Industrial processing of insects

– Innovative solutions to improve processing

Andriy Revva
Regional Business Manager
Alfa Laval Agro & Protein Systems
andriy.revva@alfalval.com

What we'll talk about today

– Agenda

WHY

Global challenges ahead

- Population growth and protein demand
- Insects to fill growing demand for global protein
- Trends in insect processing

WHAT

Process solutions

- Entire process – from feed preparation and rearing to processing, drying and packing
- Larvae processing options

HOW

Partnership

- Alfa Laval: separation, heat and fluid transfer experts
- Bühler Insect Technology Solutions: total solution provider
- Solutions for any insect breeder

Challenges of the global food industry

Source: Bühler Insect Technology Solutions

Global protein challenge

– 50% increase in protein demand by 2050

2015

Farm

525 million tons primary proteins

Food 25%

Feed

Food 15%

45%

15%

2015

Fork

7.4 billion people

2050

+265 million tons

+50%

Losses, wastes

Animal conversion

2050

+2.3 billion

Meat consumption

Will increase by 50% until 2050, most of which in Asia, Africa, and Latin America

Arable land

Today, 85% is already in use

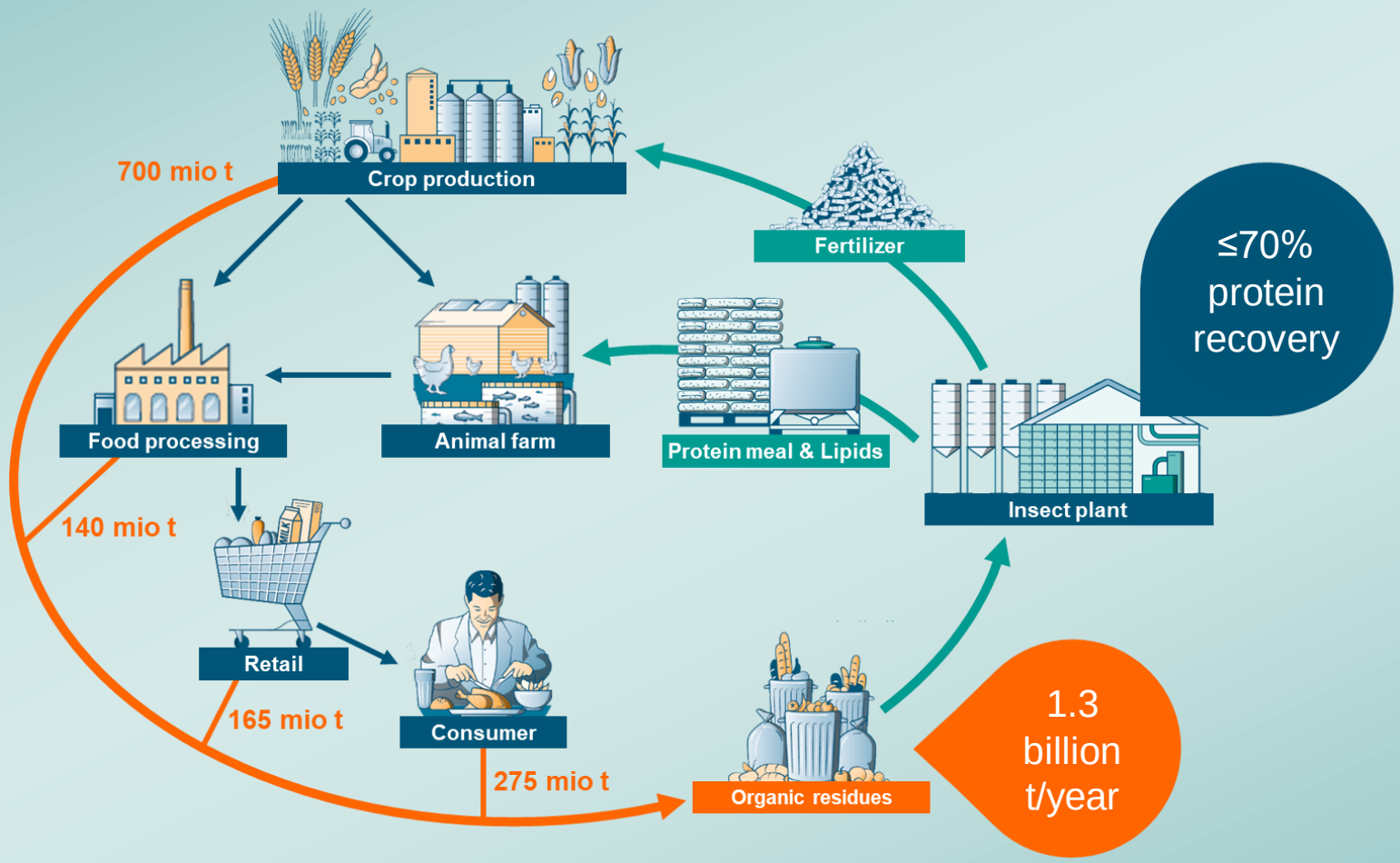
Current feed proteins

Limited availability and high price volatility

Source: Bühler Insect Technology Solutions

Why insects?

– Solving global protein and waste challenges



Source: Bühler Insect Technology Solutions

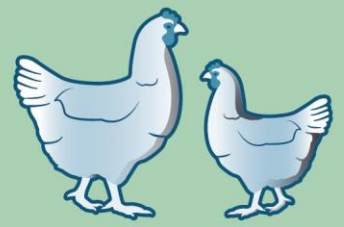
Why insects?

– Solving global protein and waste challenges

Insect proteins can be **produced locally**.

They are the natural diet of many animals.

Production with **little environmental impact**



Chicken

Land use (m^2)

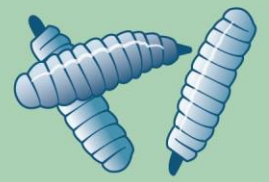
51 | 4

Water use (m^3)

34 | 5

CO_2-eq (kg)

33 | 6



Black soldier fly larvae

Energy use (kJ)

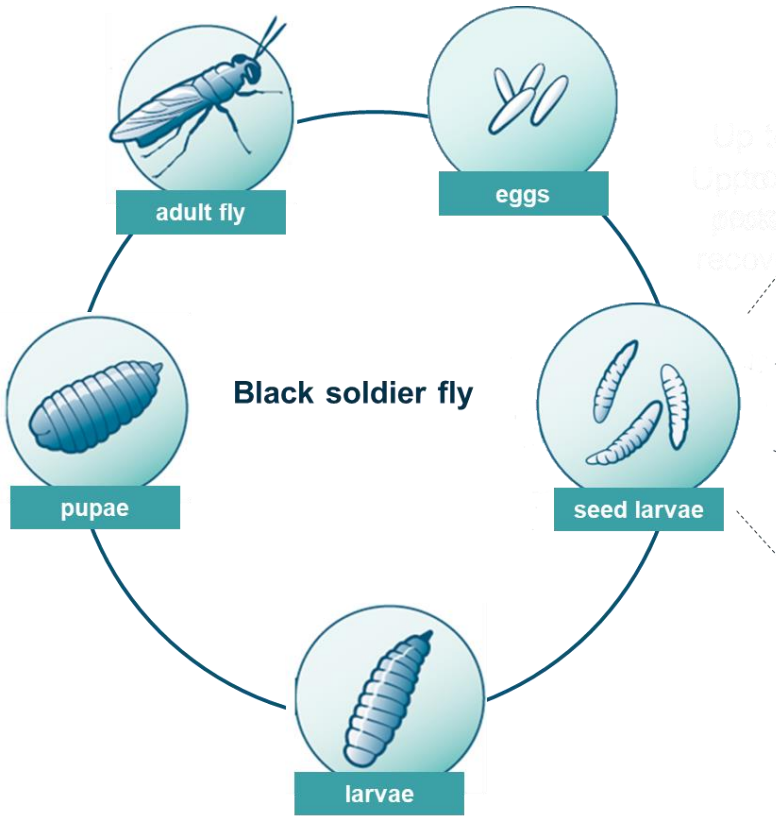
120 | 80

Impact on the environment per kilogram of protein

Source: Bühler Insect Technology Solutions

Why insects?

– Solving global protein and waste challenges



Flexible on what they eat ➡ transform large variety of feedstock

Very fast growth cycle ➡ allows efficient production

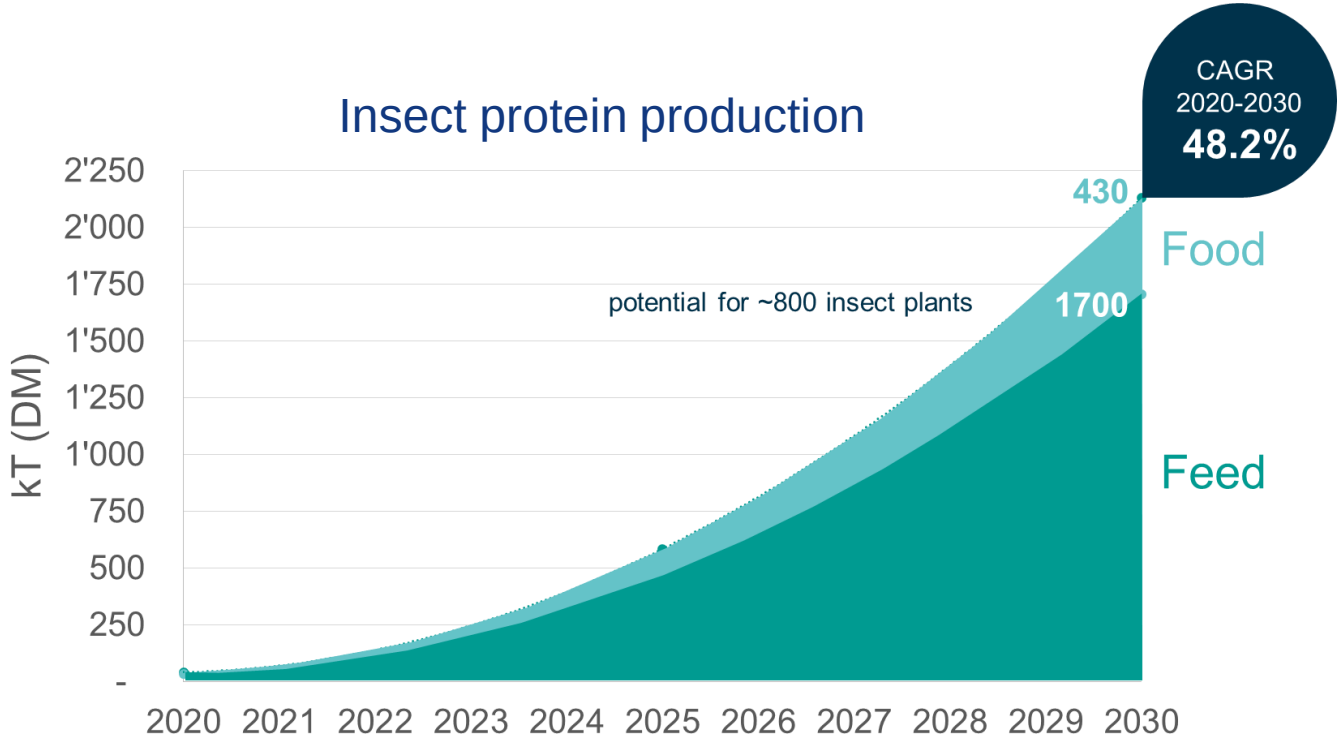
High nutrient accumulation ➡ rich in proteins, lipids, and minerals

Naturally in high densities ➡ suitable for mass rearing

Source: Bühler Insect Technology Solutions

Insect market view

– Large market potential, investments are increasing



Source: Lux Research, 2018

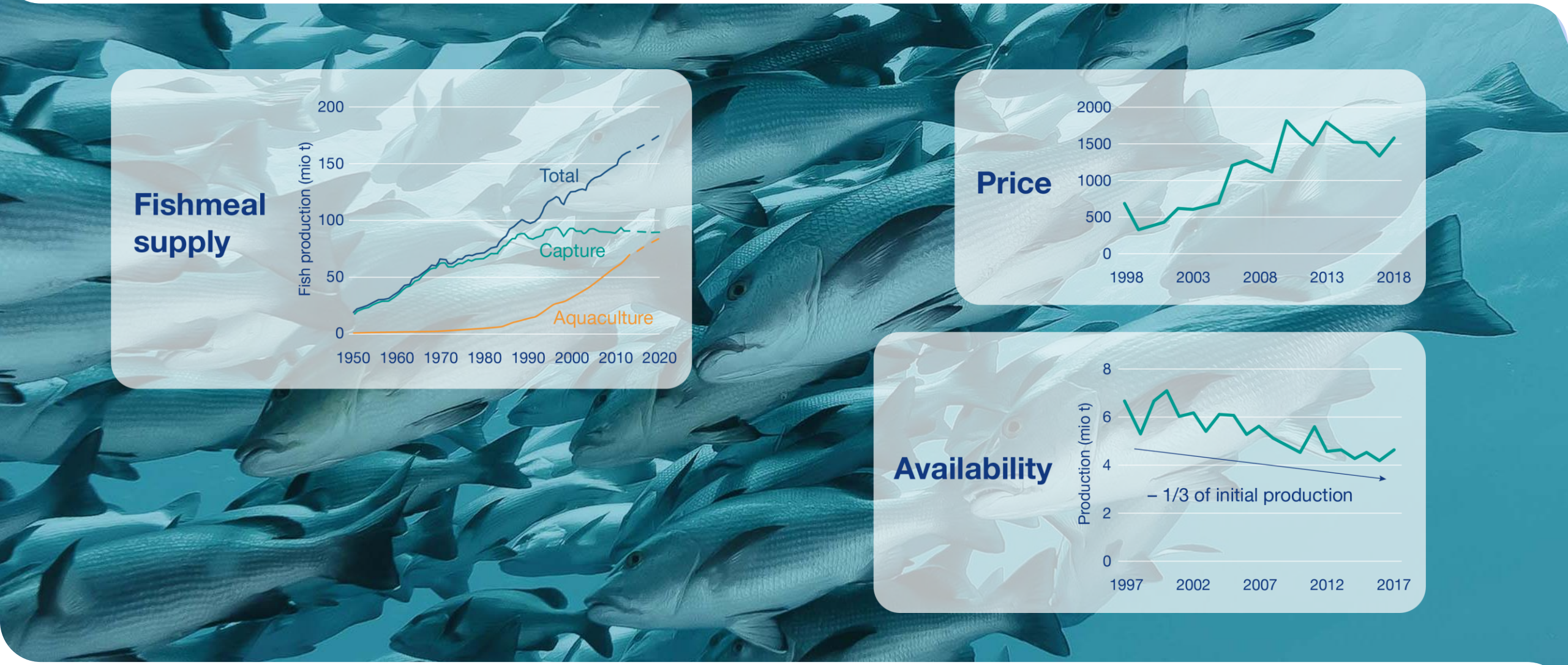
>420 MUSD have been invested in the industry!

Company	Country	Total funds raised (million USD)
Ynsect	France	150
Agriprotein	South Africa	122
InnovaFeed	France	62
Protix	Netherlands	50
BioflyTech	Spain	18
Enterra	Canada	10

Source: Bühler Insect Technology Solutions

Global protein challenge

– Fishmeal supply is drying up



Source: Bühler Insect Technology Solutions

Trends in insect processing

– Feedstock options

Consistent quality

Reliable supply

Low cost

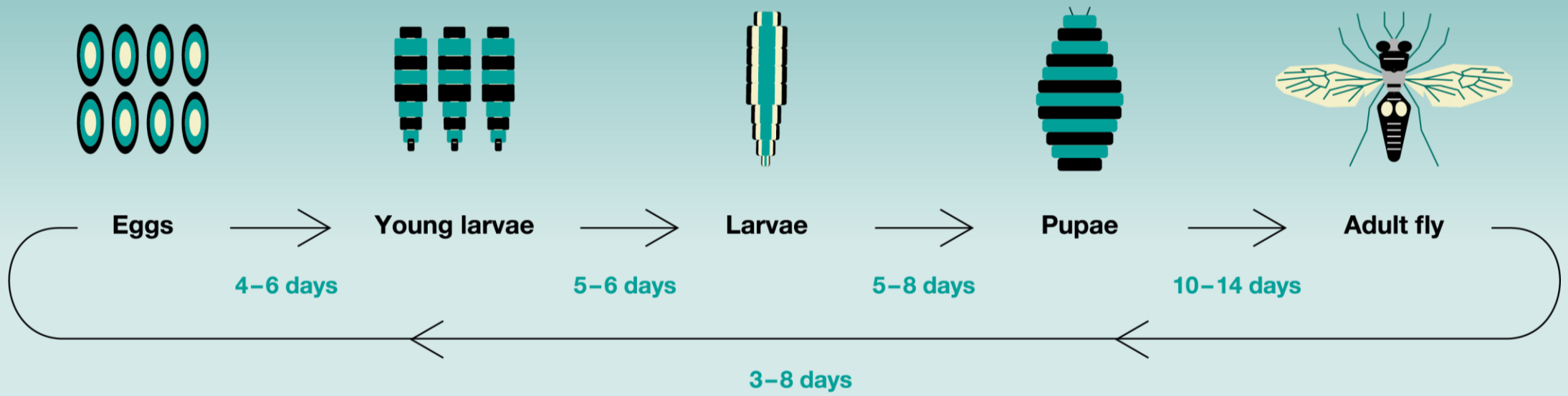
	Agricultural residues	Industrial by-products	Retail discards	Residential waste
Accepted	• Fruit and vegetable leftovers	• Brewer's spent grains • Distiller's grains • Corn slurry • Dairy and tofu residues • Vinasses and molasses • Sugar beet and fruit pulp • Potato and fruit cut-offs • Rice and wheat bran • Soybean and cocoa hulls	• Old bread	
Accepted, if controlled			• Supermarket discards • Hotel, restaurant, food service leftovers	
Not accepted	• Manure	• Slaughterhouse waste		• Household waste • Sewage

Source: Bühler Insect Technology Solutions

Trends in insect processing

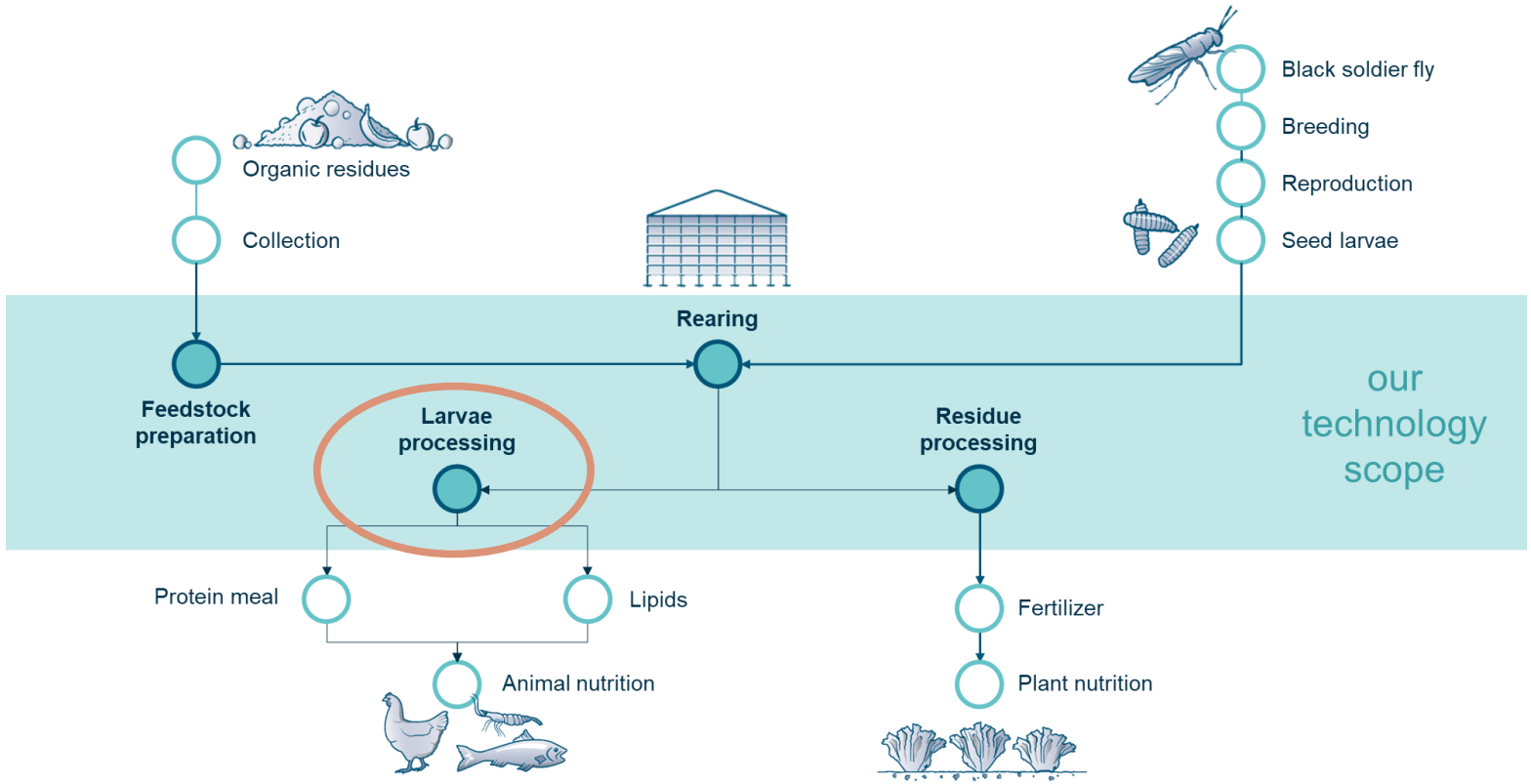
– Black soldier fly: most suitable for feed production

Black soldier fly lifecycle



Trends in insect processing

– Our role is to provide reliable technology



Source: Bühler Insect Technology Solutions

Trends in insect processing

– Product description and potential applications

Protein meal

Key benefits: Balanced amino acid profile with very good palatability and digestibility

Application examples:
- Hypoallergenic dog food
- High performance fish feed
- Attractant for shrimp feed
- High-growth broiler feed

Insect lipids

Key benefits: Easy digestible energy with high lauric acid content

Application examples:
- High performance piglet feed
- Chicken starter feed
- Cosmetics
- Detergents

Fertilizer

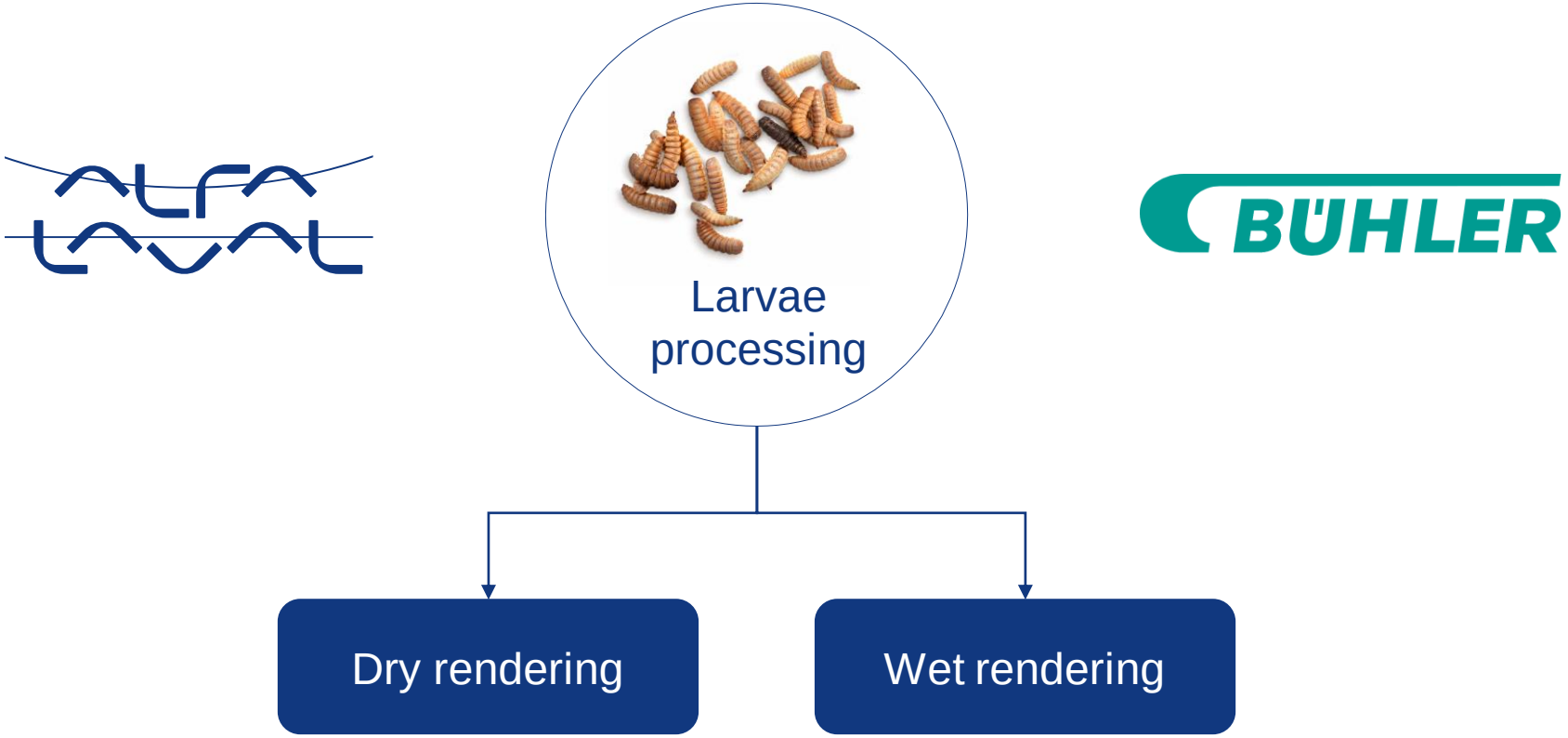
Key benefits: Slow nutrient release over time with chitin as functional component

Application examples:
- Soil improver for home gardens
- Low fertile soil amendment
- High yield crop production
- Biogas production

Source: Bühler Insect Technology Solutions

Larvae processing

– Which route to choose?

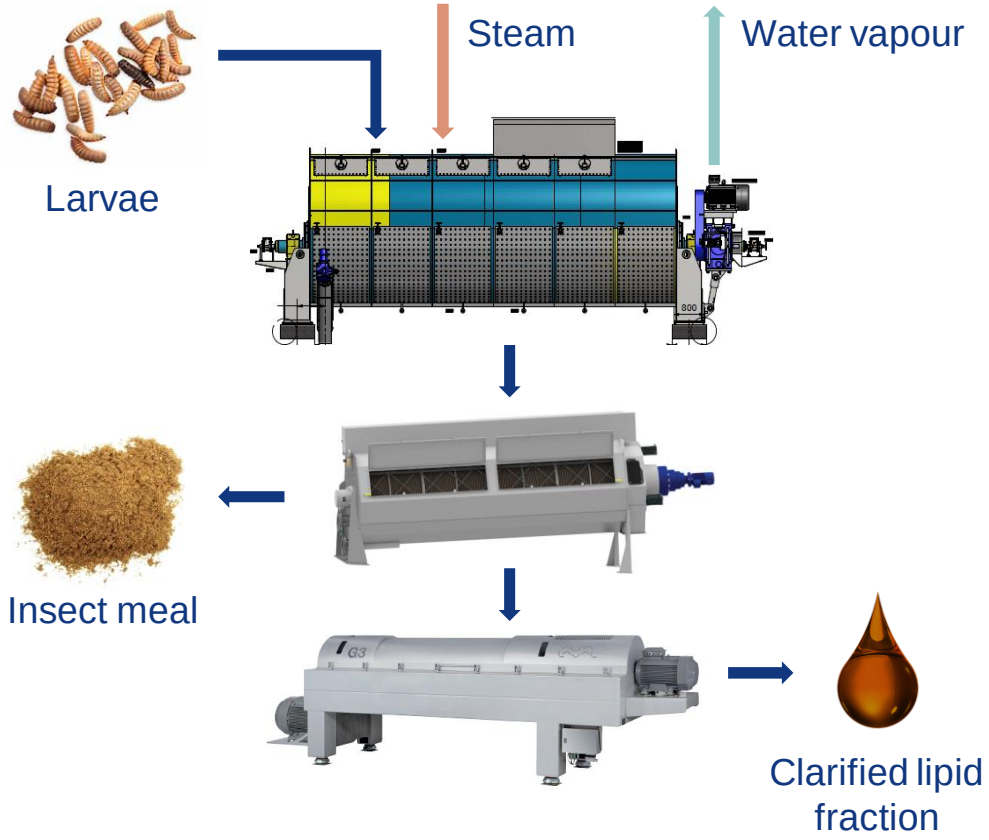


Larvae processing

Dry rendering

Larvae processing – dry rendering

– Overview

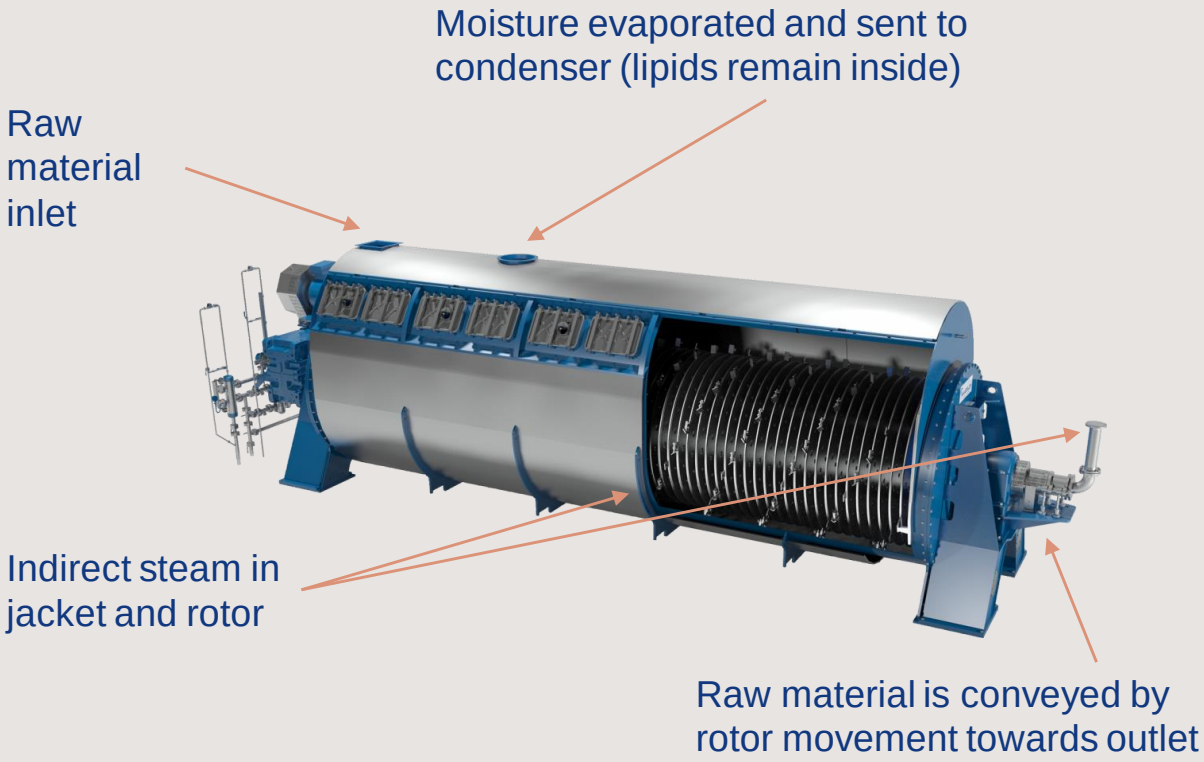


Classic, straightforward process method

- Heating and drying
  - Heating indirectly in the cooker / dryer
  - High temperature and long holding time
- Screw press
  - Separating insect meal from effluent
- Decanter
  - Clarifies the lipid fraction

Larvae slurry – dry rendering

– Heating/drying

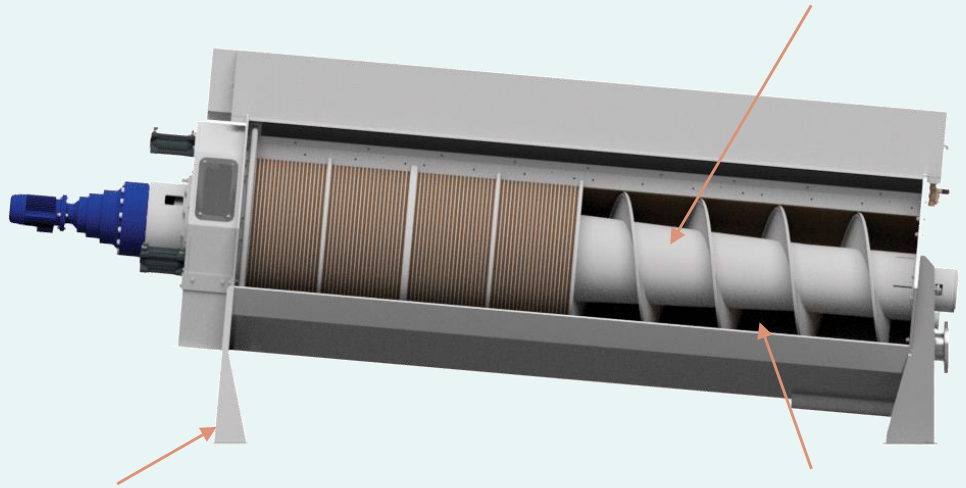


- Heating indirectly in the cooker/dryer
- High temperature
- Long process time
- High energy consumption

Larvae processing – dry rendering

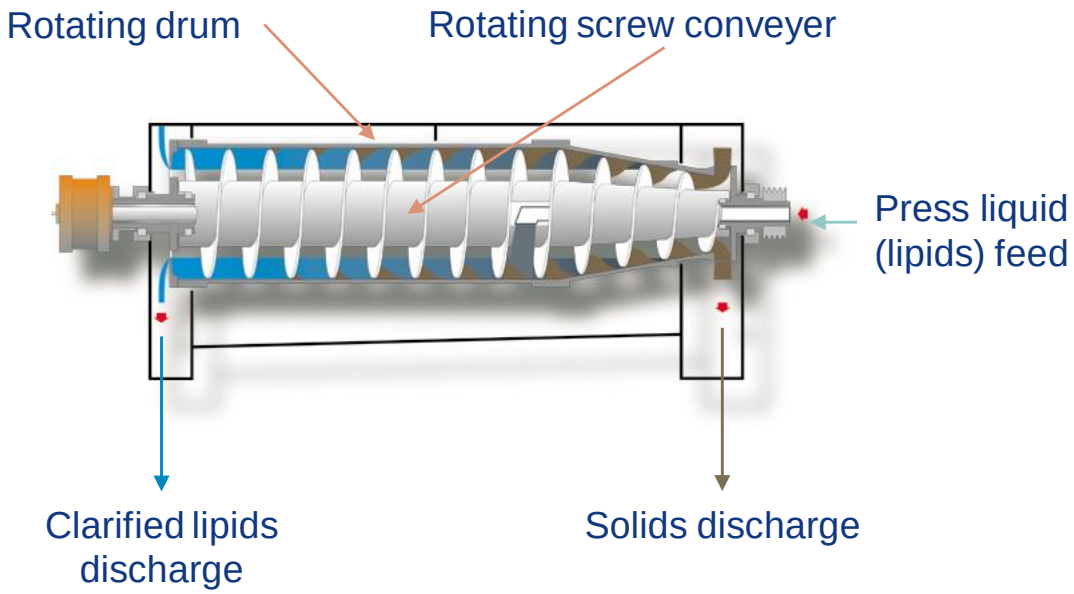
– Screw press

- Dryer slurry separation by means of filtration
- Press liquid sent for onward processing in the decanter
- Solids leave the outlet as dry press cake



Larvae processing – dry rendering

– Decanter



Two-phase decanter

- Centrifugal force separates the press liquid into a clarified lipids and solids

Larvae processing – dry rendering

– Pros and cons

Upsides

- Simple technology
- Easily accessible
- Requires relatively low maintenance

Downsides

- Lower quality end-products
- Very high energy consumption
- Never hygienic
- Long startup and shutdown time

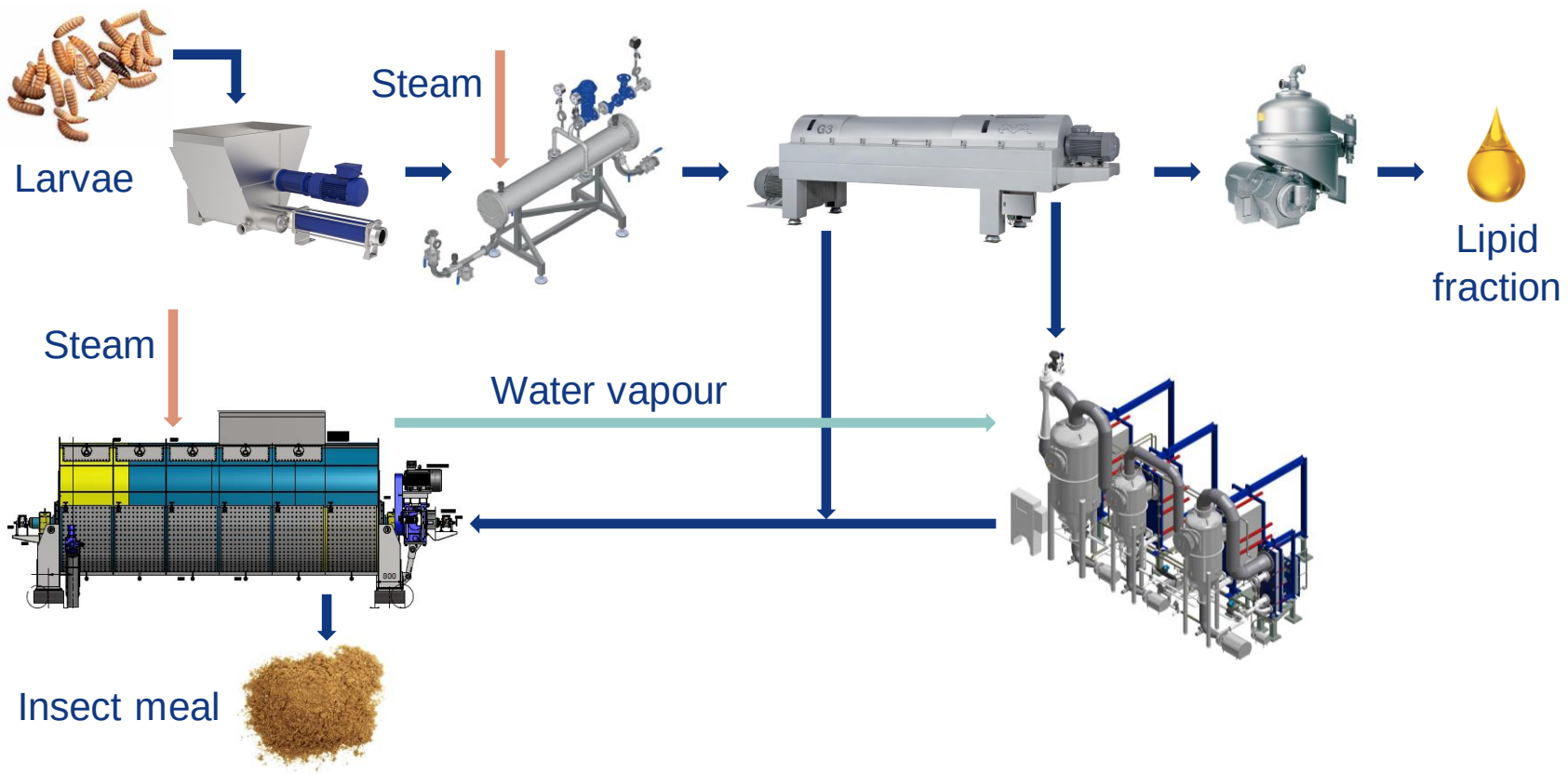
Over 1,200 kg/h boiler steam for 1,000 kg of evaporated water

Larvae processing

Alfa Laval CentriFlow wet rendering

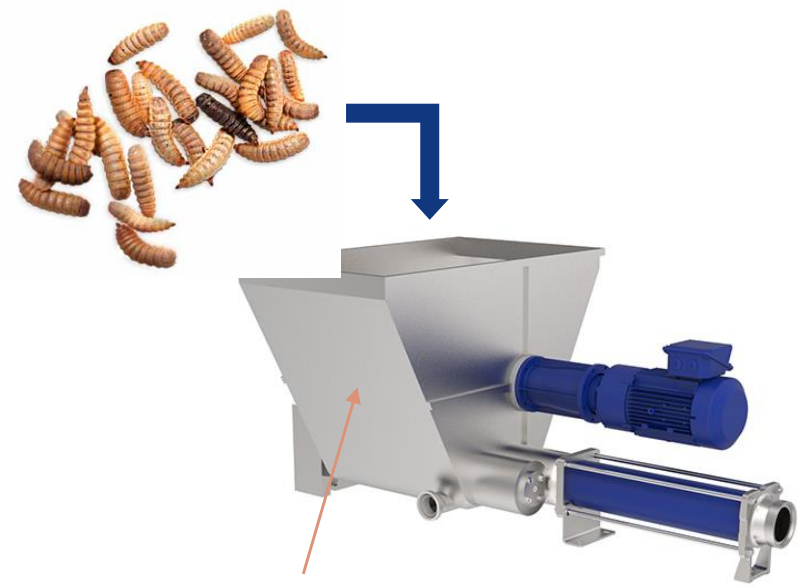
Larvae processing – Alfa Laval CentriFlow wet rendering

– High quality end-product, low energy consumption



Larvae processing – Alfa Laval CentriFlow wet rendering

– Raw material preparation



Pre-cutting of
larvae into puree

Larvae processing

Heating

– Alfa Laval CentriFlow wet rendering

Larvae processing – Alfa Laval CentriFlow wet rendering

– Raw material heating

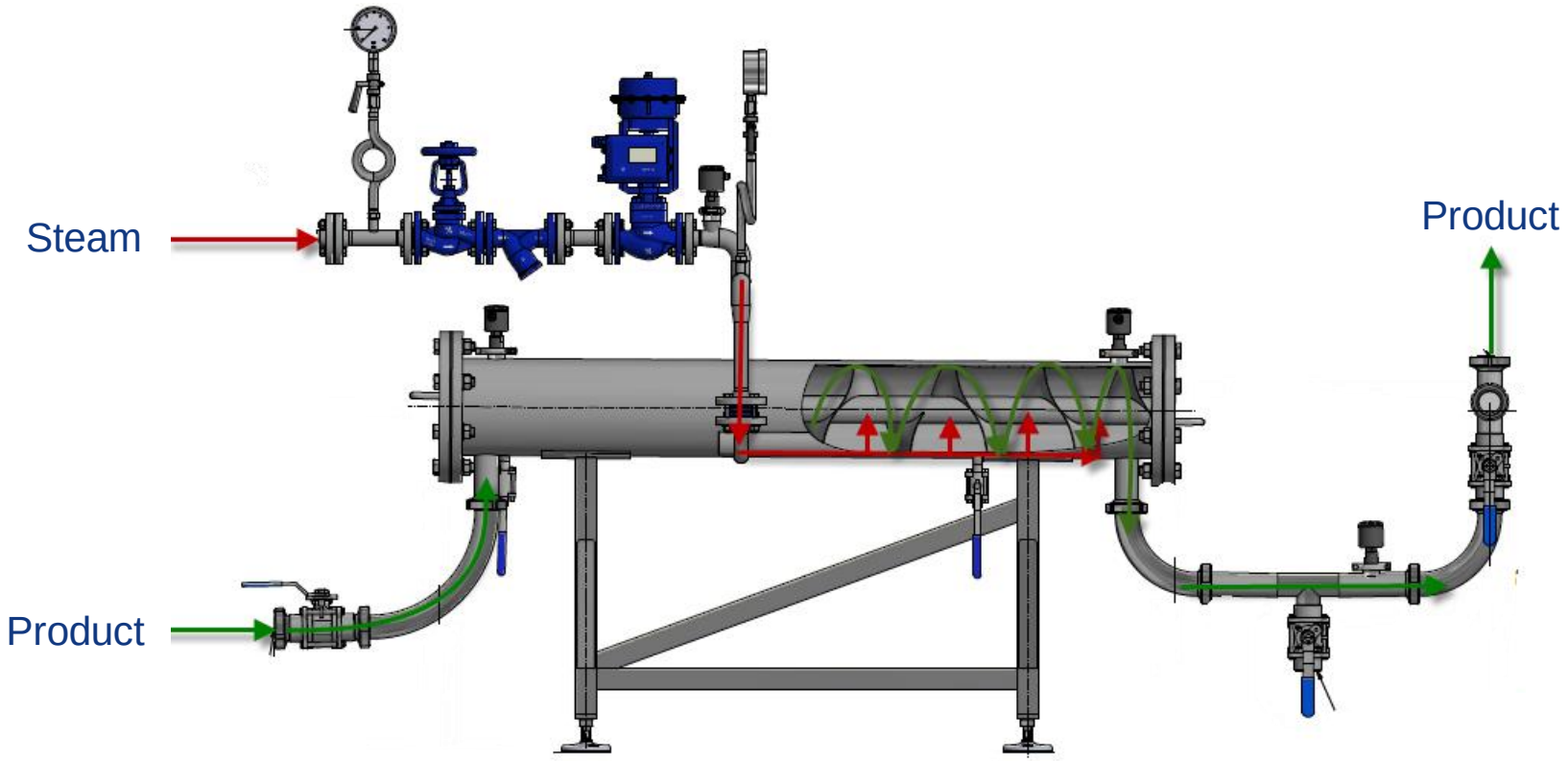
Raw material heating

Direct heating (steam injection)

Indirect heating

Larvae processing – Alfa Laval CentriFlow wet rendering

– Direct heating (steam injection) of raw materials



Larvae processing – Alfa Laval CentriFlow wet rendering

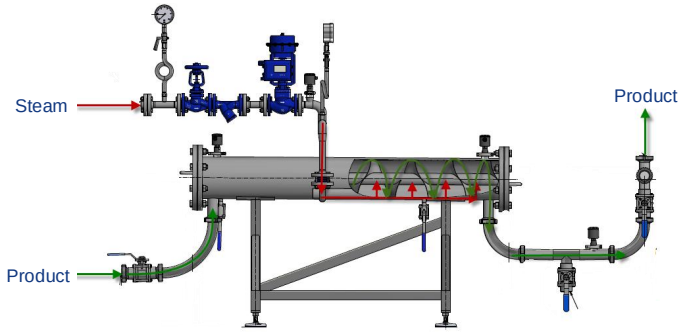
– Direct heating (steam injection) of raw materials

Upsides

- Final product quality
- High production flexibility
- Compact size
- Low investment cost
- Low cost maintenance

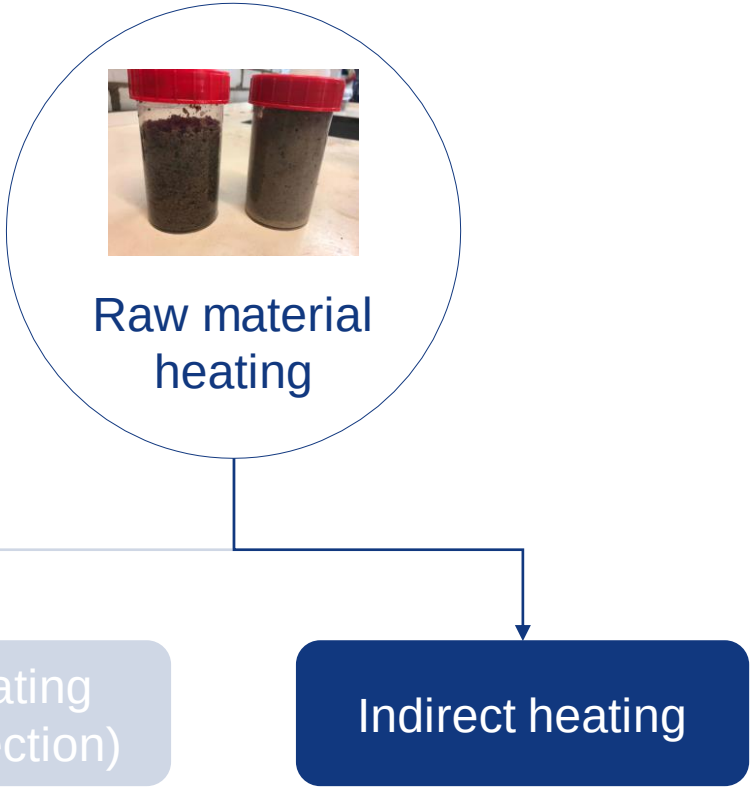
Downsides

- Addition of moisture
- CIP considerations



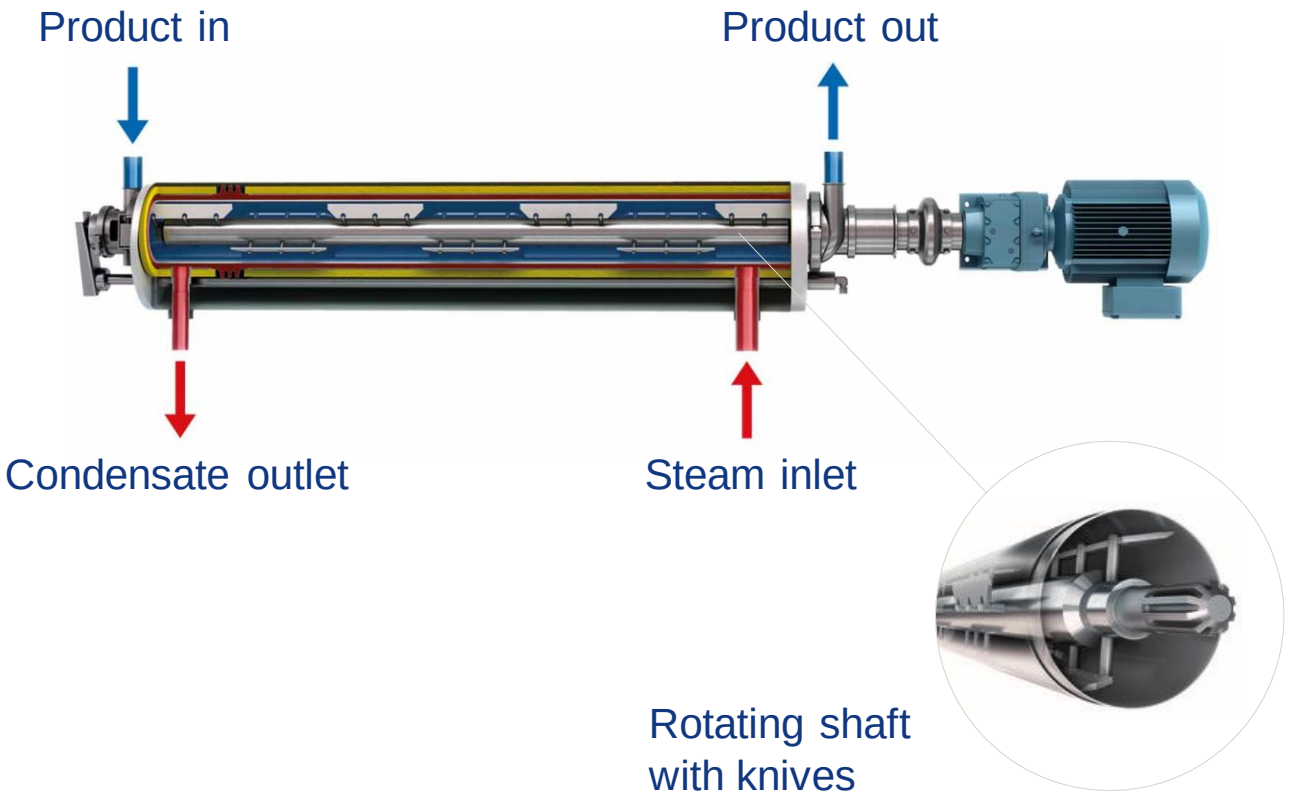
Larvae processing – Alfa Laval CentriFlow wet rendering

– Indirect heating of raw materials



Larvae processing – Alfa Laval CentriFlow wet rendering

– Indirect heating of raw materials



Contherm scraped surface heat exchanger

Larvae processing – Alfa Laval CentriFlow wet rendering

– Indirect heating of raw materials

Upsides

- Final product quality
- Hygienic design
- No added moisture
- Compact size

Downsides

- Maintenance required
- Risk of fouling
- Investment cost

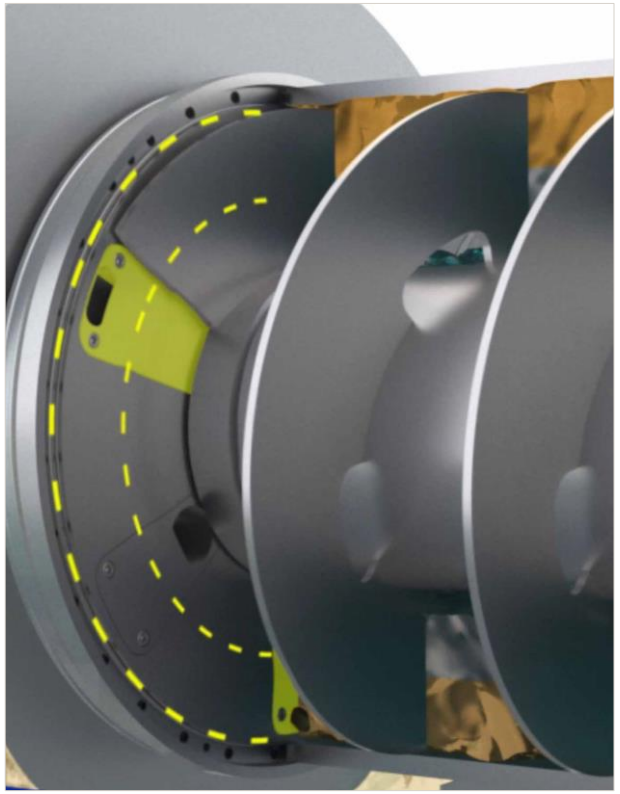
Larvae processing

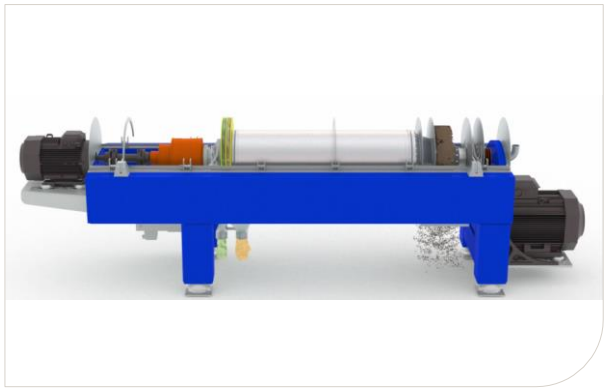
Three-phase decanter processing

– Alfa Laval CentriFlow wet rendering

Larvae processing – Alfa Laval CentriFlow wet rendering

– Three-phase decanter processing

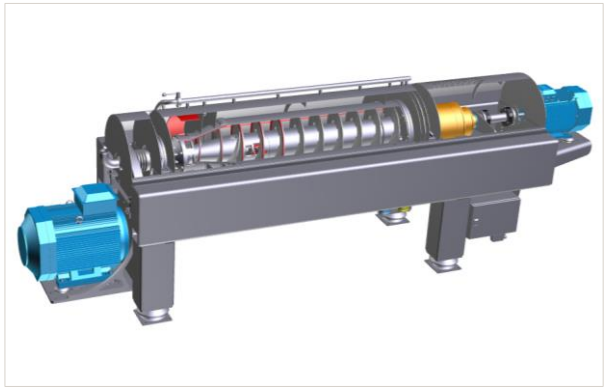


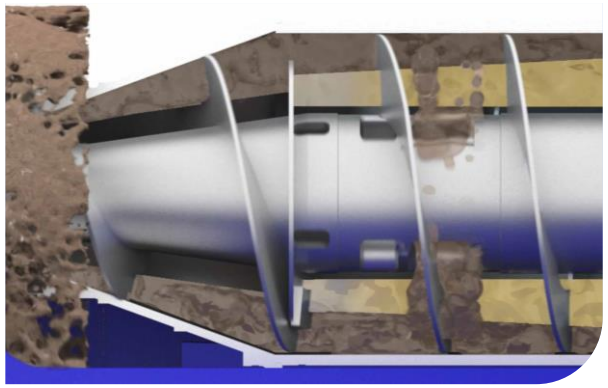


- Optimized for insect processing
- Efficient three-phase separation

Larvae processing – Alfa Laval CentriFlow wet rendering

– Three-phase decanter processing

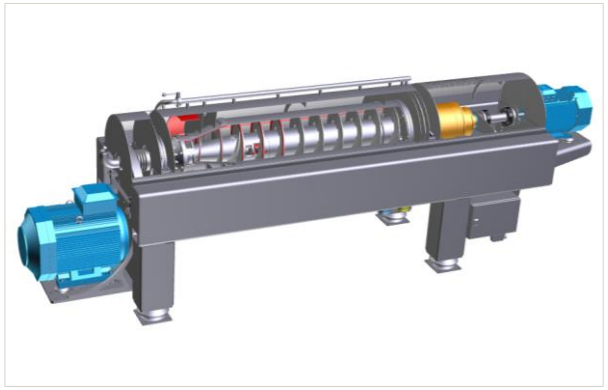


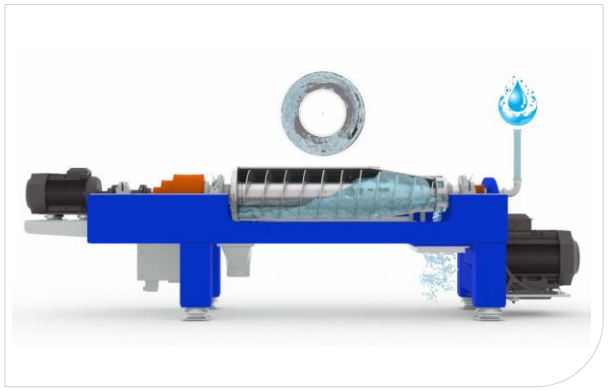


- Three-phase decanter de-waters the solids and separates the stick water and lipid fractions
- Special baffle disc for high dewatering efficiency
- This improves the dewatering process and reduces dryer energy costs

Larvae processing – Alfa Laval CentriFlow wet rendering

– Three-phase decanter processing





- CIP nozzles improve cleanability
  - Bowl exterior
  - Space between the bowl and casing
- CIP inner tube and CIP mode
  - Bowl interior
  - Solids conveyor
  - Outlets

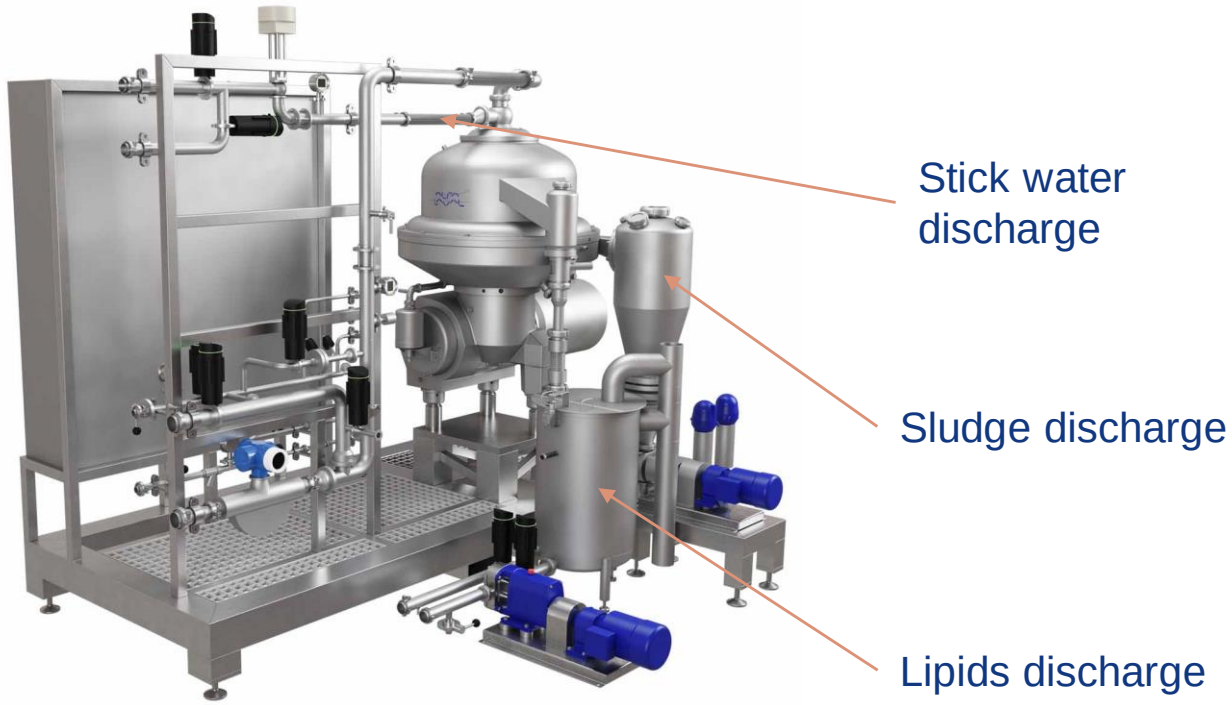
Larvae processing

Purification in centrifugal separator

– Alfa Laval CentriFlow wet rendering

Larvae processing – Alfa Laval CentriFlow wet rendering

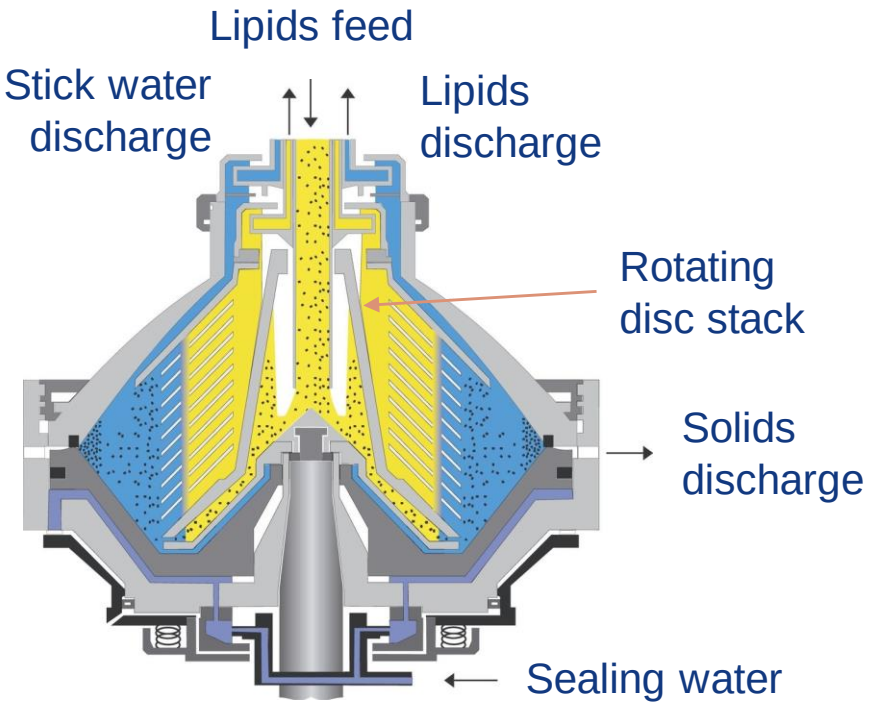
– Purification in centrifugal separator

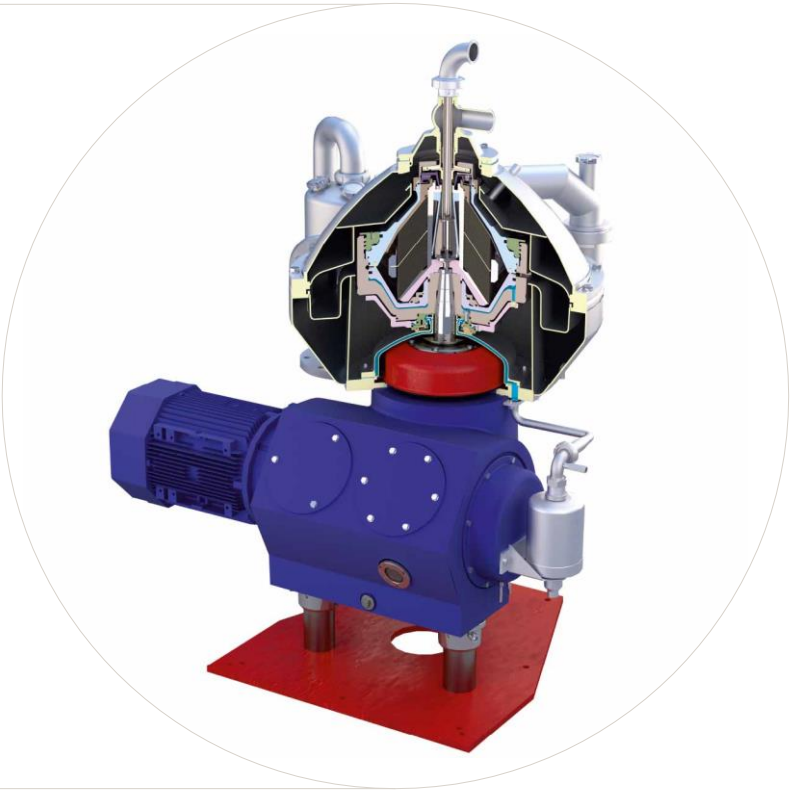


- Purifies the lipids (oil)
- Discharges:
  - Purified lipids or oil through an open oil outlet
  - Sludge through open outlet
  - Stick water by means of gravity disc (pressure)

Larvae processing – Alfa Laval CentriFlow wet rendering

– Purification in centrifugal separator





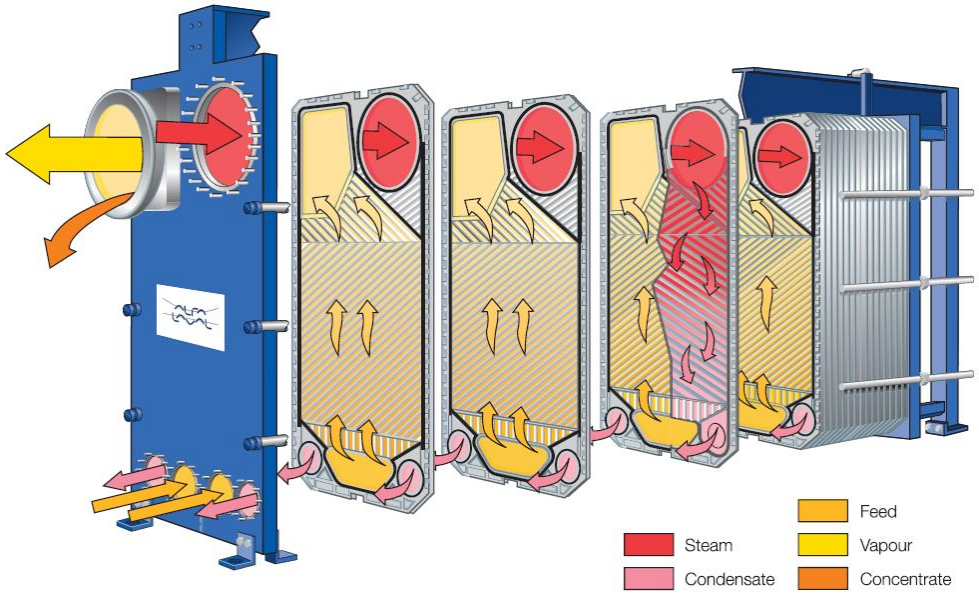
Larvae processing

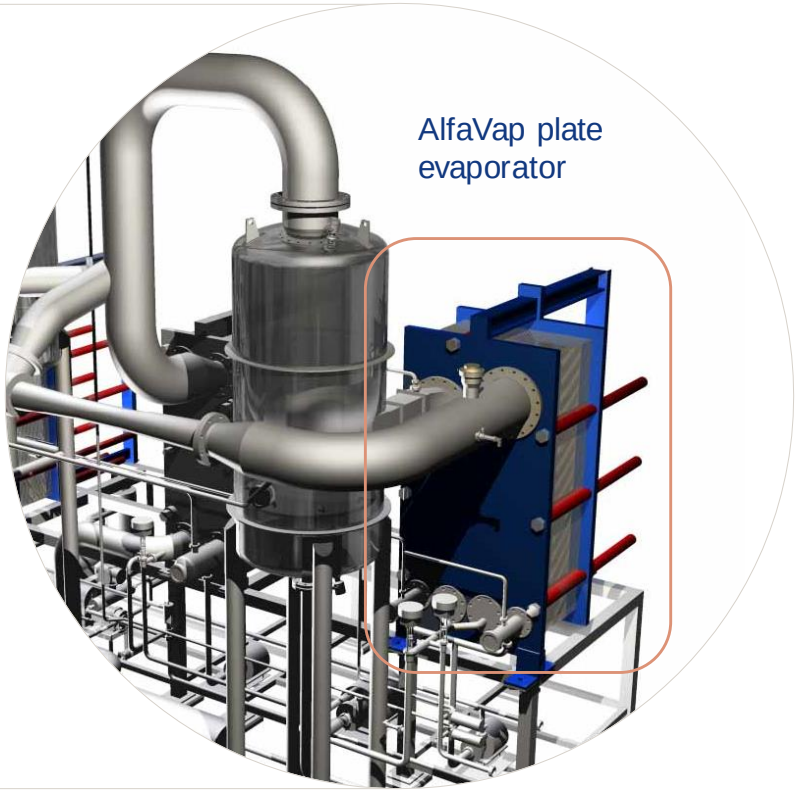
Evaporation and concentration

– Alfa Laval CentriFlow wet rendering

Larvae processing – Alfa Laval CentriFlow wet rendering

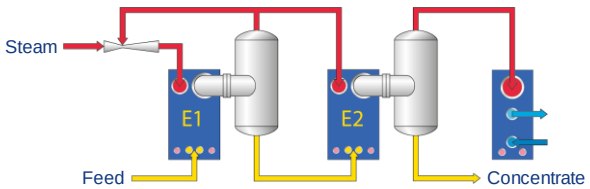
– Evaporation and concentration



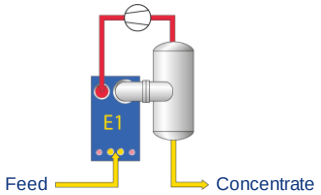


Larvae processing – Alfa Laval CentriFlow wet rendering

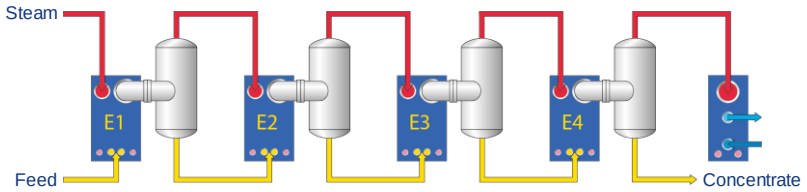
– Evaporation and concentration



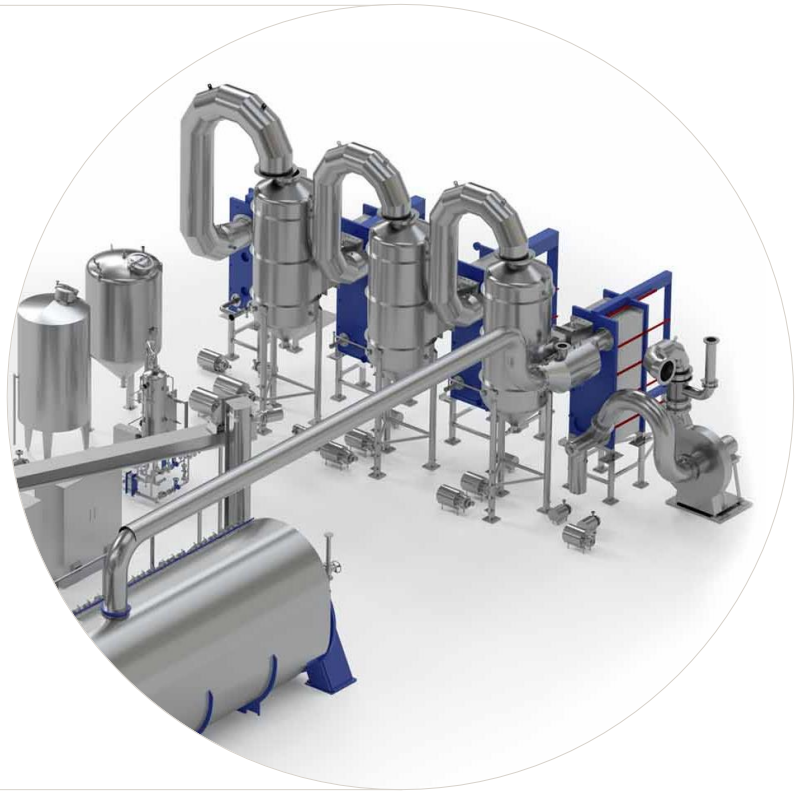
AlfaVap Thermal
Vapour Recompressor



AlfaVap Mechanical
Vapour Recompressor



AlfaVap Waste Heat



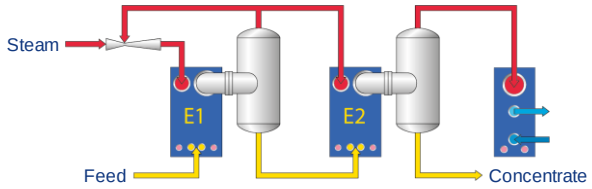
Larvae processing – Alfa Laval CentriFlow wet rendering

– Evaporation and concentration

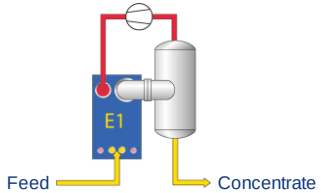
Process considerations

Upsides

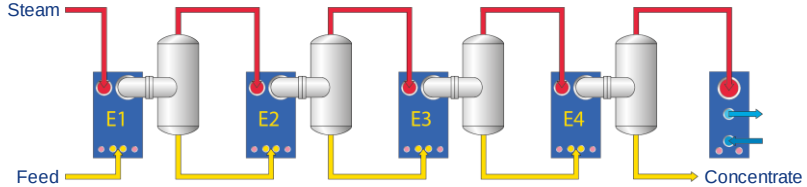
- Protein recovery
- Energy savings
- Possibility to choose cheapest energy source



AlfaVap Thermal Vapour Recompressor



AlfaVap Mechanical Vapour Recompressor



AlfaVap Waste Heat

Larvae processing – Alfa Laval CentriFlow wet rendering

– Evaporation and concentration

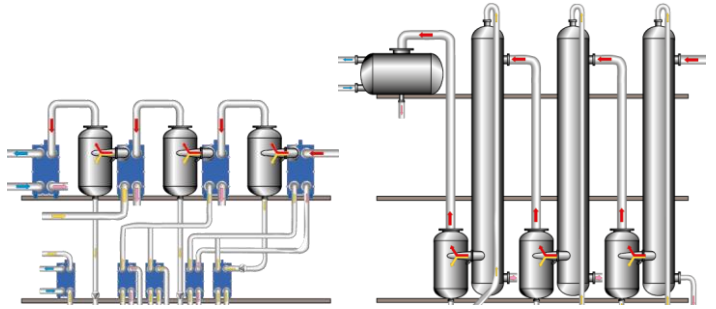
Equipment considerations

Upsides

- Higher concentration
- Flexibility
- Extremely compact
- Long running time
- Efficient Cleaning-in-Place (CIP)

Downsides

- Gasket replacement



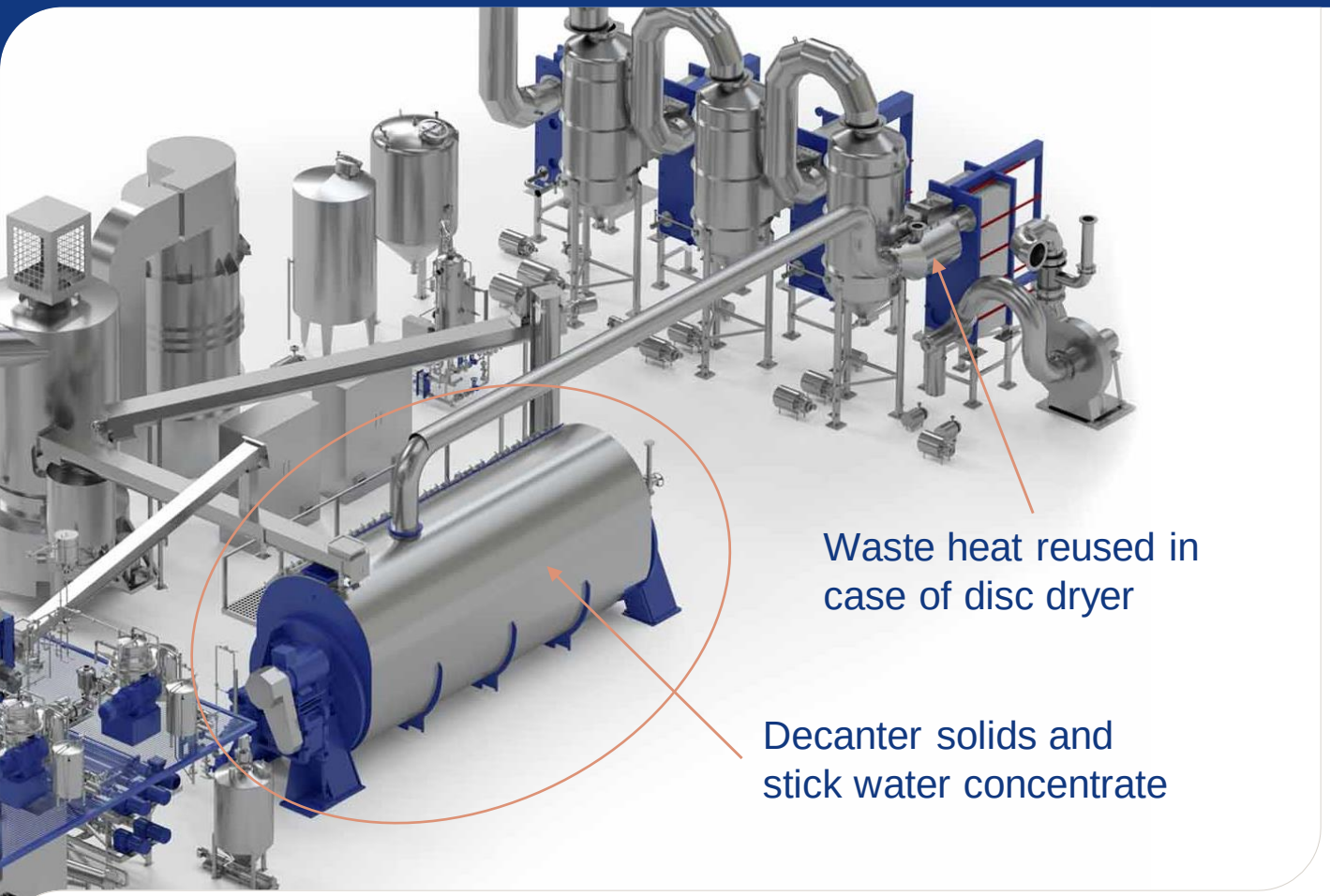
Larvae processing

Drying

– Alfa Laval CentriFlow wet rendering

Larvae processing – Alfa Laval CentriFlow wet rendering

– Drying

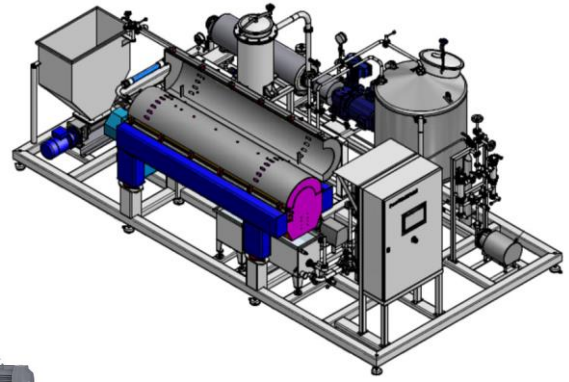


- Different dryer technologies can be used

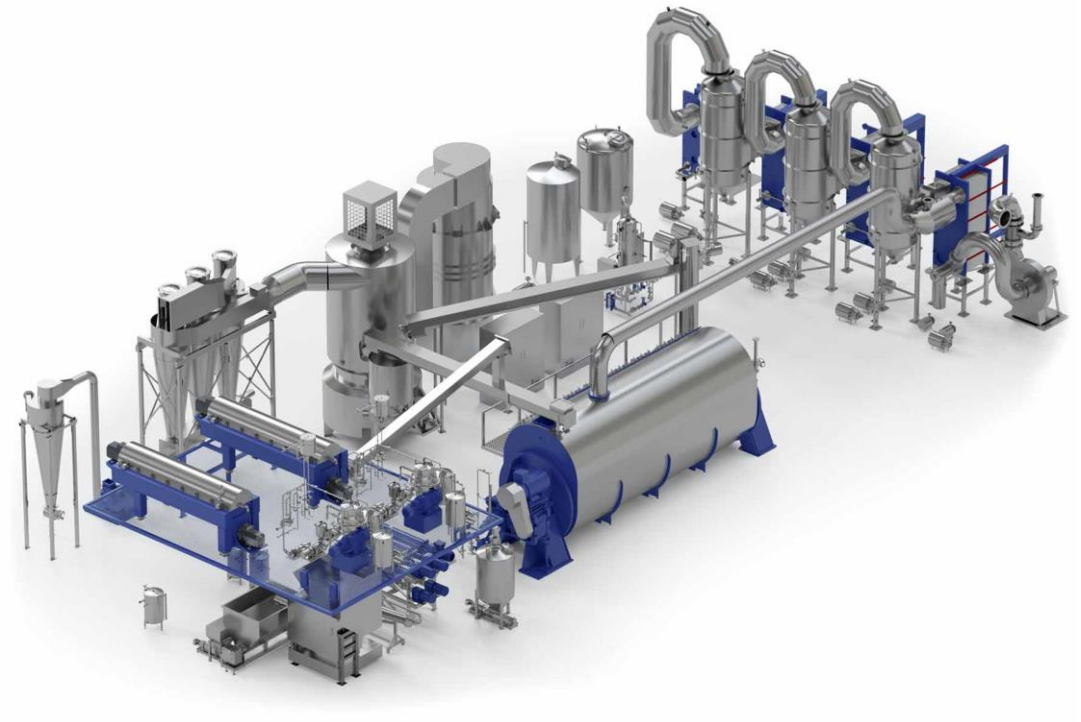
Larvae processing

– Alfa Laval CentriFlow wet rendering

Individual machines



Complete systems



Larvae processing

Dry rendering vs. wet rendering

Larvae processing

– Dry rendering vs. Alfa Laval CentriFlow wet rendering

Dry rendering

Upsides

- Simple technology
- Easily accessible technology

Downsides

- Lower quality end products
- Very high energy consumption
- Never hygienic
- Long start-up time

Alfa Laval CentriFlow wet rendering

Upsides

- High quality end products
- Low energy consumption
- Hygienic design
- Quick start-up time
- Flexibility to increase capacity

Downsides

- Addition of moisture
- Higher maintenance

Larvae processing

– Dry rendering vs. Alfa Laval CentriFlow wet rendering

Dry rendering

Oil after decanter


Oil after decanter

Alfa Laval CentriFlow wet rendering


Oil after decanter

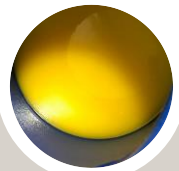

Oil after decanter

Show me the money

– Dry rendering vs. Alfa Laval CentriFlow wet rendering

Dry rendering

- Food-grade protein impossible
- Low protein digestibility and low protein content for the aquafeed industry
- Animal husbandry (poultry, pork) sectors seek lower meal prices



Alfa Laval wet rendering

- Food-grade protein possible
- Aquafeed industry can be interested
- Pet food sector could be interested

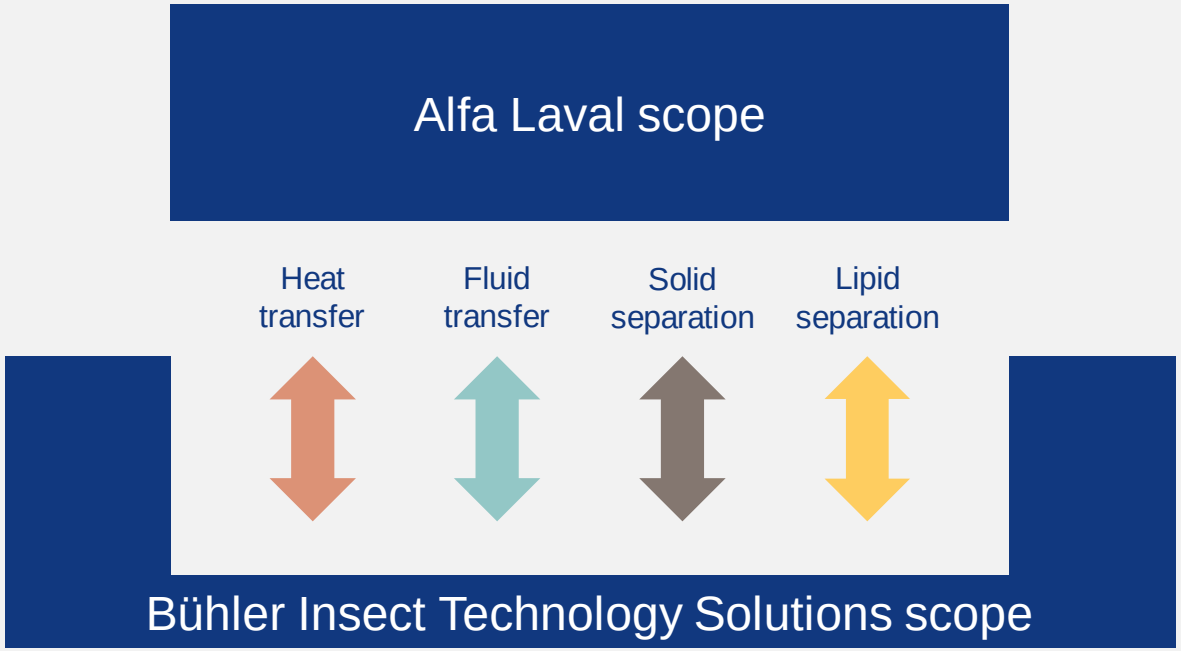
With CentriFlow wet rendering, a medium sized BSF rearing operation with 12,500 TPY larvae / 3.000 TPY protein meal production, potentially could increase the revenue by up to MUSD 4 per year.

A strategic partnership

Alfa Laval and Bühler Insect Technology Solutions (BITS)

Alfa Laval and Bühler Insect Technology Solutions

– Best of both worlds

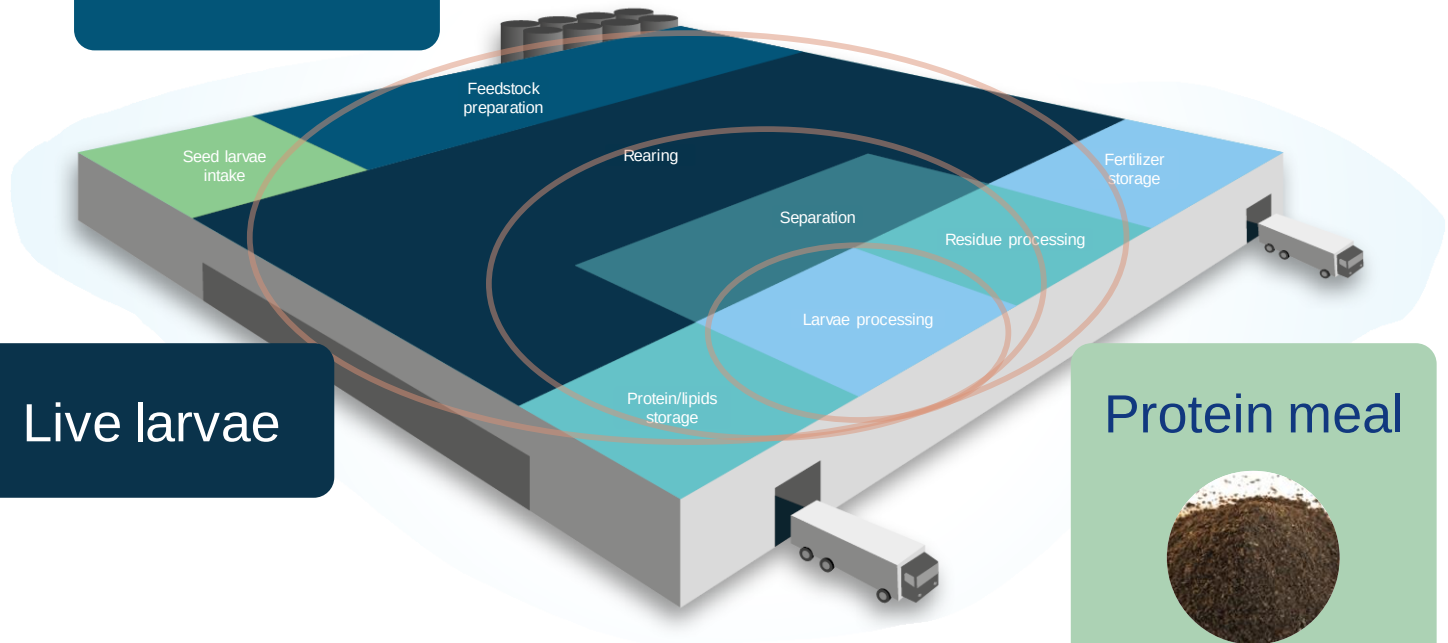


- Knowledge sharing and joint expertise
- Highly flexible, tailored solutions
- Fast ramp-up from pilot-scale to industrial-scale production
- Ongoing collaboration on R&D, marketing and aftersales services

Insect processing plant

– From specific processing unit to complete industrial solution

Feedstock



Live larvae

Fertilizer

Protein meal

Lipids

Source: Bühler Insect Technology Solutions

Q&As


ALFA
LAVAL