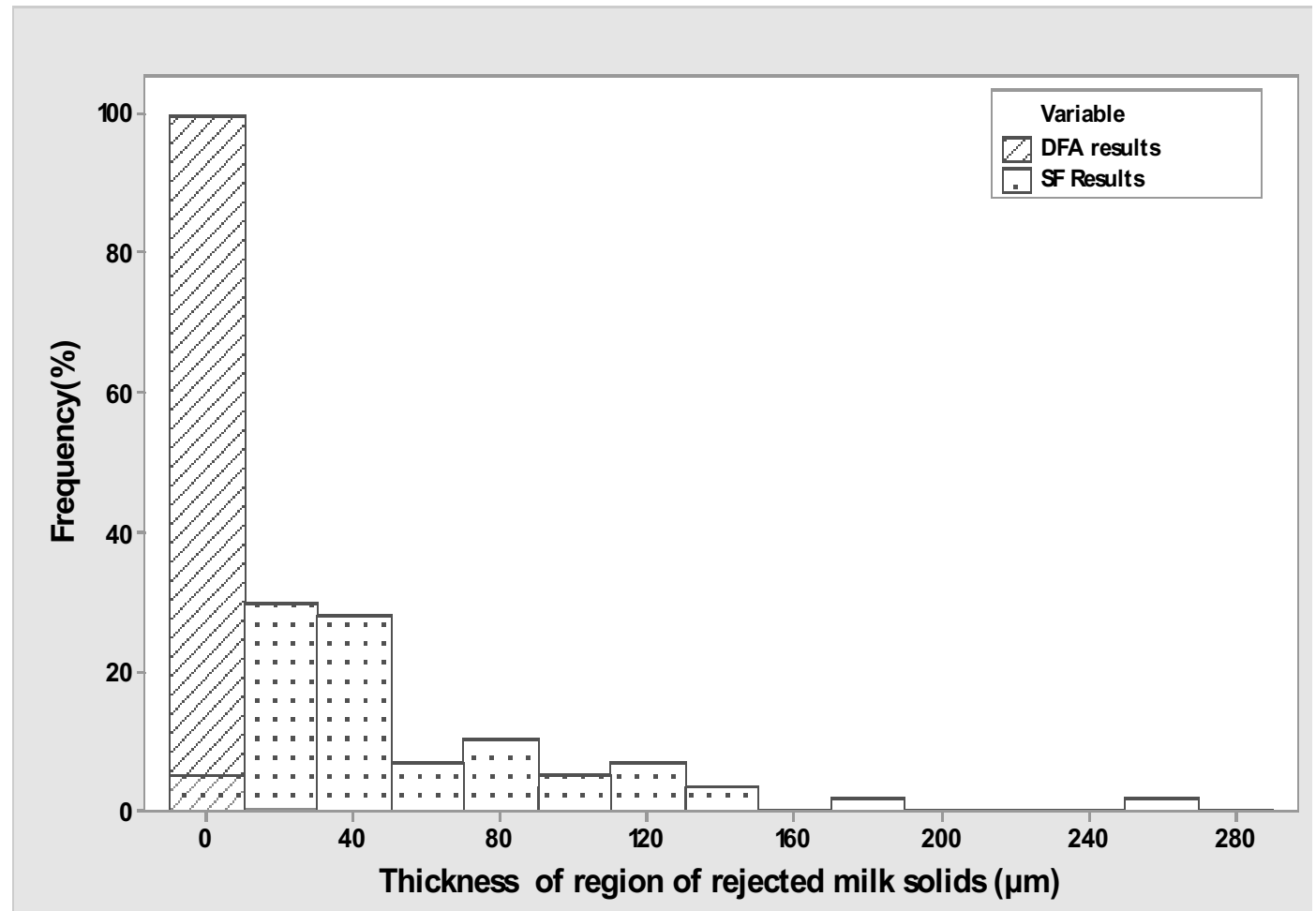






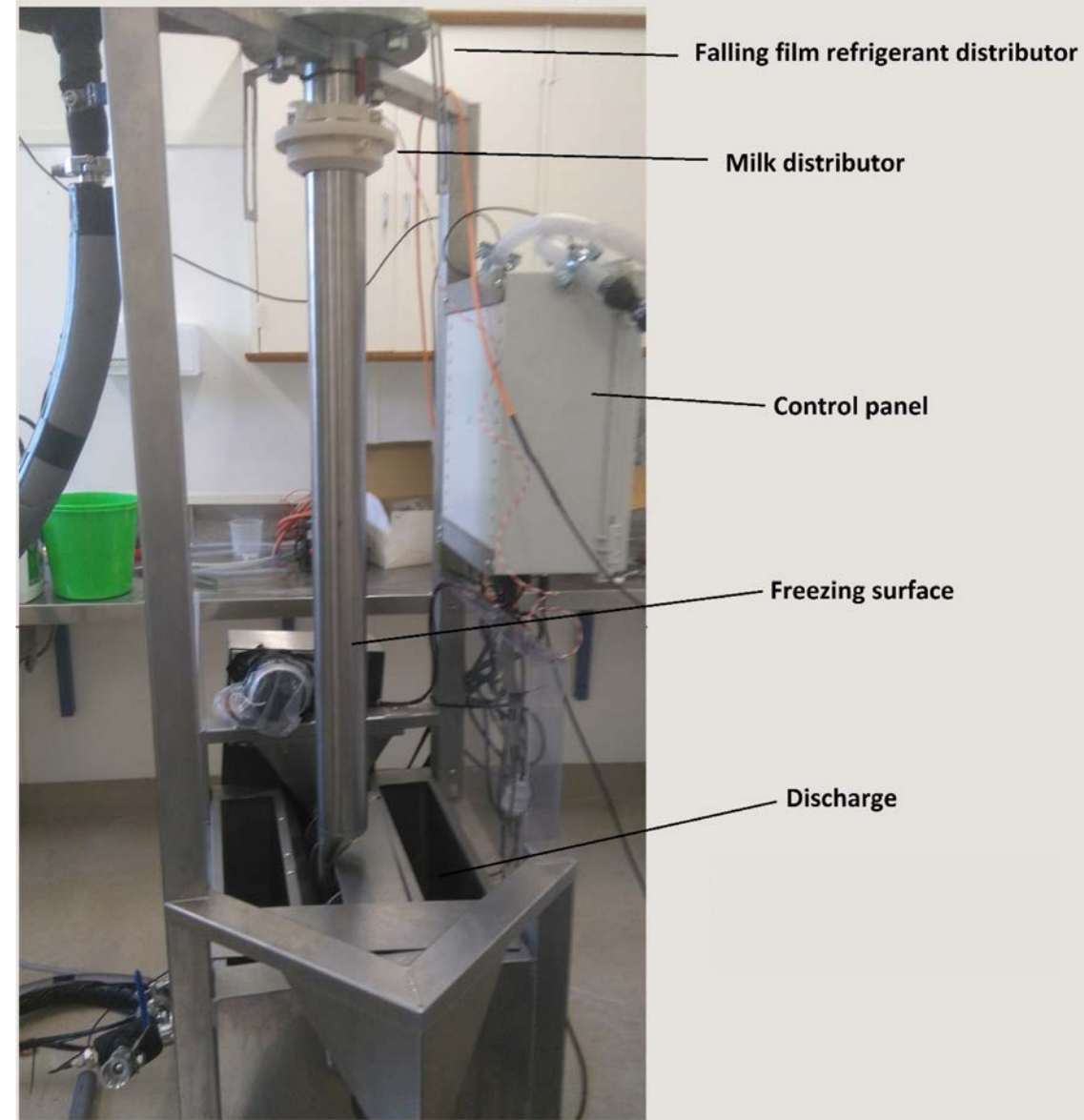


- Soft particles become noticeable as “grittiness” over  $\sim 80\mu\text{m}$
- The slow frozen samples have bands this large, but not the rapidly frozen samples:
  - $3.23 \pm 1.54\mu\text{m}$  for rapidly frozen
  - $55.3 \pm 48.8\mu\text{m}$  for slowly frozen



# Falling Film Freezer

- Trialled with water+ Milk
  - Even at high freezing speeds, still slight freeze concentration. Decrease in milk concentration during process 17.7% vs 19.8%.
- Water ice is removed easily by a pulse of heat.
- Frozen milk is significantly more “cohesive”- water ice is brittle.
- Frozen milk doesn’t crack and detach like water ice- needs to be scraped off.
- System modified with scraper.





- Builds on the work done thus far.
- Combines several cooling and forming steps to make pelletised frozen milk.
- Designed to maintain high levels of food hygiene.
- Extremely robust and compact.
- Very economical Capex/Opex
- Currently working through commercialisation with manufacturer and patent applications.



# Possible Processes

