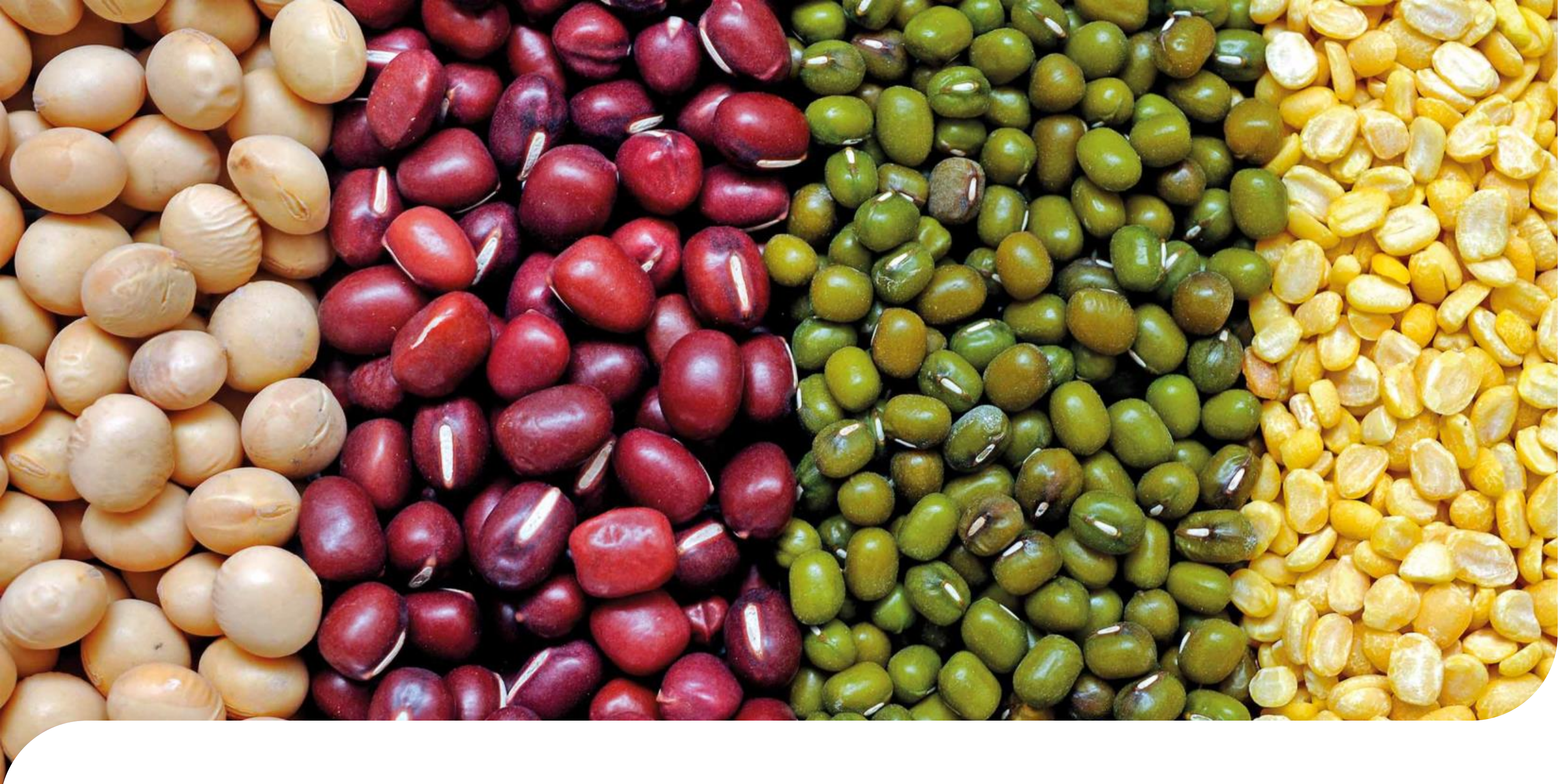


Vegetable protein processing

Joosep Masik

What we'll talk about today

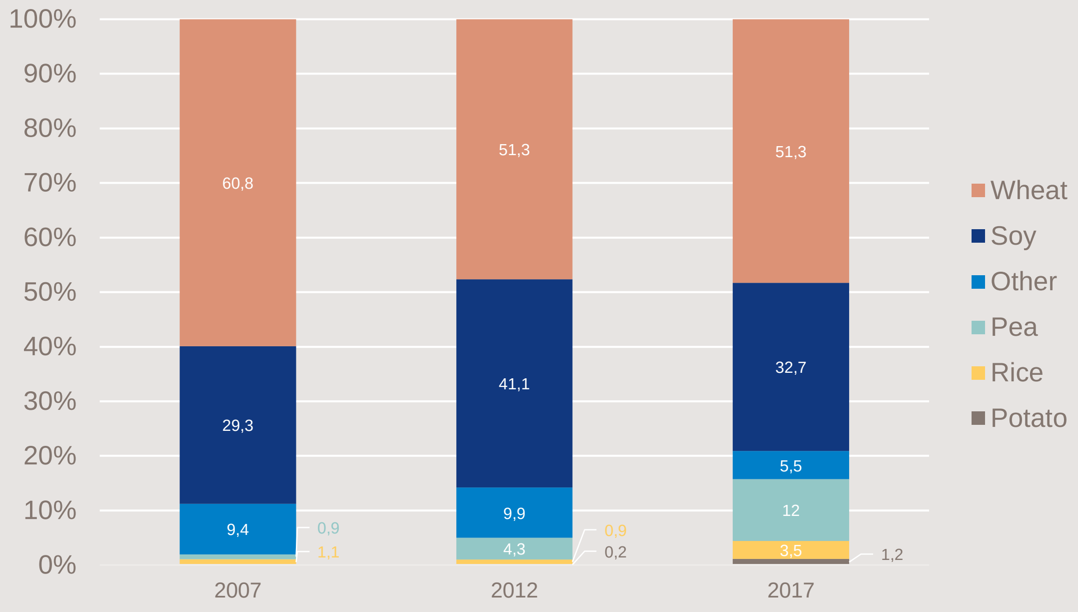
− Agenda

- Vegetable protein potential
- Types of raw materials
- Oilseed crop pre-treatment and basic process
- Starch crop pre-treatment and basic process
- Solutions for effluent management
- Why Alfa Laval?

Vegetable protein potential

– Market growth and source diversity

Protein types as % of new F&B launches tracked with plant-based protein (EU, 2017)



Source: Plant-Based Proteins Market: Global Industry Analysis (2012–2016) and Forecast (2017–2025)

- Plant-based protein market expected to reach $16.3 billion by 2025
- Plant-based protein market CAGR of 5.7% between 2017–2025
- Ahead: More diverse plant-based protein sources with various by-products

Source: European Vegetable Protein Association

Types of vegetable protein feedstocks

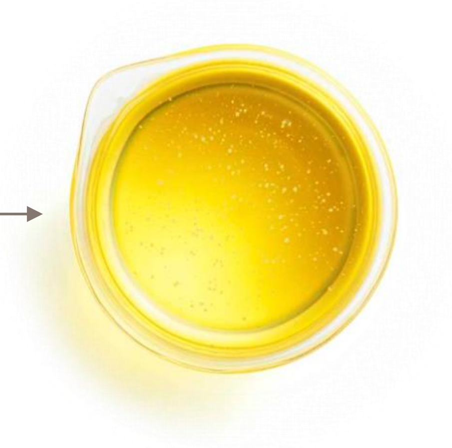
Raw material

Oilseeds

Starch crops

Conventional processing of oilseeds

Oilseed



Oil – high value in very high demand for food uses

Meal – low value and used as animal feed

Oilseeds

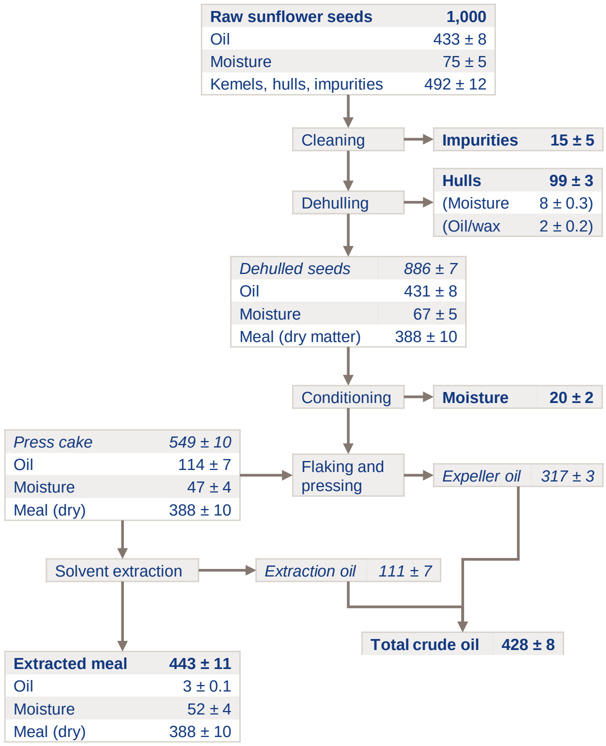
− Extracting protein out of the meal by-product

- Instead of animal feed, high protein products (approx. 80%) and low fibre products (less than 5%) could be produced for human consumption
- Potential feedstocks for oilseed vegetable protein production: soybean, sunflower, rapeseed, cottonseed, lupin, and linseed
- De-oiled meal as raw material – focus on oil extraction conditions

Oilseed processing

– Potential raw material for vegetable protein found in meal

- Processing 1,000 kg of sunflower seeds yields:
  - 428 kg oil
  - 433 kg meal
  - Meal protein content ≈ 32%
- This translates into 138 kg of pure protein that could be recovered



Source: AOCS

Mean composition of sunflower cake

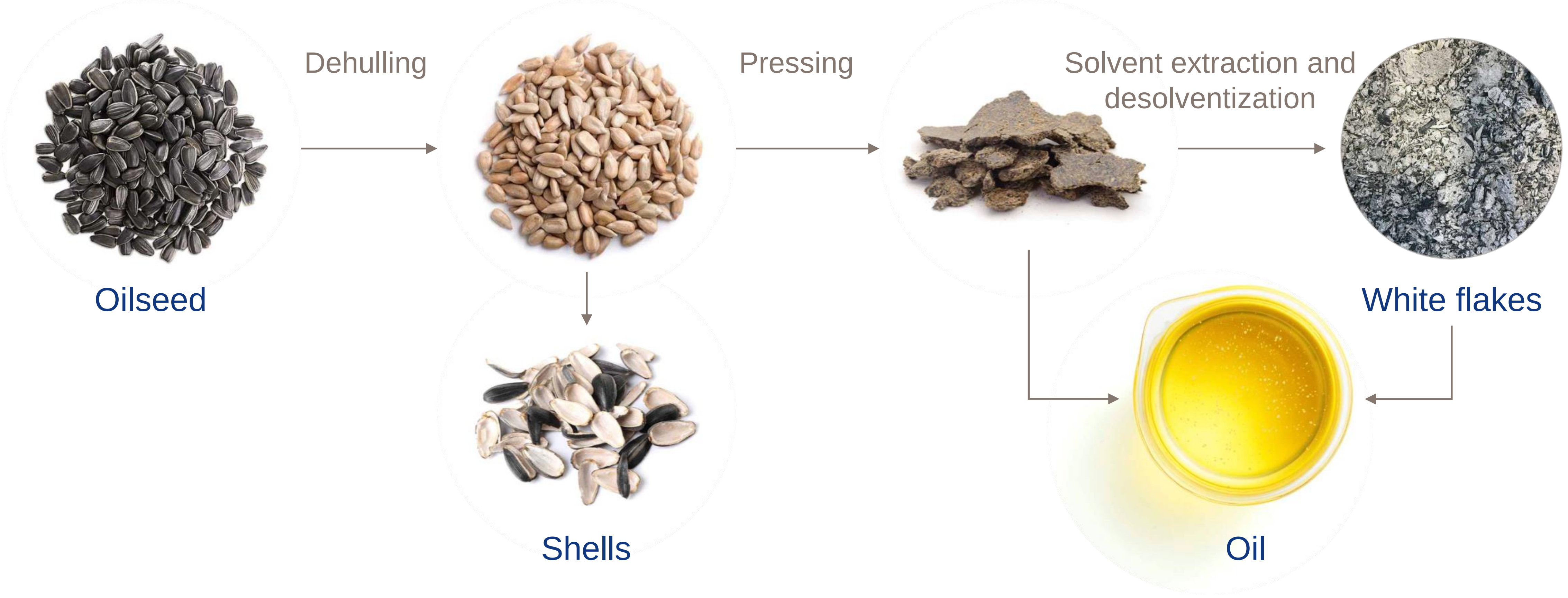
Component	Mean composition (%)	Data from different publications* (%)
Moisture	9.0	8.0–9.0–10.4
Dry matter	91.0	91.0–92.0–89.6
Crude proteins	32.0	29–34–32
Crude lipids	1.5	1.15–2.00
Ash	6.5	6.0–4.3–6.6–7.1
Total phenolics	3.5	3.4–2.4–4.7
Crude fibre	41.0	29–50–43
Lignin	26.8–8.4	
Hemicelluloses	13.0	12.6–12.9
Cellulose	23.0	22.9–22.5

* Boni et al. (1987), Bautista et al. (1990), Parrado and Bautista (1993), Dominguez et al. (1995), Ramachandran et al. (2007) and Geneau-Sbartaï et al. (2008)

Source: Anne Lomascolo et al. (2012)

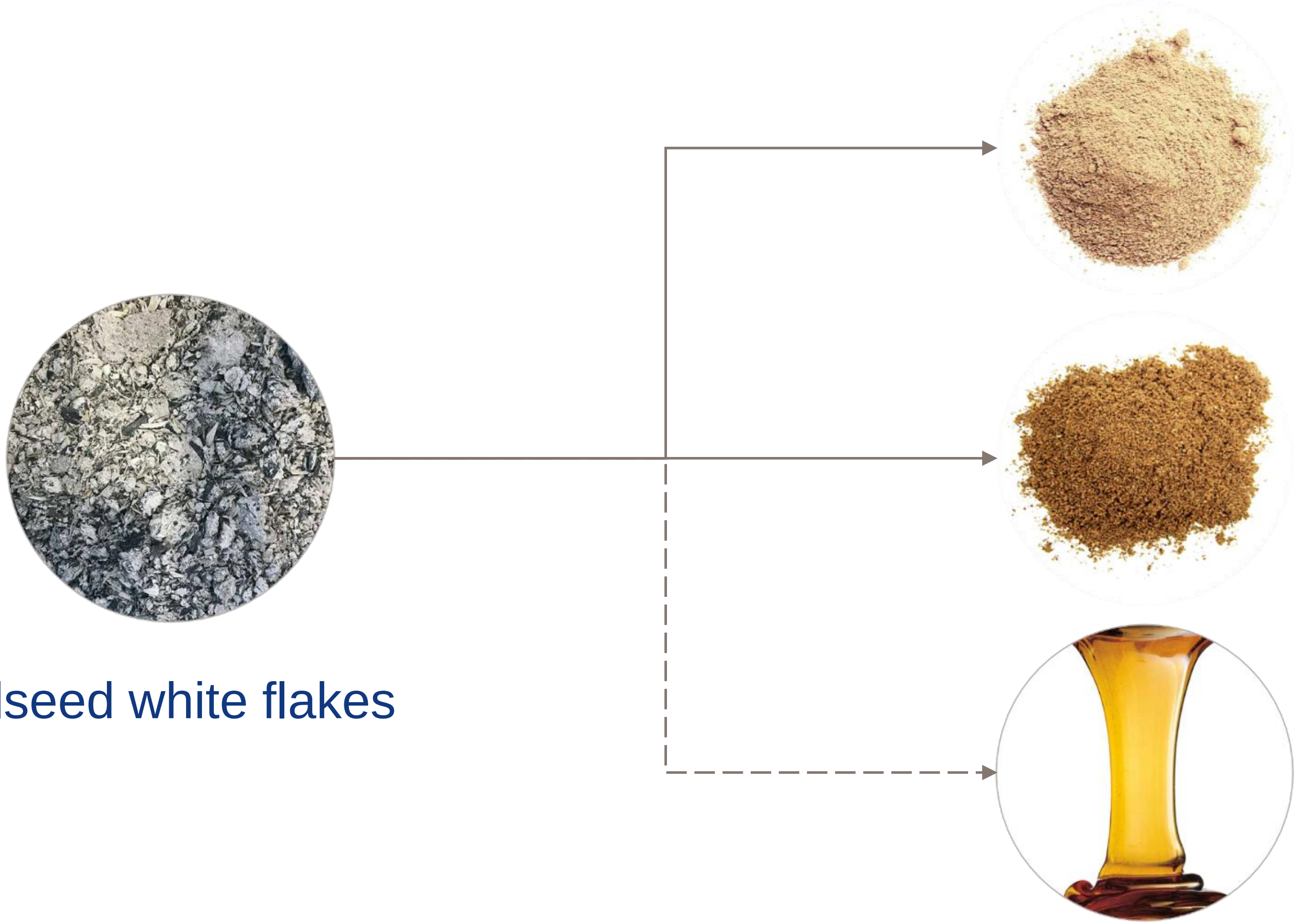
Oilseed processing

– Typical process to pretreat sunflower seeds for vegetable protein extraction



Alfa Laval oilseed technology

– Extracting protein, fibre and sugar syrup from oilseed white flakes



Protein

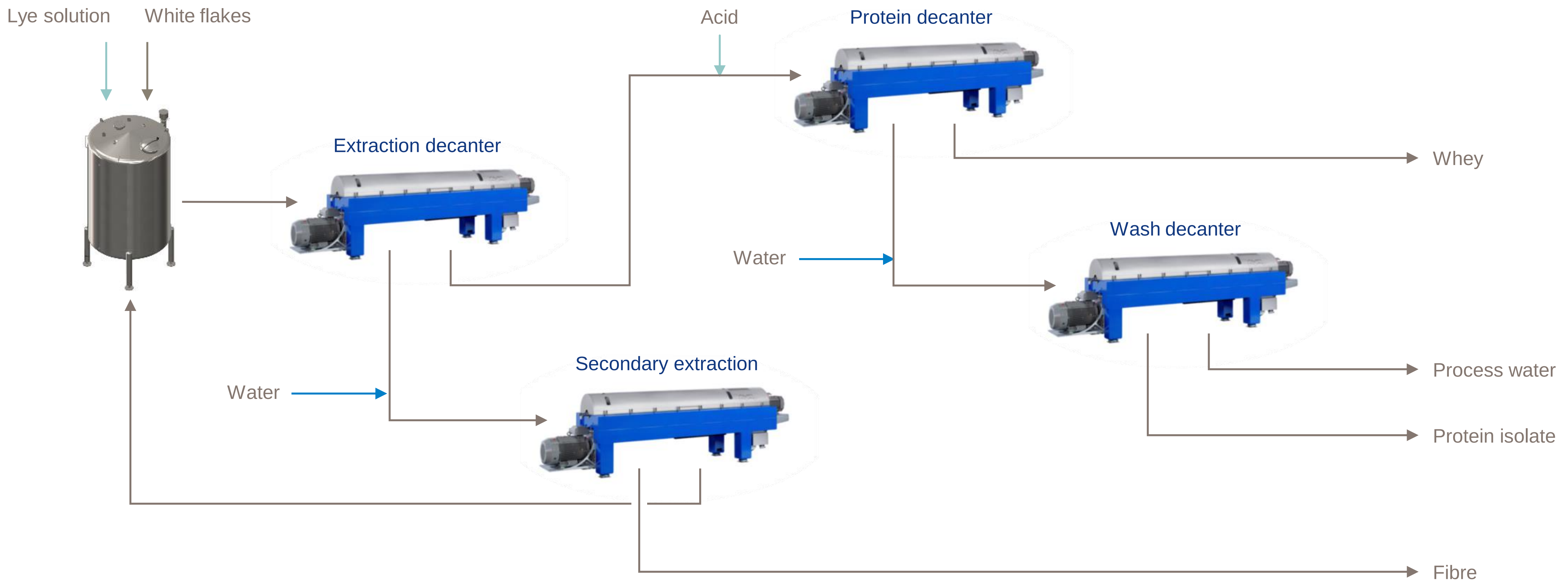
Fibre

Oligosaccharides syrup

Oilseed white flakes

Oilseed process

– Typical flow chart for vegetable protein processing



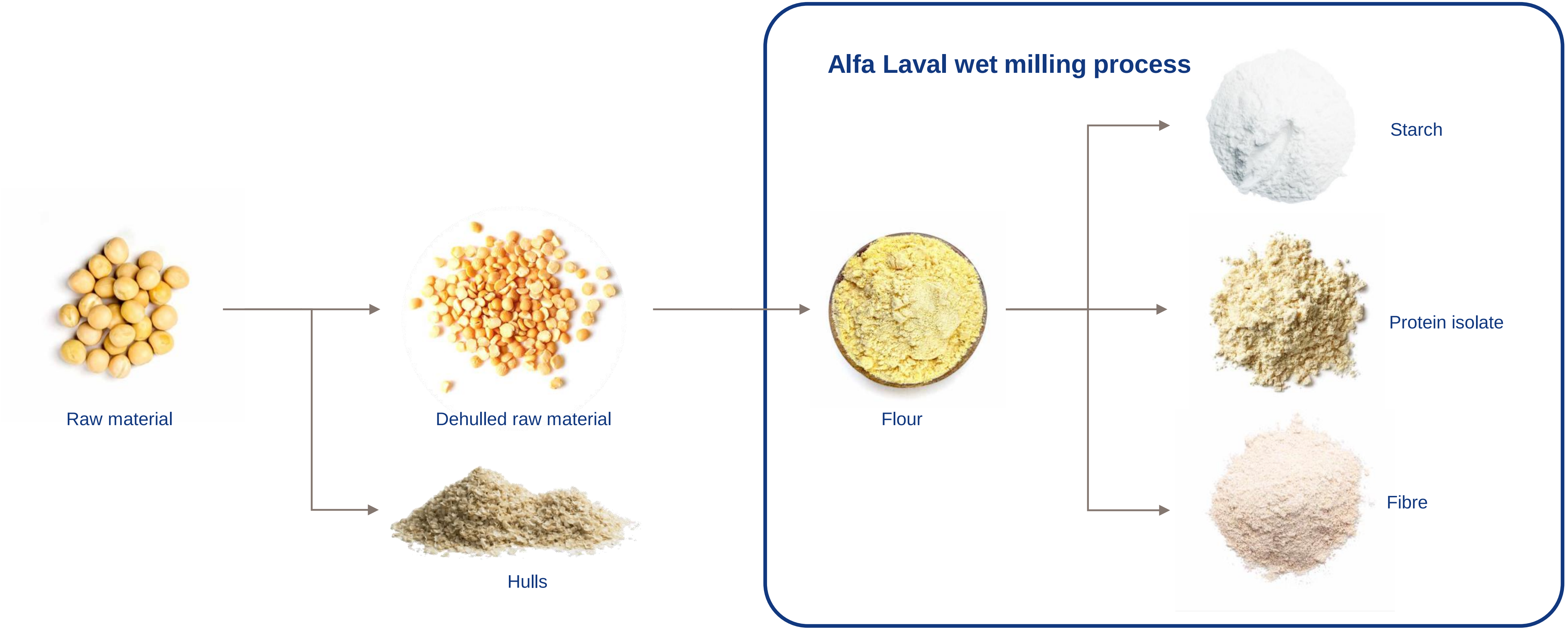
Starch crops

– Vegetable protein processing

- Besides vegetable protein manufacturing, focus is also on food- or technical grade starch and, in some cases, food-grade fibre production
- Potential feedstocks: yellow pea, faba bean, mung bean, chickpea, lentil, etc.
- Milled flour, either hulled or dehulled, as raw material

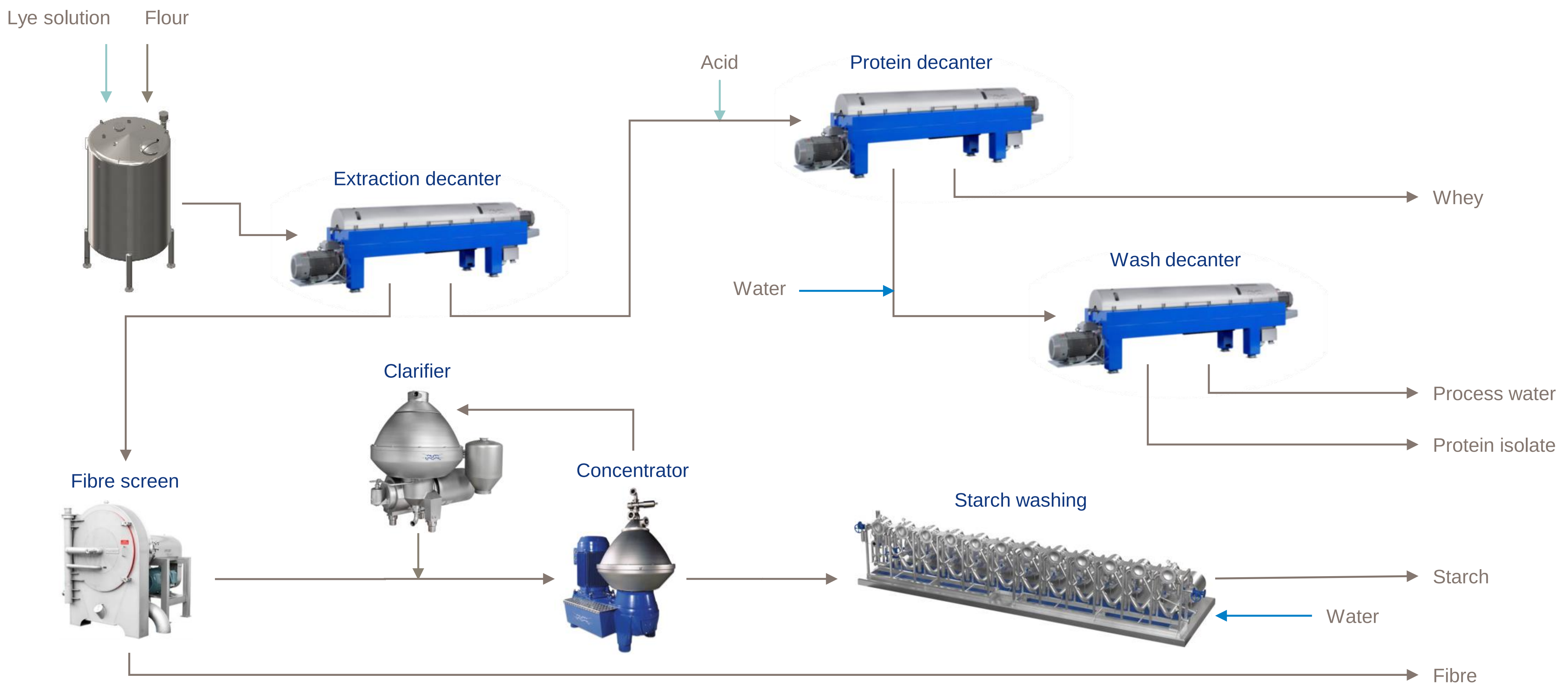
Starch crop process

− Fractionation of yellow peas into starch, protein and fibre



Starch crop process

– Typical process



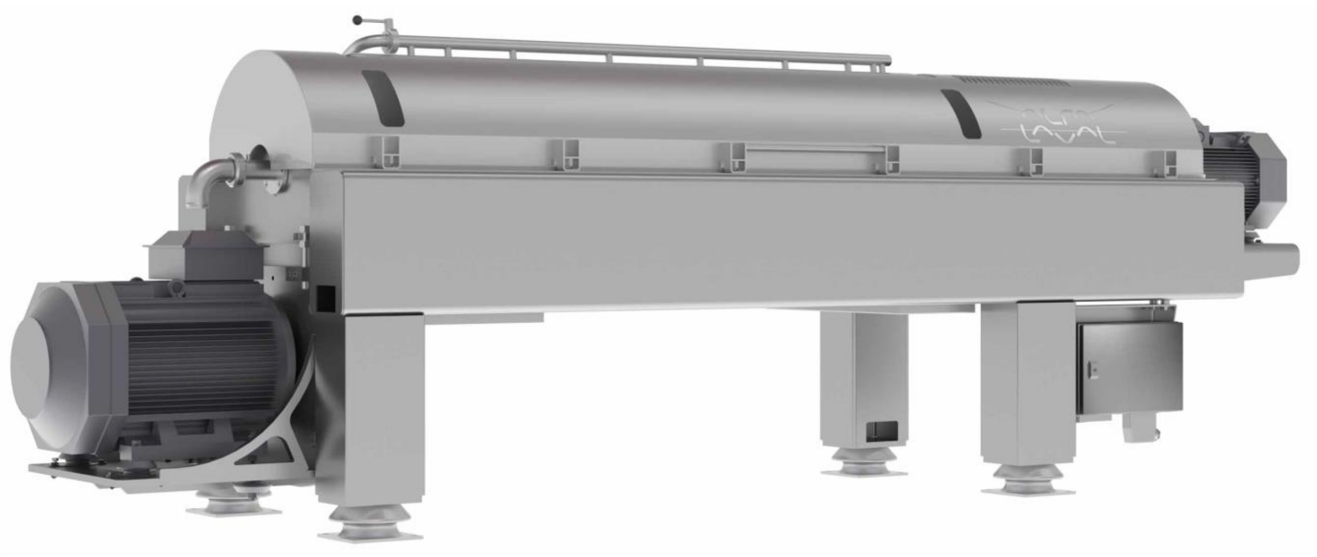
Heat treatment of protein

– Pasteurization systems before drying

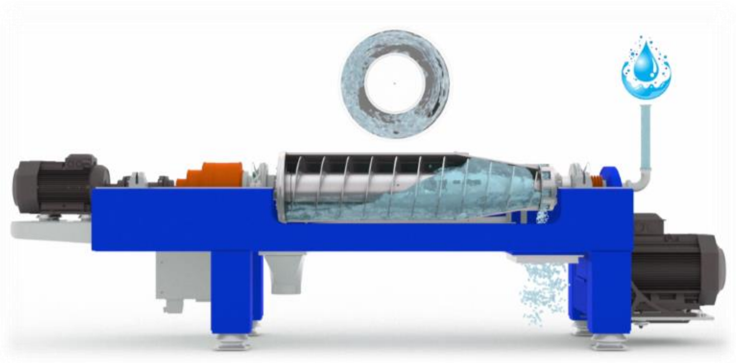
- UHT-type at high temperature and short residence time
- The protein is rapidly heated and cooled
- Limited protein denaturation

Foodec decanter centrifuge

– Key values



- High-performance two-phase separation for vegetable protein applications
- Easy control
- Cleanability: Fully CIP-able, automatic CIP sequences



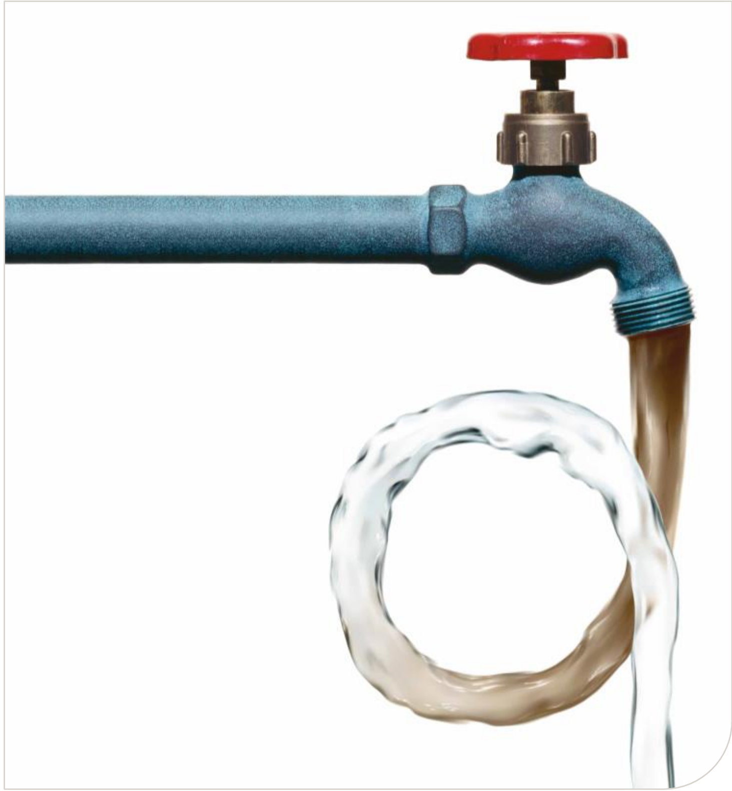
Pressurized liquid discharge

– Paring disc

- Reduces foam formation
- Closed and pressurized liquid discharge (up to 5 bar)
- Limits air uptake in decanter

Challenges in protein isolate production

- Wastewater treatment
- Protein wet fractionation process uses high volumes of water
  - 1:18 for oilseed crops
  - 1:6 for starch crops
- Ambition is to reduce water intake



Possibilities for whey treatment

– Recovery of water and valuable by-products

Evaporation systems

Membrane systems

Possibilities for whey treatment

− Recovery of water and valuable by-products

Evaporation systems

- Efficient thermal or mechanical vapor compression systems
- Compact and simple to install
- Well proven in handling highly viscous process liquids
- Easy to adjust capacity by modifying the number of plates
- Heat exchanger design prevents fouling
- Long processing times and less downtime

Possibilities for whey treatment

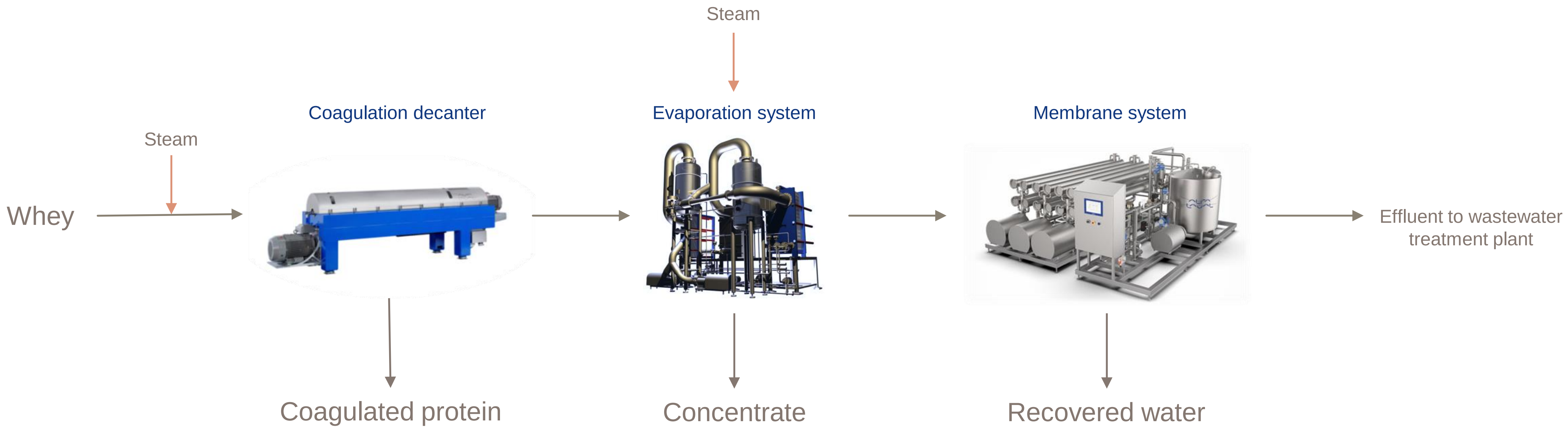
– Recovery of water and valuable by-products

- Highly selective ultrafiltration and diafiltration membranes that capture and purify proteins
- Reverse osmosis membranes
  - Recover more water by treating condensate from evaporator or permeate from ultrafiltration system
  - Reduce hydraulic load on wastewater plant
  - Reduce freshwater intake

Membrane systems

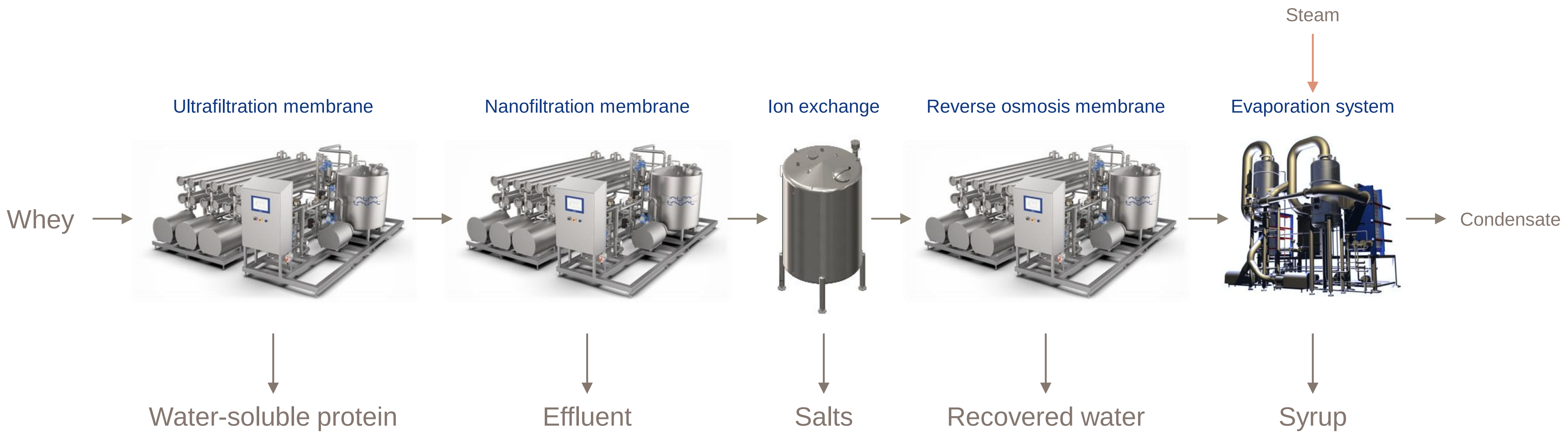
Whey processing

– Example for process



Whey processing

– Example for a syrup process



Hygiene and Cleaning-in-Place

- Broad portfolio of Alfa Laval hygienic components such as pumps, valves, pipes, and fittings
- Alfa Laval process lines are designed with hygiene in mind
- Fully automatic efficient CIP systems
- Ensure consistently high quality of the final product

Why Alfa Laval?

- World leader in separation equipment and wet fractionation
- Holistic approach to complete wet processing line
- Solutions to reduce water use in protein wet fractionation
- Pilot-scale feedstock testing at Alfa Laval's testing facility
- Case-by-case approach to different raw materials

Alfa Laval Innovation & Test Centre

– Case story with sunflower

Alfa Laval vegetable protein systems

Separation equipment

Decanters

Separators

Evaporators

Starch equipment

Membranes

Thermal equipment

Heat exchangers

Direct steam injection

Flow equipment

Agitators

Hygienic pumps

Hygienic valves

References

- More than 180 decanters working in various vegetable protein process lines
- More than 50 different wet milling process lines supplied for different feedstocks

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