# Doped Diamond-Like Carbon (DLC) coated surfaces to reduce fouling from milk

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## Materials and methods

### Experimental surface
- Doped Diamond-Like Carbon (DLC)
  - DLC-1
  - DLC-2
  - DLC-3
- Unmodified stainless steel (316 SS 2B)

### Fouling fluid
- Raw whole milk
- Whey Protein Isolate (WPI) solution

### Fouling measurement
- Invasive methods
  - Weight of fouling deposit
  - Qualitative - visual observation
  - Chemical composition
- Non-invasive methods
  - Heat transfer coefficient (U-value)
  - Pressure drop (ΔP)
  - Hot water inlet temperature

## Theory and mechanism of fouling
- Heat denaturation of proteins
- Interactions with proteins and minerals

## Fouling deposits on processing surfaces

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## Results

### Milk fouling

#### (a) Lab scale

#### (b) Pilot scale

### WPI fouling

#### (a) Lab scale

#### (b) Pilot scale

## Summary
- When raw whole milk was used to study the commercial processing conditions, daily variation in milk composition led to wide variations in fouling behaviour between experiments.
- About 5 - 15 % less fouling deposits were observed on all three DLC coated surfaces at lab scale (Fig. 7a).
- The difference between control and DLC-1 was statistically significant.
- However, no statistical difference in fouling deposition was noticed between control and coatings at pilot scale (Fig. 7b).
- The difference between control and DLC-1 at pilot scale (~10%) was not statistically significant.
- Results in this study contradict the literature for reported benefits in fouling mitigation on DLC coatings. The literature tends to report the initial fouling on modified surfaces from WPI / WPC / SMIF solutions that might mask any long term or industrially relevant benefits.
- No reported literature of milk fouling on DLC coating.
- Much lower levels of fouling was observed when using WPI instead of raw milk. The small amount of fouling observed with WPI mean that no difference was found between control and DLC coatings, at either lab or pilot scale.

## Reference

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