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Life circle of hydrolysate production

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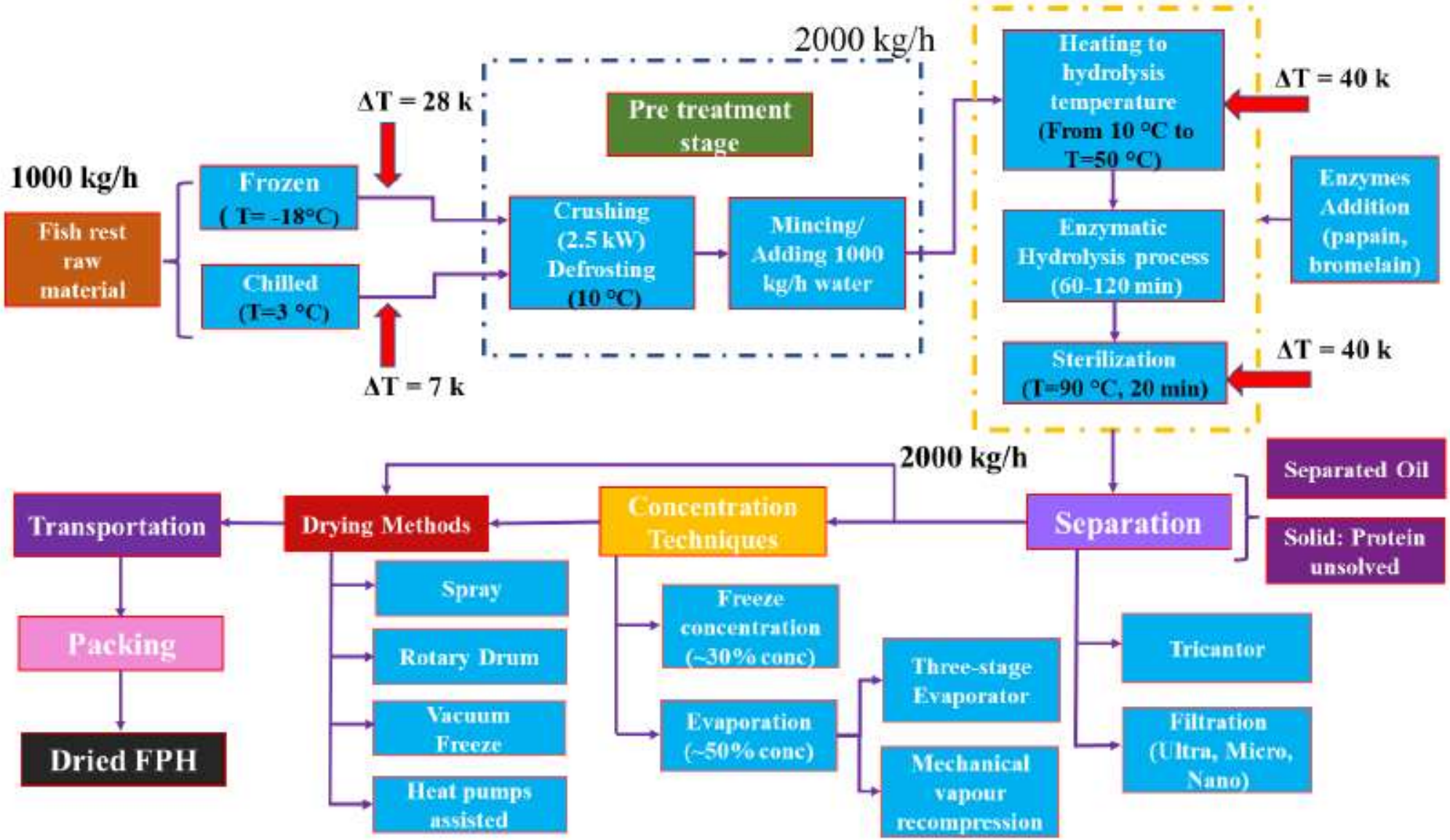
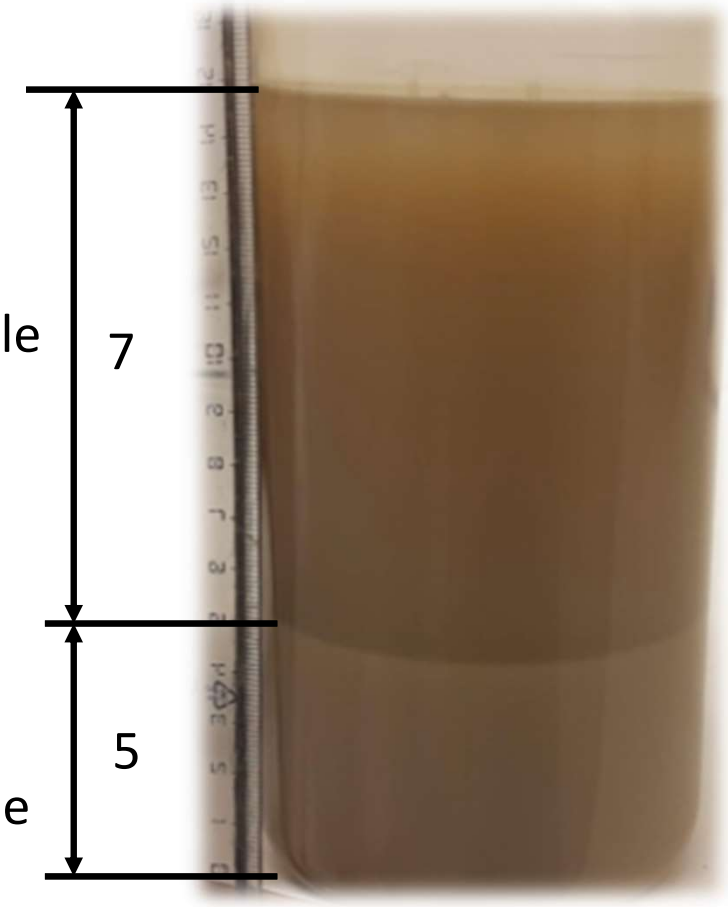
Generalized scheme representing the process flow



RRM: Frozen or fresh?



Freezing

Frozen storage

Denaturation

High level of non-soluble fraction

Cold-chain rules the process

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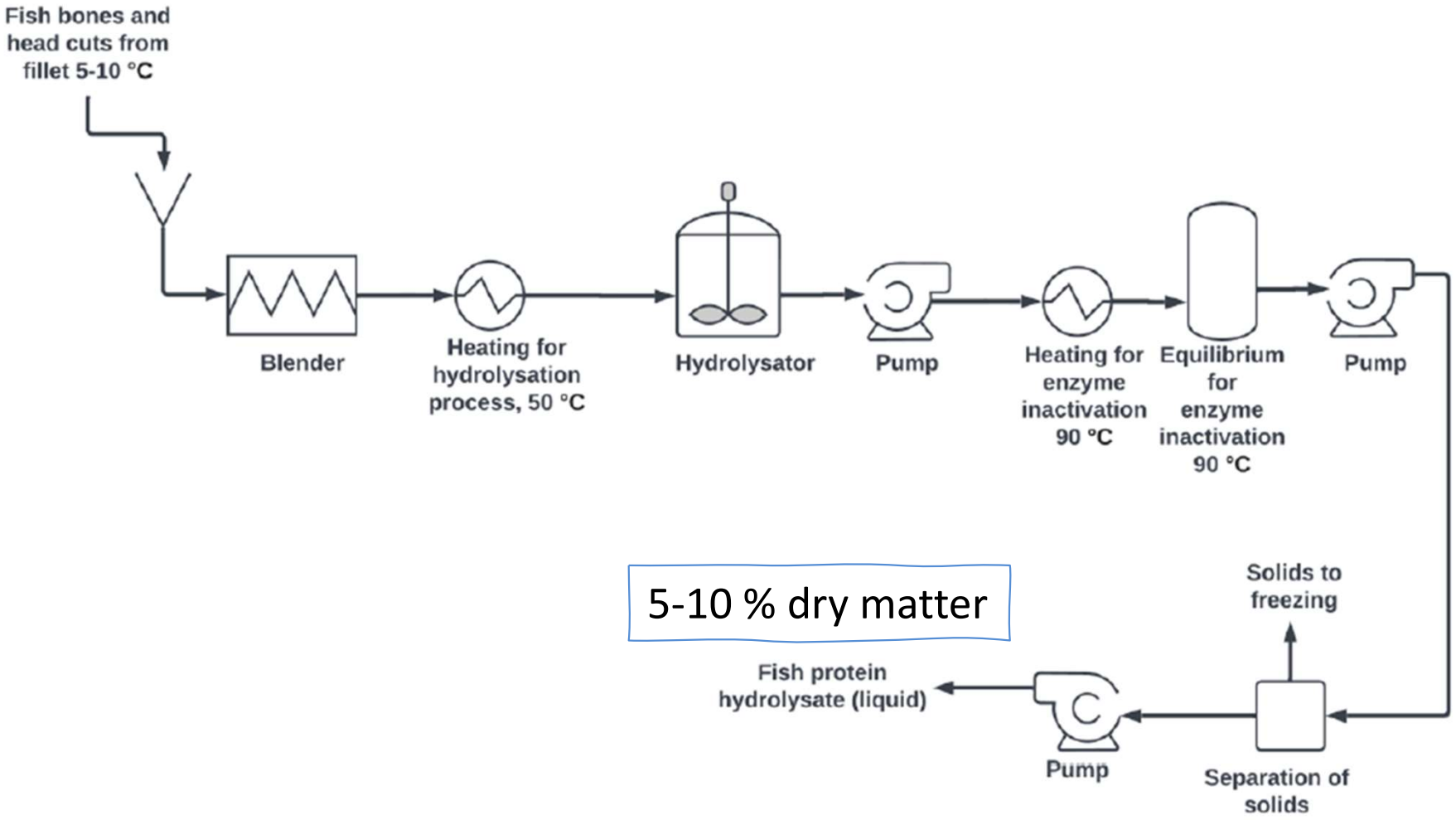
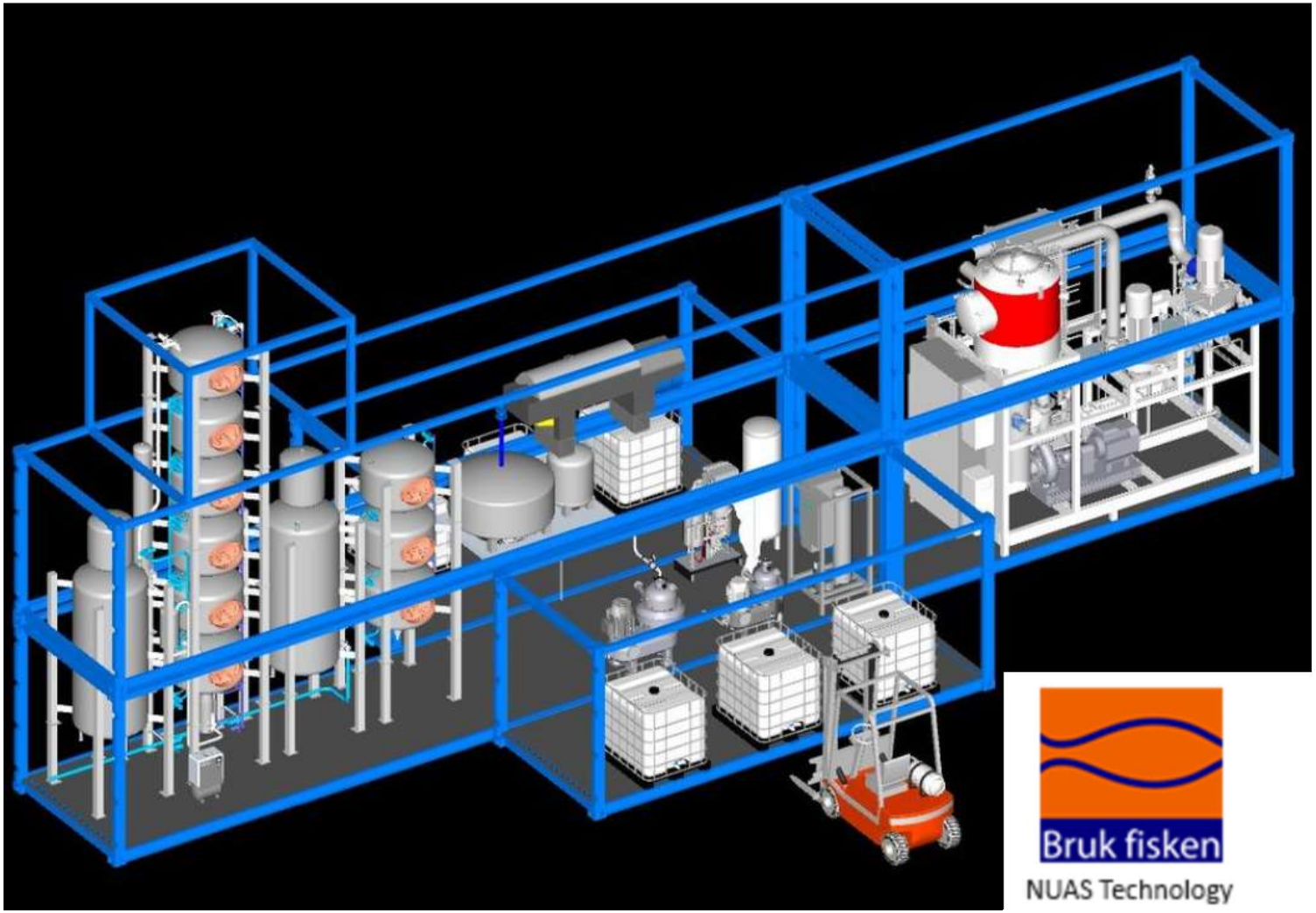
Primary processing



Primary processing- continuous flow



Bruk fisken

NUAS Technology

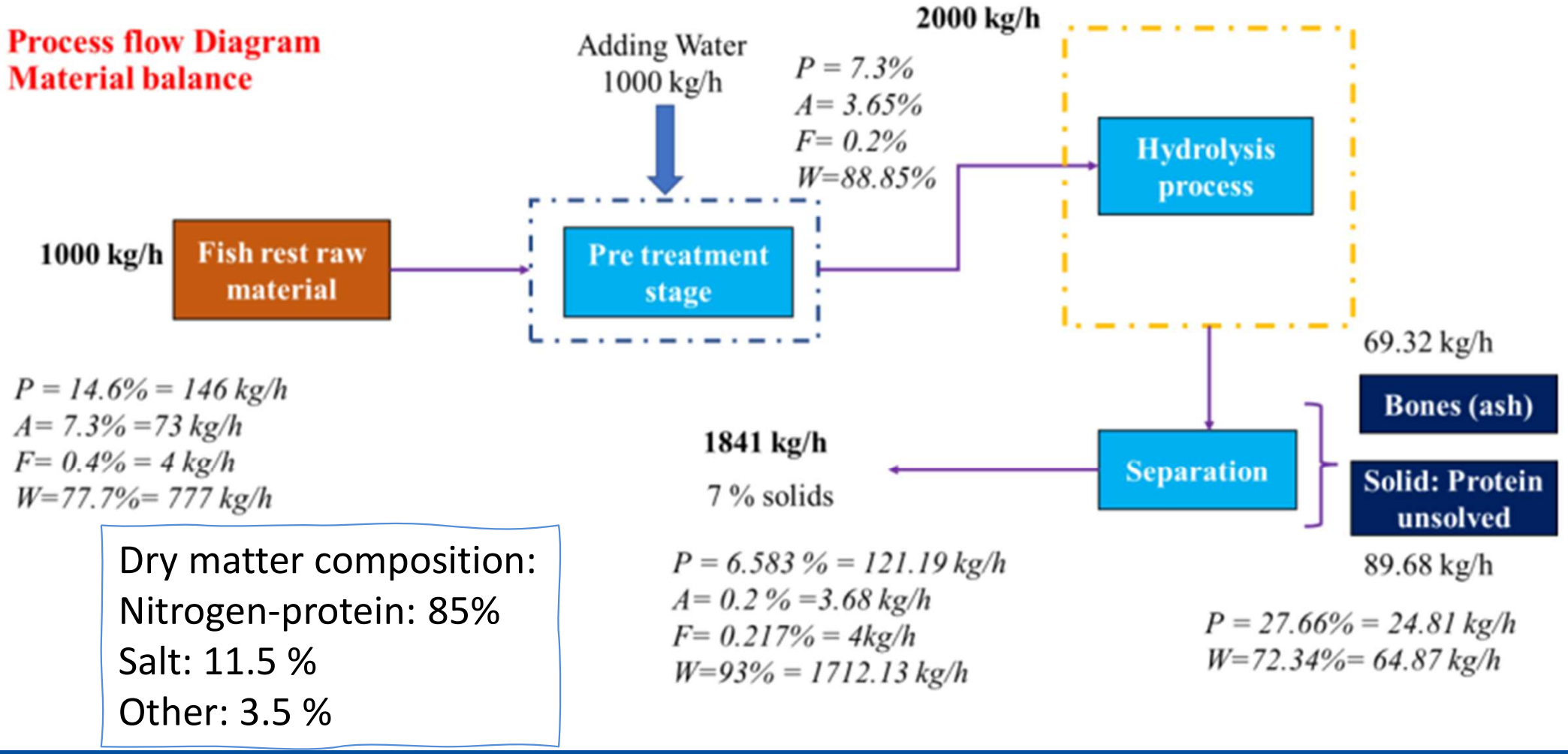
Anaerobic hydrolysation

Two step separation:

- Tricanter
- Polisher

Lemon-yellow powder
Low oxidation level
High level of lipid separation (below 1% d.b.)

Material balance *based on Myra production unit

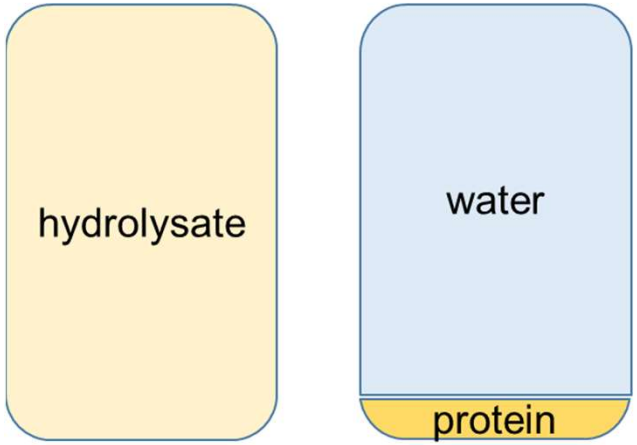


Dry matter composition:
Nitrogen-protein: 85%
Salt: 11.5 %
Other: 3.5 %

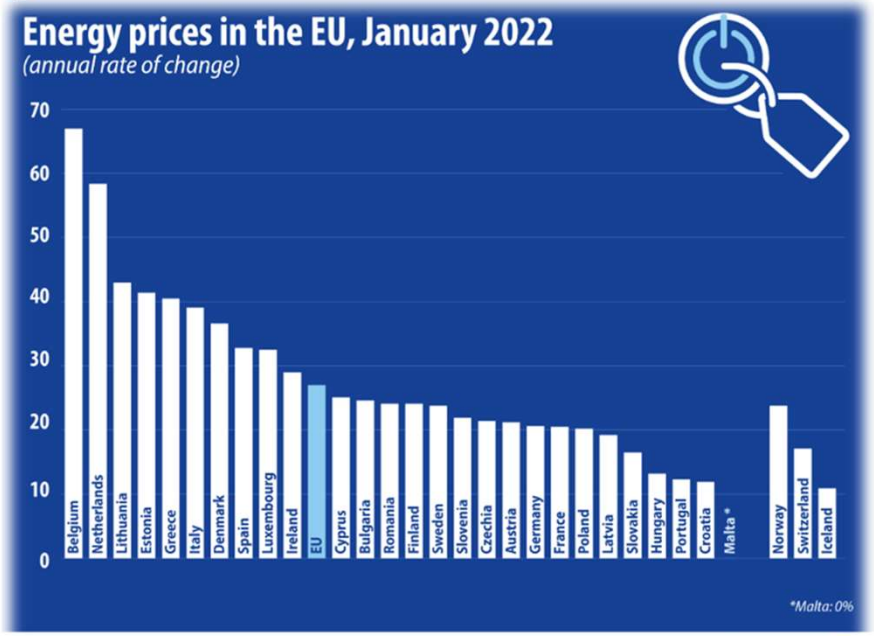
Ways of hydrolysate stabilization

- ✓ Sterilization and further conservation (thermal or chemical)
- ✓ Direct freezing (blocks)
- ✓ Drying (powder form)

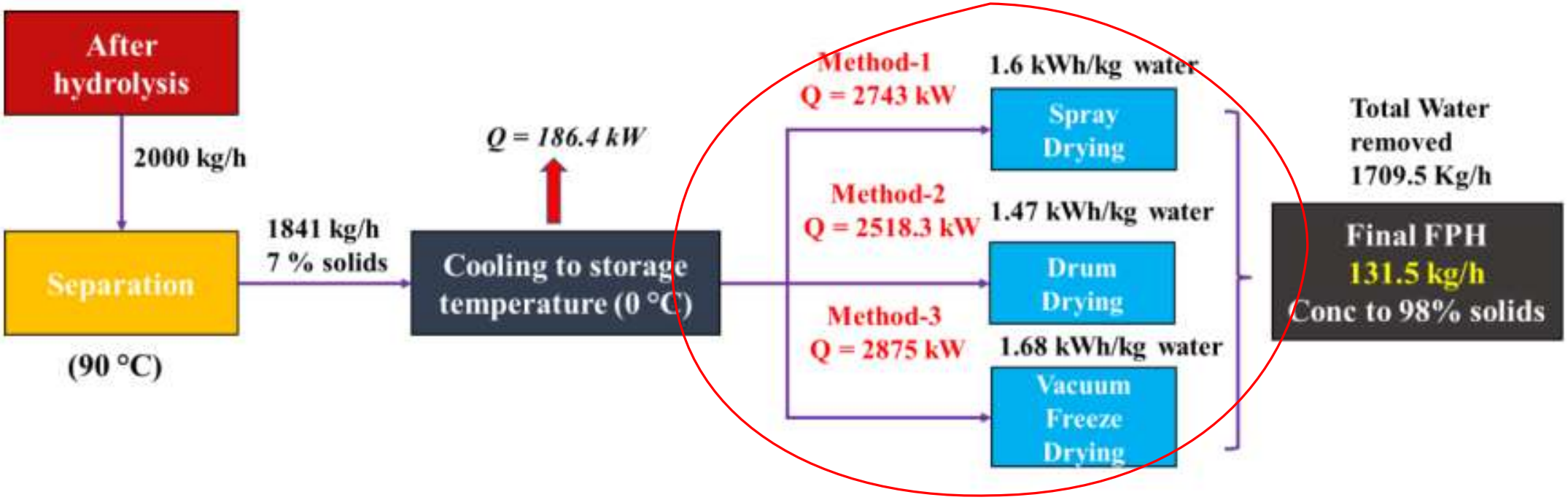
The great problem: high moisture content



Removing of 1 kg of water
requires from 0.5 to 15 kWh



Standard process: direct drying



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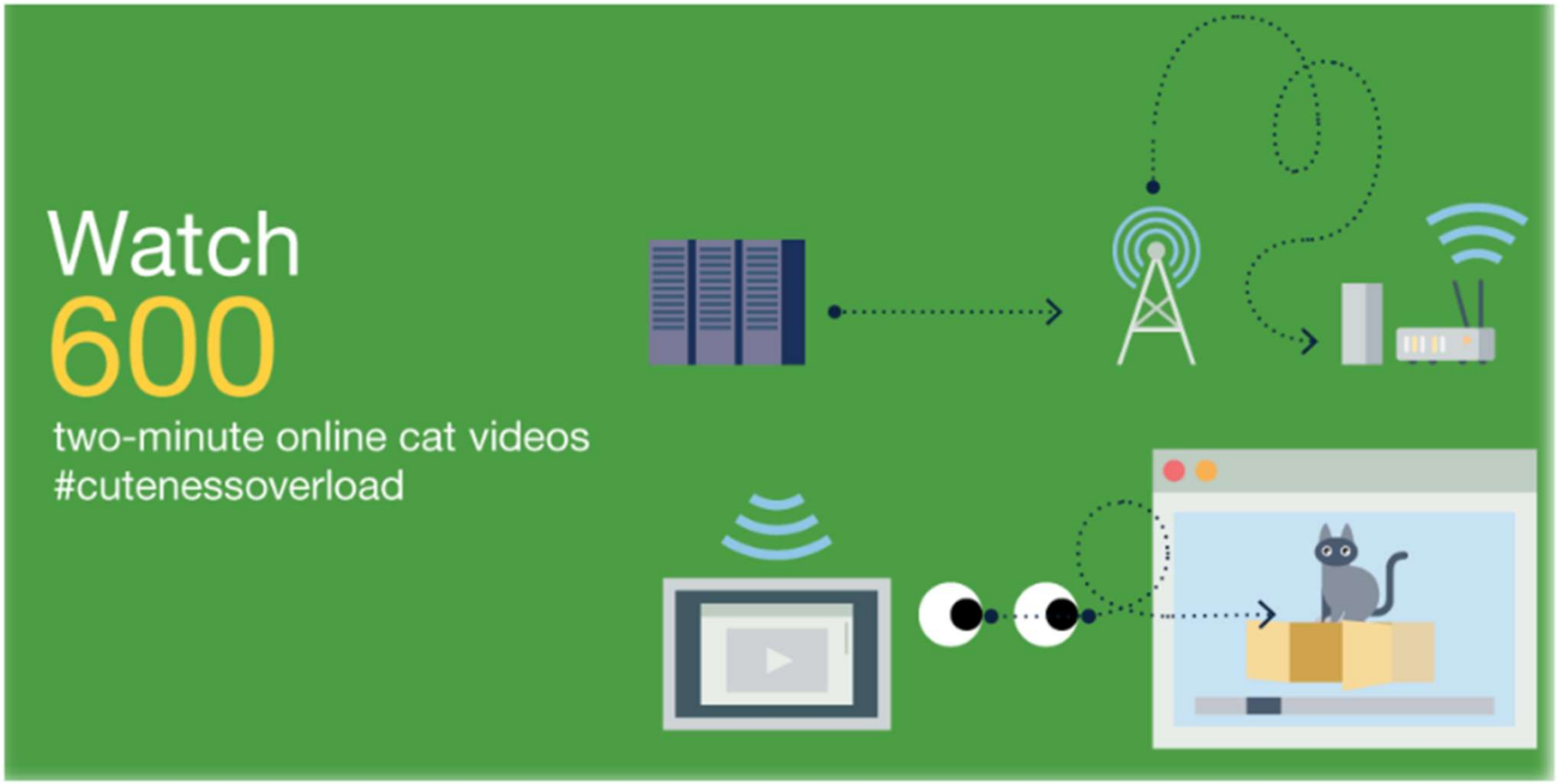
The great problem: high moisture content

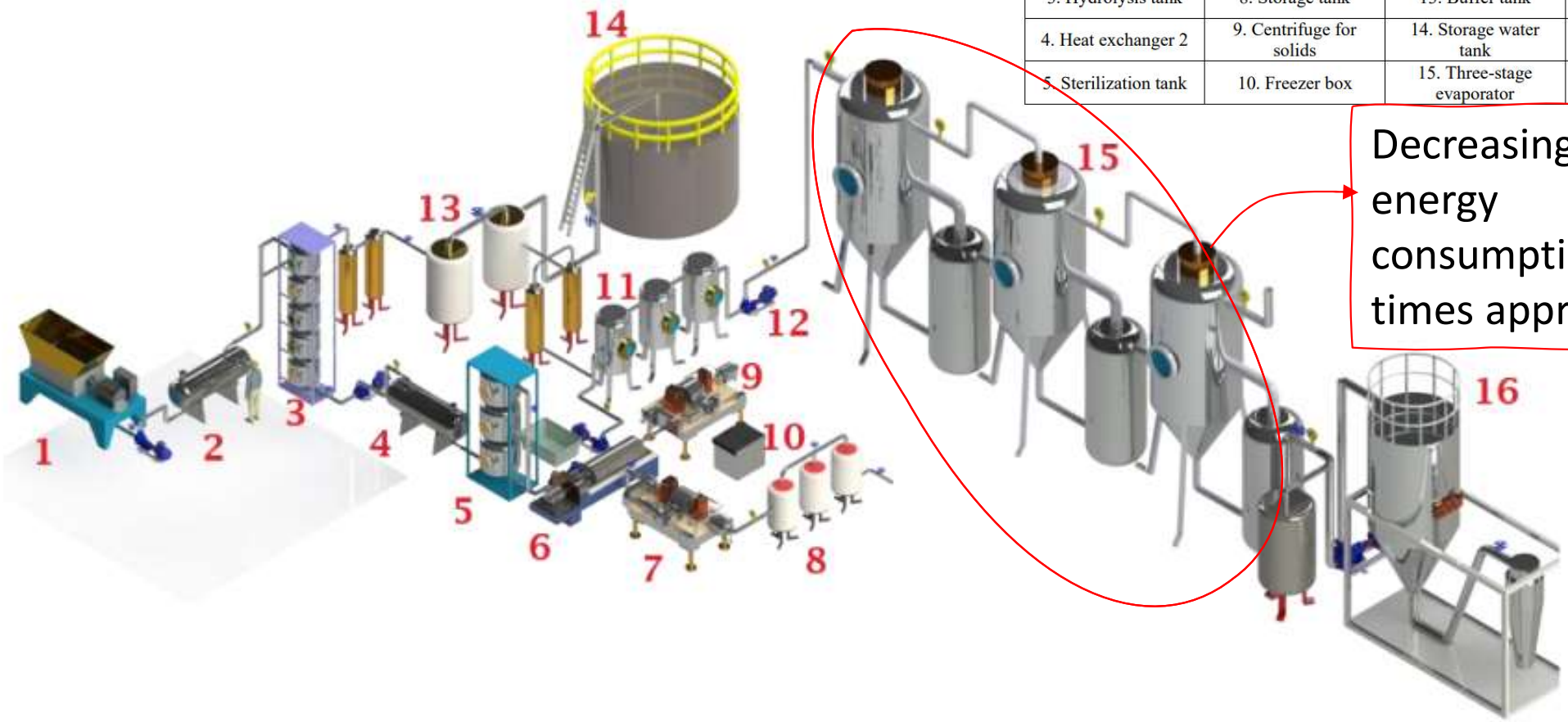
Here's what one kilowatt-hour can do for you:



https://www.wnhydro.com/en/index.asp

Energy efficient production line

1. Crusher	6. Tricantor	11. FPH accumulator tank	16. Spray dryer
2. Heat exchanger 1	7. Centrifuge for oil	12. Pump	17. Mechanical vapor recompression
3. Hydrolysis tank	8. Storage tank	13. Buffer tank	18. Rotary drum drying
4. Heat exchanger 2	9. Centrifuge for solids	14. Storage water tank	19. Membrane filtration
5. Sterilization tank	10. Freezer box	15. Three-stage evaporator	20. Freeze concentration unit



Decreasing energy consumption 2-3 times approx

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Energy efficient production line

- ✓ Large size
- ✓ Steam is required
- ✓ Sticking of product to the wall
- ✓ Anti-foaming agent is required
- ✓ Denaturation of protein

- ✓ Operates between below 100 °C
- ✓ Low investment costs
- ✓ Final concentration 40-50 %

Energy efficient production line

1. Crusher	6. Tricantor	11. FPH accumulator tank	16. Spray dryer
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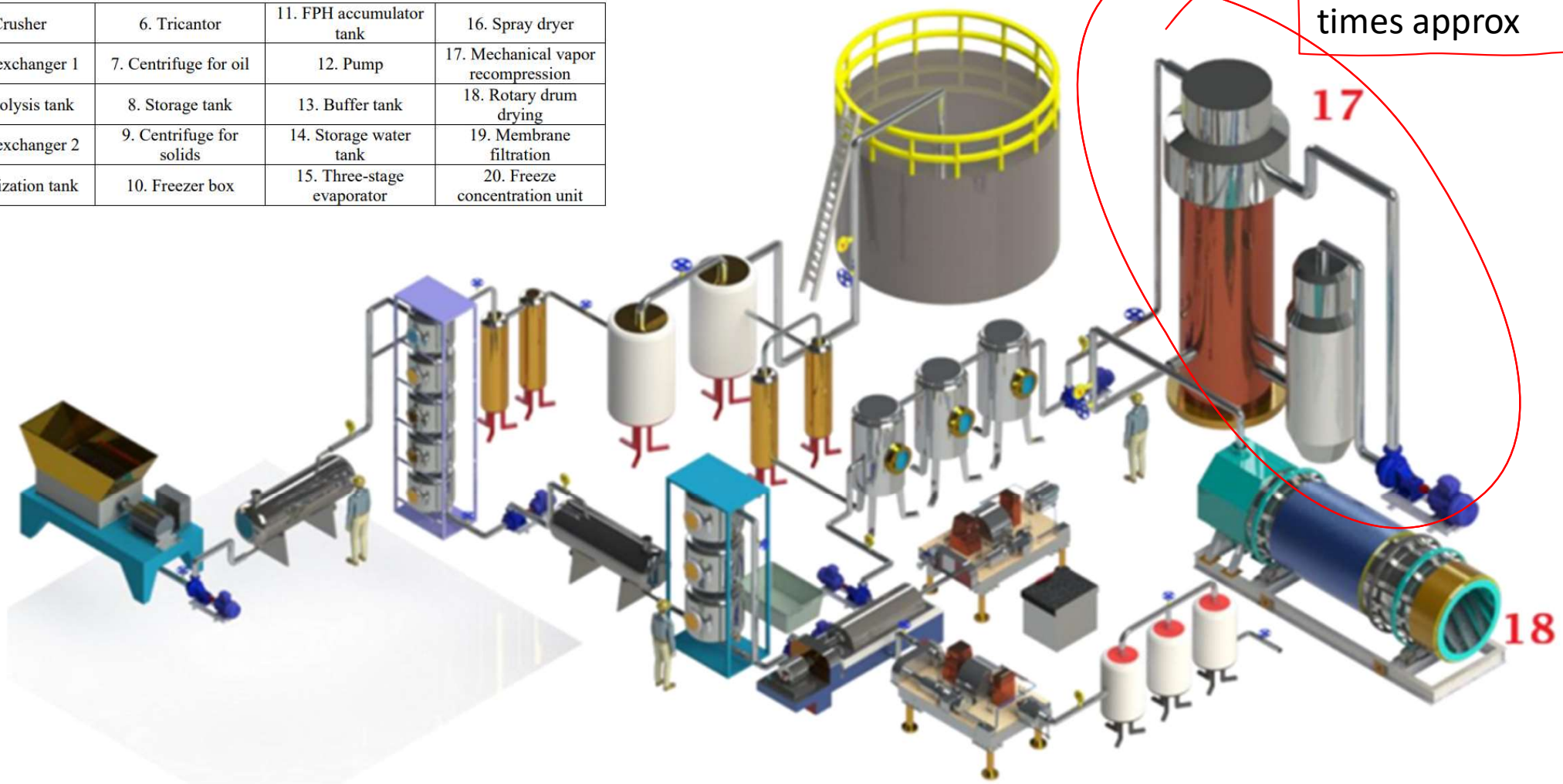
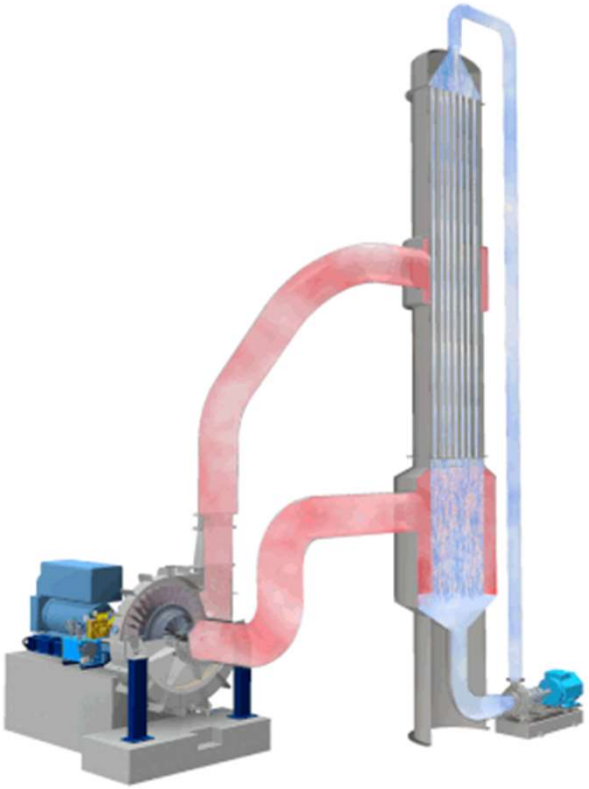
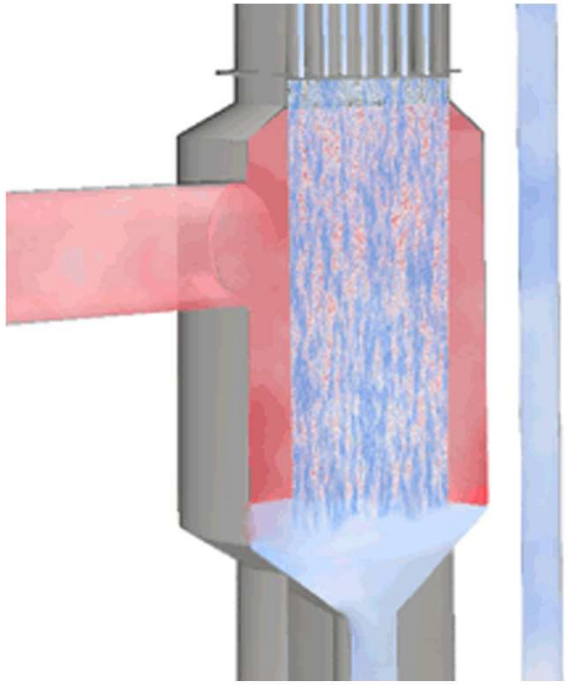
Decreasing energy consumption 5-6 times approx



Energy efficient production line



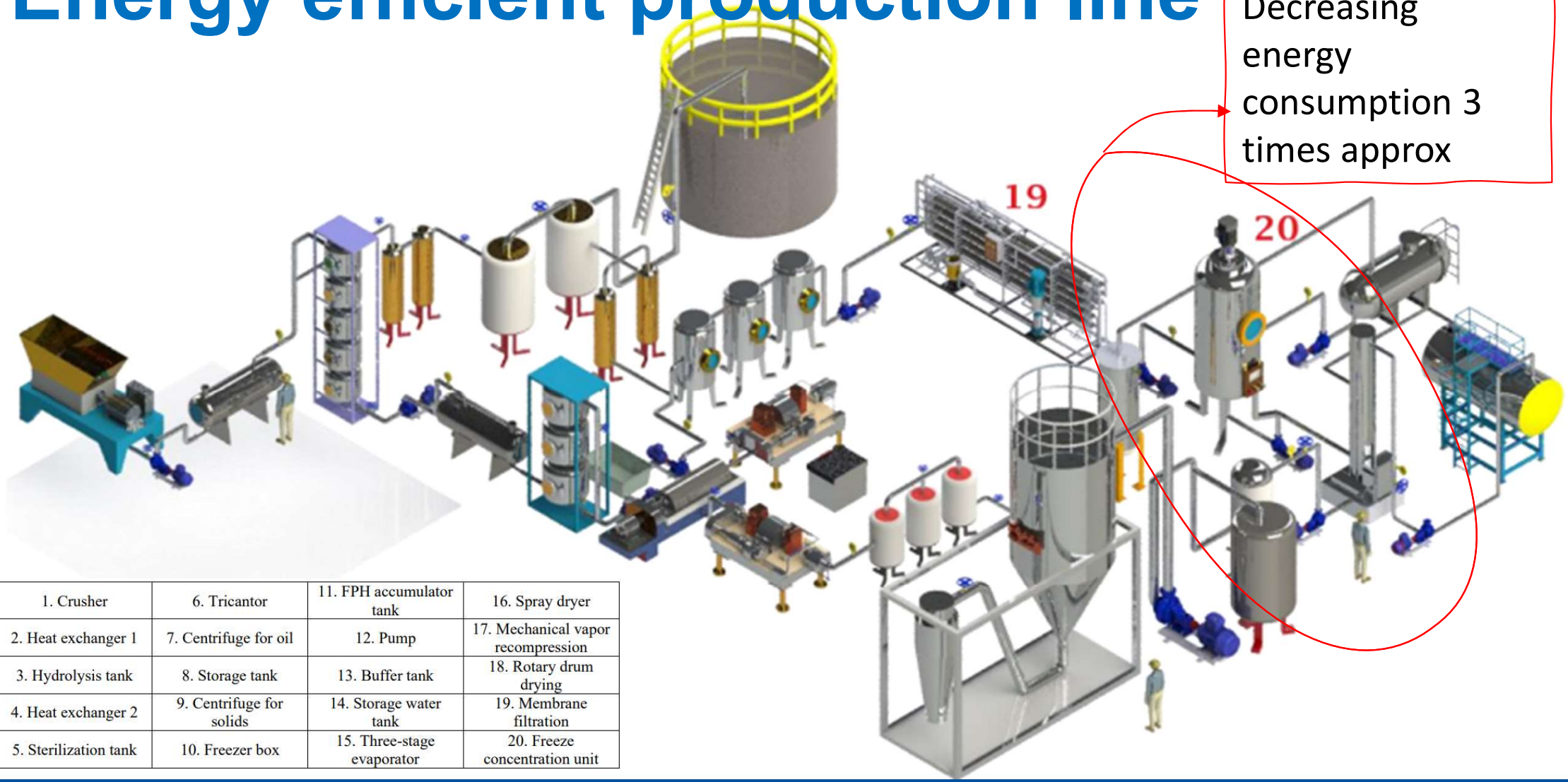


- ✓ Large size
- ✓ Steam is required at the beginning
- ✓ Sticking of product to the wall
- ✓ Anti-foaming agent is required
- ✓ High investment costs
- ✓ Denaturation of protein

- ✓ Operates between below 100 °C
- ✓ Low running costs
- ✓ Final concentration 40-50 %

Energy efficient production line

Decreasing energy consumption 3 times approx



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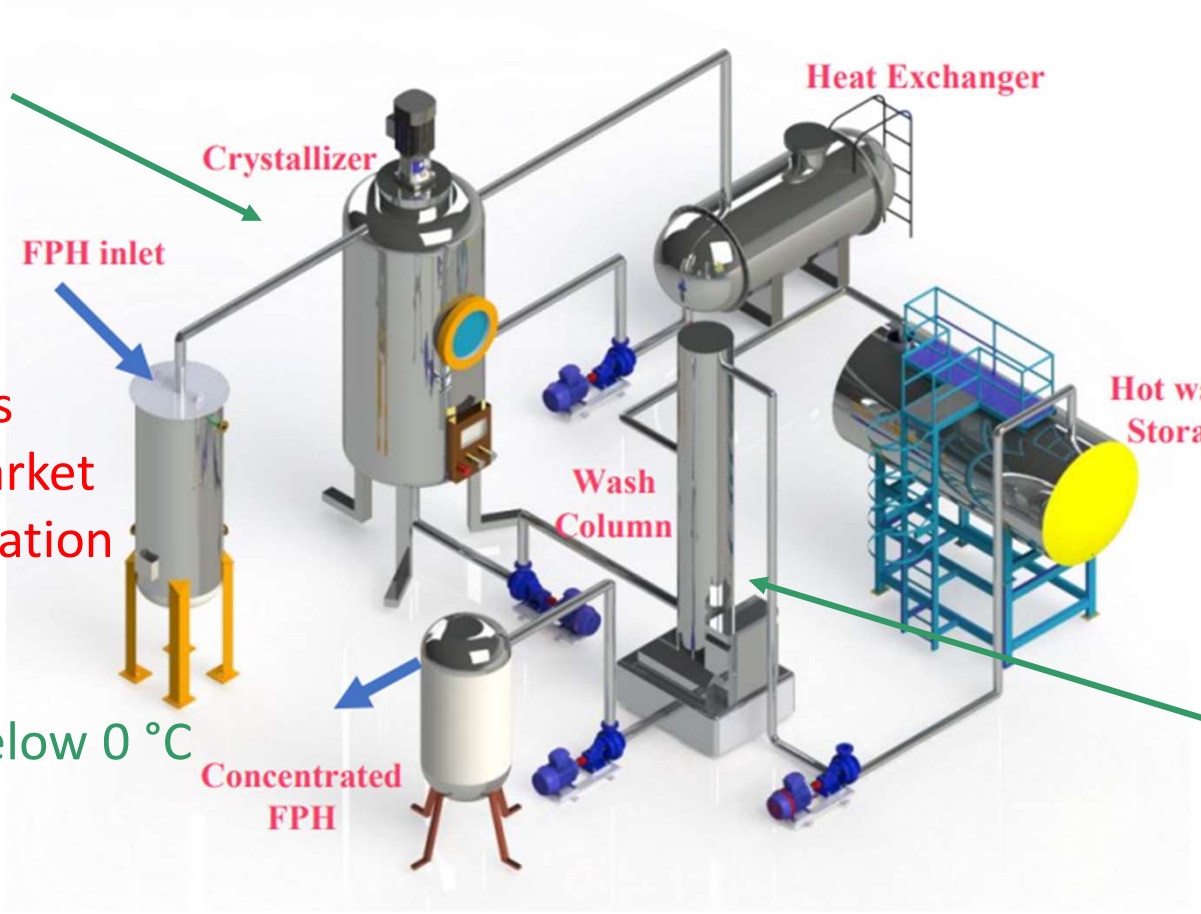
Energy efficient production line



- ✓ High investment costs
- ✓ Few producers on market
- ✓ Requires good purification
- ✓ Concentration 30 %

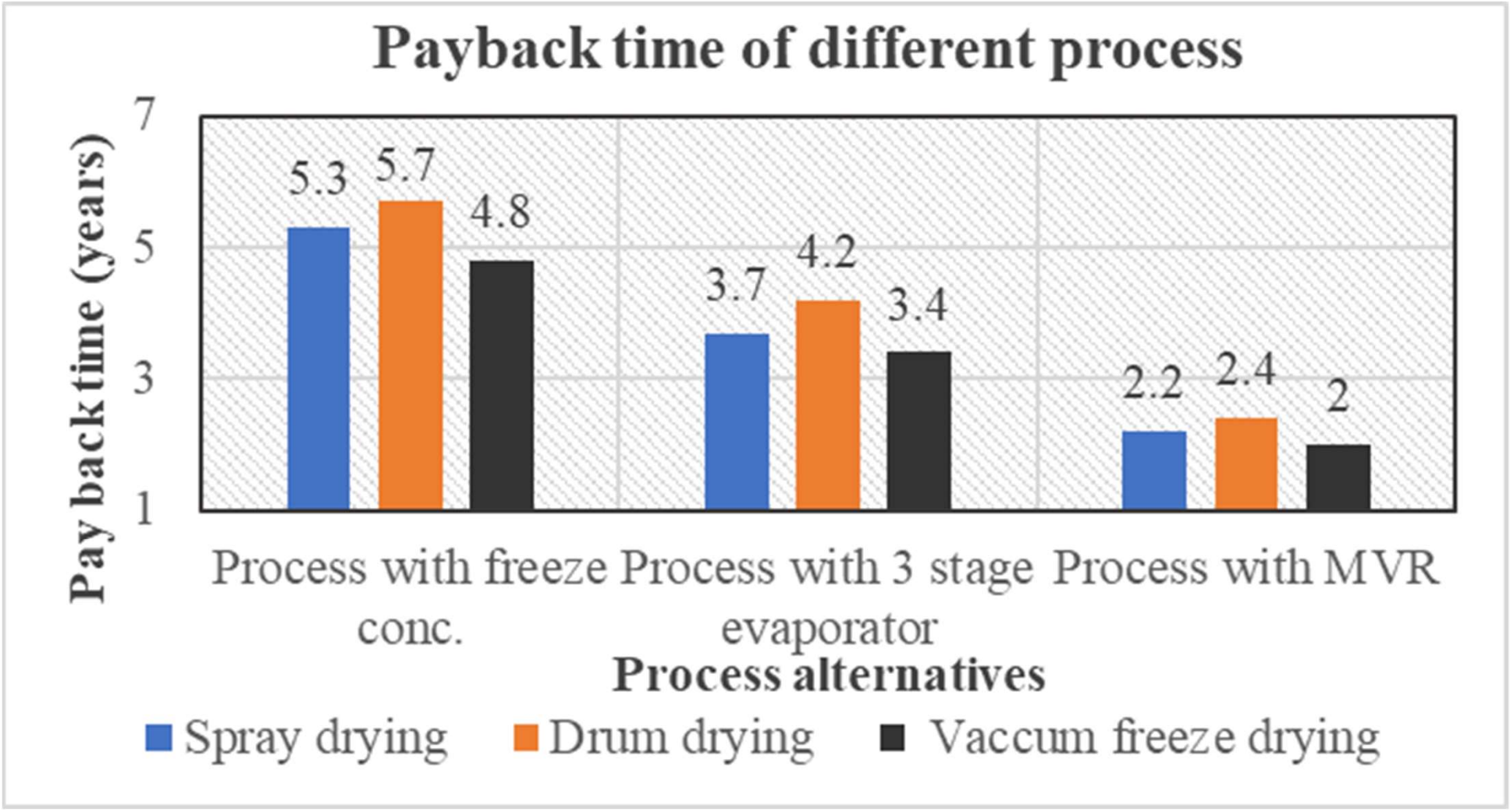
- ✓ Operates between below 0 °C
- ✓ No denaturation
- ✓ Low running costs

Energy demands, summary

Drying method used	Freeze concentration	Three effect evaporators	Mechanical vapor recompression	Direct drying
Spray drying	1245.3	1182	629	3183
Drum drying	1124.3	1158	606	2958
Vacuum freeze-drying	1230	1163	611	3315

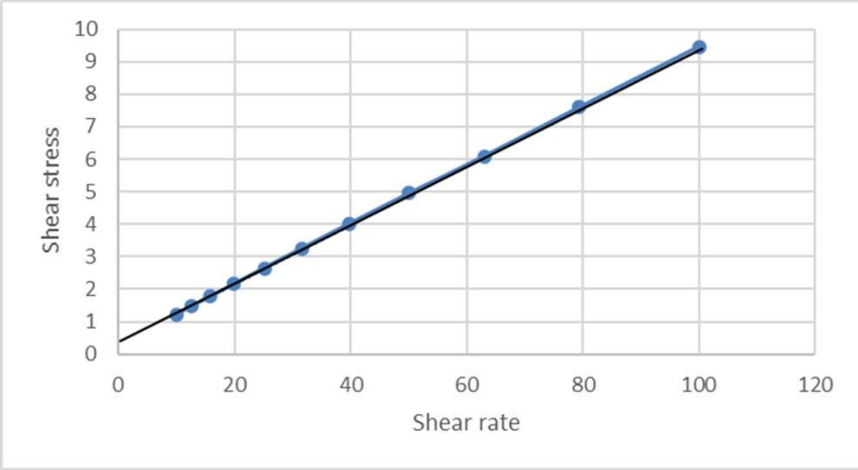
Processing of 1 ton RRM per hour (kWh)

Economic feasibility



Some comments about the properties

Type of hydrolysate		6°C		25°C		50°C	
	TS(%)	*m*	*τ*	*m*	*τ*	*m*	*τ*
Nanofiltation	15	0.0062	[<0.01]	0.0036	[<0.01]	0.0022	[<0.01]
	30	0.035	0.038	0.018	[<0.01]	0.0097	[<0.01]
	50	0.7	3.4 ± 0.6	0.28	0.6	0.091	0.27 ± 0.06
Top layer	15	0.0054	[<0.01]	0.0032	[<0.01]	0.0021	[<0.01]
	30	0.029	0.049 ± 0.03	0.016	0.012	0.0088	0.014
	50	0.43	1.1	0.19	0.28 ± 0.1	0.069	0.11



Conclusions

- ✓ Production of hydrolysates from RRM to powder is energy intensive process
- ✓ Cold chain is essential for increasing of liquid fraction during the hydrolysation process
- ✓ Evaporation, mechanical vapor recompression (MVR) and freeze-concentration help to decrease energy during drying step
- ✓ MVR is very efficient if considering high solids in concentrate
- ✓ The limitation of the MVR method – viscosity of hydrolysate and relatively high temperature. High solid concentration can be unacceptable for spray drying
- ✓ Freeze-concentration is beneficial in terms of cold treatment - high sustainability
- ✓ All the methods require purification

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THANK YOU FOR YOUR ATTENTION
Questions are welcome