

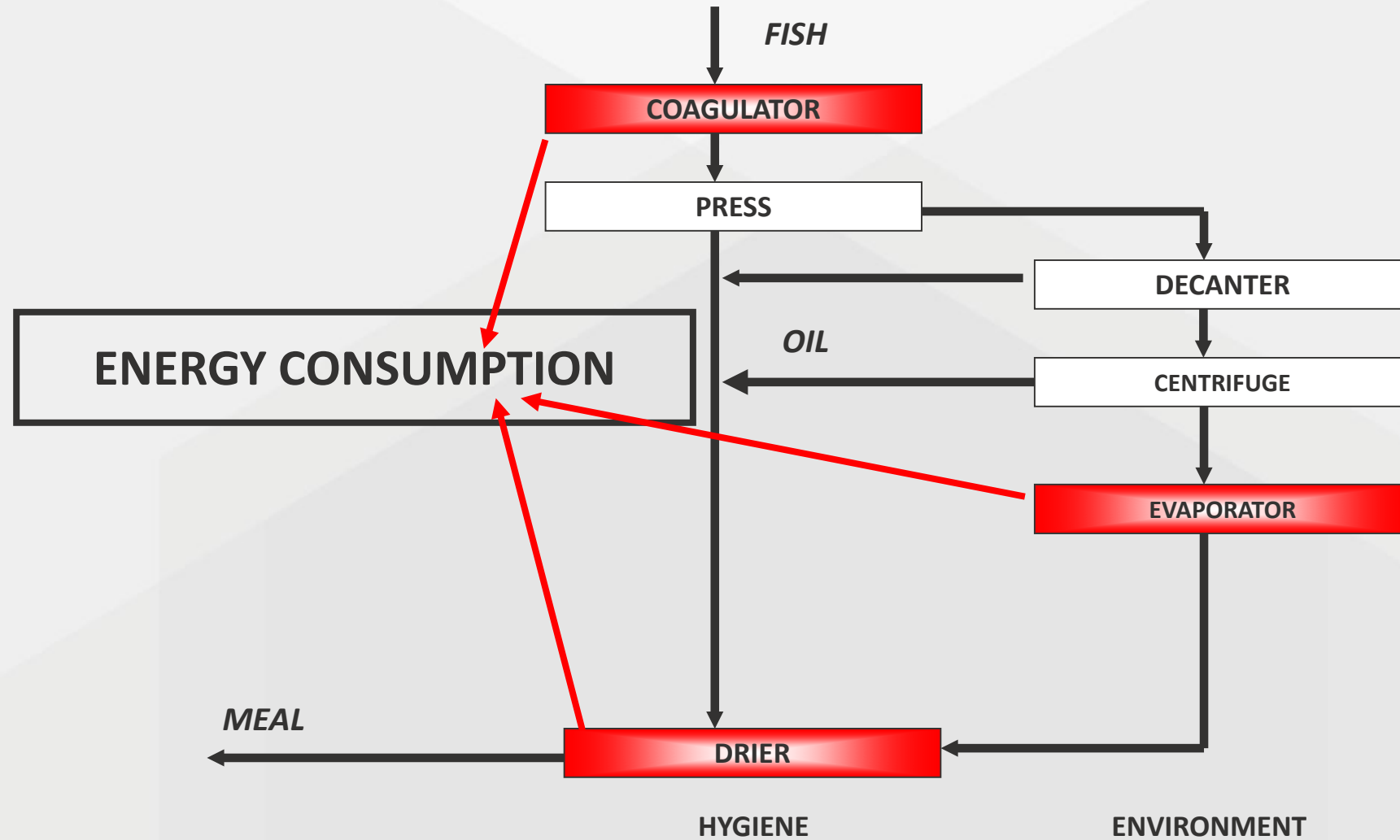


HAARSLEV™
Processing Technology

PROCESSING METHODS *OPTIMUM PROCESSING PARAMETERS*

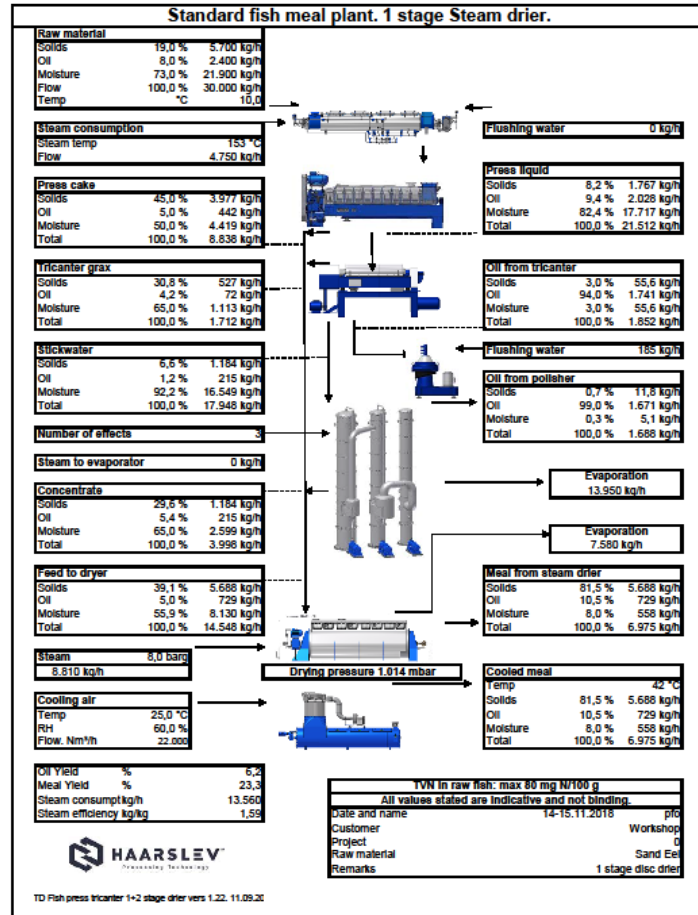
Peder Fosbøl

- Energy quality relations for different coagulation and water removal processes.
- Is high digestibility obtained at high energy consumption or?





Drier	Evaporator	Energy consumption Drier. kg fuel/kg evaporated	Energy consumption Evaporator kg fuel/kg evaporated Wh/kg evaporated	Energy consumption Coagulator Kg fuel/kg fish	Total fuel consumption kg/h
Steam drier Atm.	WHE	0,090	0	0,0106	1000
Vacuum Disc drier	WHE	0,087	0	0,0106	975
Hot air drier, drum	SHE, MVR	0,087	0,030 kg/kg 30 Wh/kg	0,0106	1395
Superheated steam, drum	WHE	0,097	0	0,0106	1050
Steam Drier+ hot air drier	75-80 %, TS split, WHE	0,090	0	0,0106	1000
Steam Drier+ hot air drier	60-65 % TS split, WHE+MVR,SHE	0,090	0,030 kg/kg 30 Wh/kg	0,0106	1125
Flash Drier, Air	MVR, SHE	0,087	0,030 kg/kg 30 Wh/kg	0,0106	1395



- Evaporation
- Evaporator 14 t/h
- Drier 7.6 t/h
- Steam consumption (Atm)
- Coagulator: 4,750 kg/h
- Drier: 8,810 kg/h



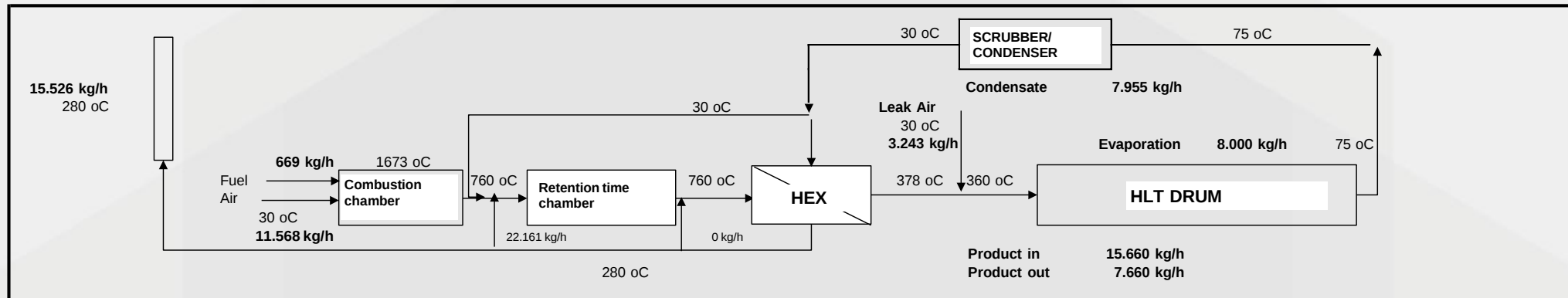
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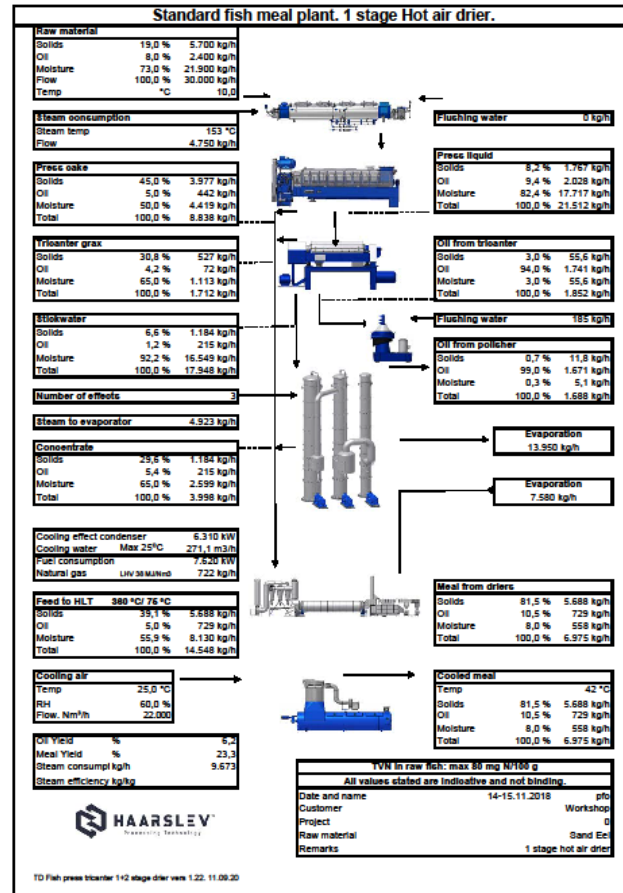
Low Product temperature

Condensate

No odor emission

No waste heat utilization





- Evaporation
- Evaporator 14.0 t/h
- Drier 7.6 t/h
- Steam consumption
- Coagulator: 4,750 kg/h
- Evaporator: 4,900 kg/h
- Fuel to drier 700 kg/h



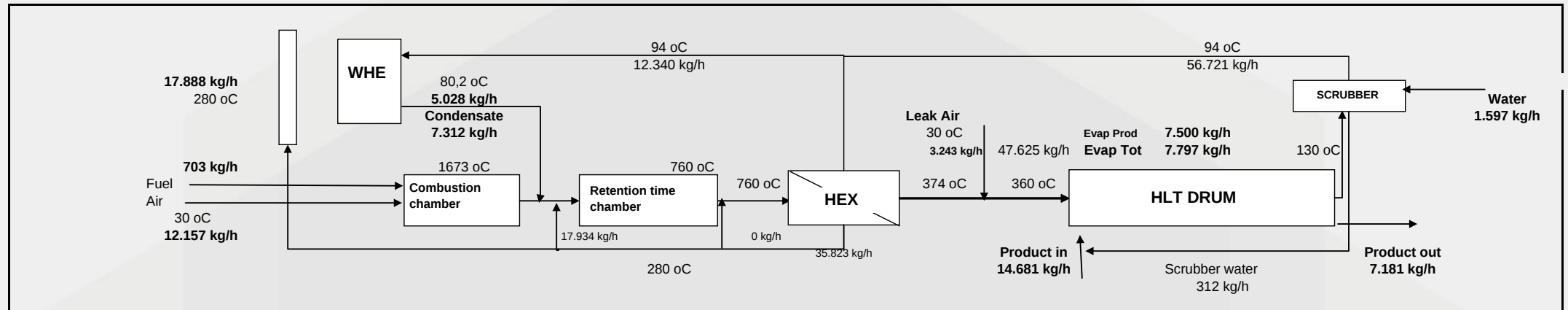
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Superheated steam, drum	WHE	0,097	0	0,0106	1050
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Steam Drier+ hot air drier	60-65 % TS split, WHE+MVR,SHE	0,090	0,030 kg/kg 30 Wh/kg	0,0106	1125
Flash Drier, Air	MVR, SHE	0,087	0,030 kg/kg 30 Wh/kg	0,0106	1395

High Product temperature

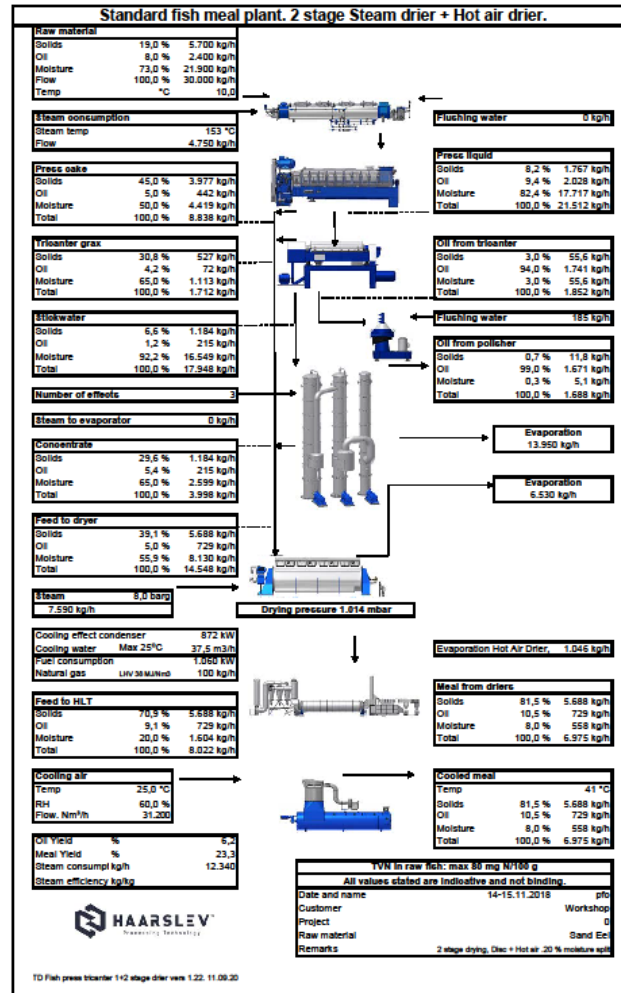
Condensate

No odor emission

Waste heat utilization



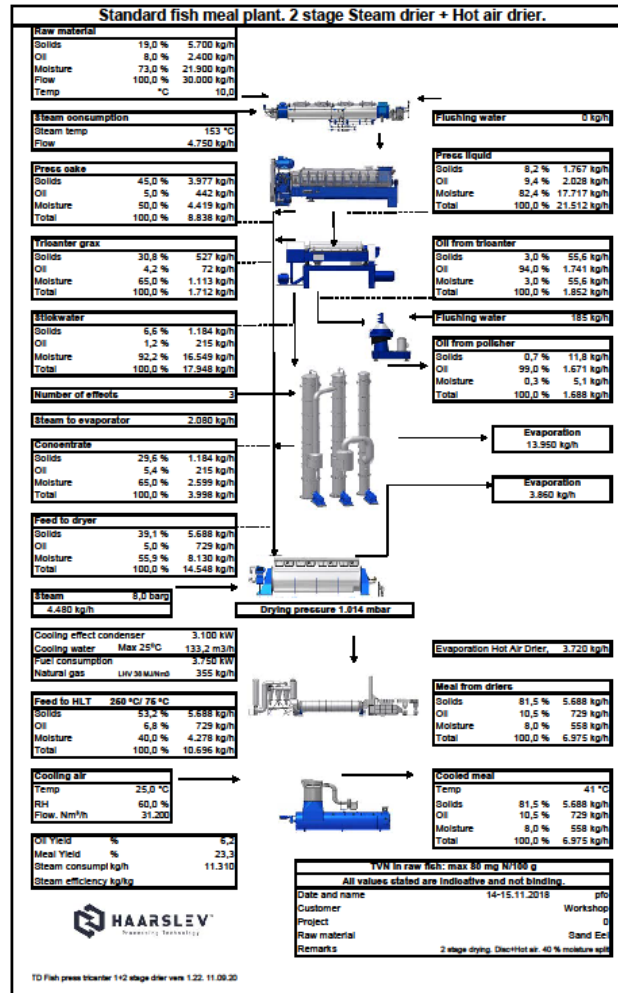
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Vacuum Disc drier	WHE	0,087	0	0,0106	975
Hot air drier, drum	SHE, MVR	0,087	0,030 kg/kg 30 Wh/kg	0,0106	1395
Superheated steam, drum	WHE	0,097	0	0,0106	1050
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Flash Drier, Air	MVR, SHE	0,087	0,030 kg/kg 30 Wh/kg	0,0106	1395



Split at 20 % moisture between driers

- Evaporation
- Evaporator 14.0 t/h
- Disc Drier 6.5 t/h
- Hot air drier 1.1 t/h
- Coagulator steam: 4,750 kg/h
- Disc drier steam: 7,590 kg/h
- Hot air drier fuel: 100 kg/h gas

Drier	Evaporator	Energy consumption Drier. kg fuel/kg evaporated	Energy consumption Evaporator kg fuel/kg evaporated Wh/kg evaporated	Energy consumption Coagulator Kg fuel/kg fish	Total fuel consumption kg/h
Steam drier Atm.	WHE	0,090	0	0,0106	1000
Vacuum Disc drier	WHE	0,087	0	0,0106	975
Hot air drier, drum	SHE, MVR	0,087	0,030 kg/kg 30 Wh/kg	0,0106	1395
Superheated steam, drum	WHE	0,097	0	0,0106	1050
Steam Drier+ hot air drier	75-80 %, TS split, WHE	0,090	0	0,0106	1000
Steam Drier+ hot air drier	60-65 % TS split, WHE+MVR,SHE	0,090	0,030 kg/kg 30 Wh/kg	0,0106	1125
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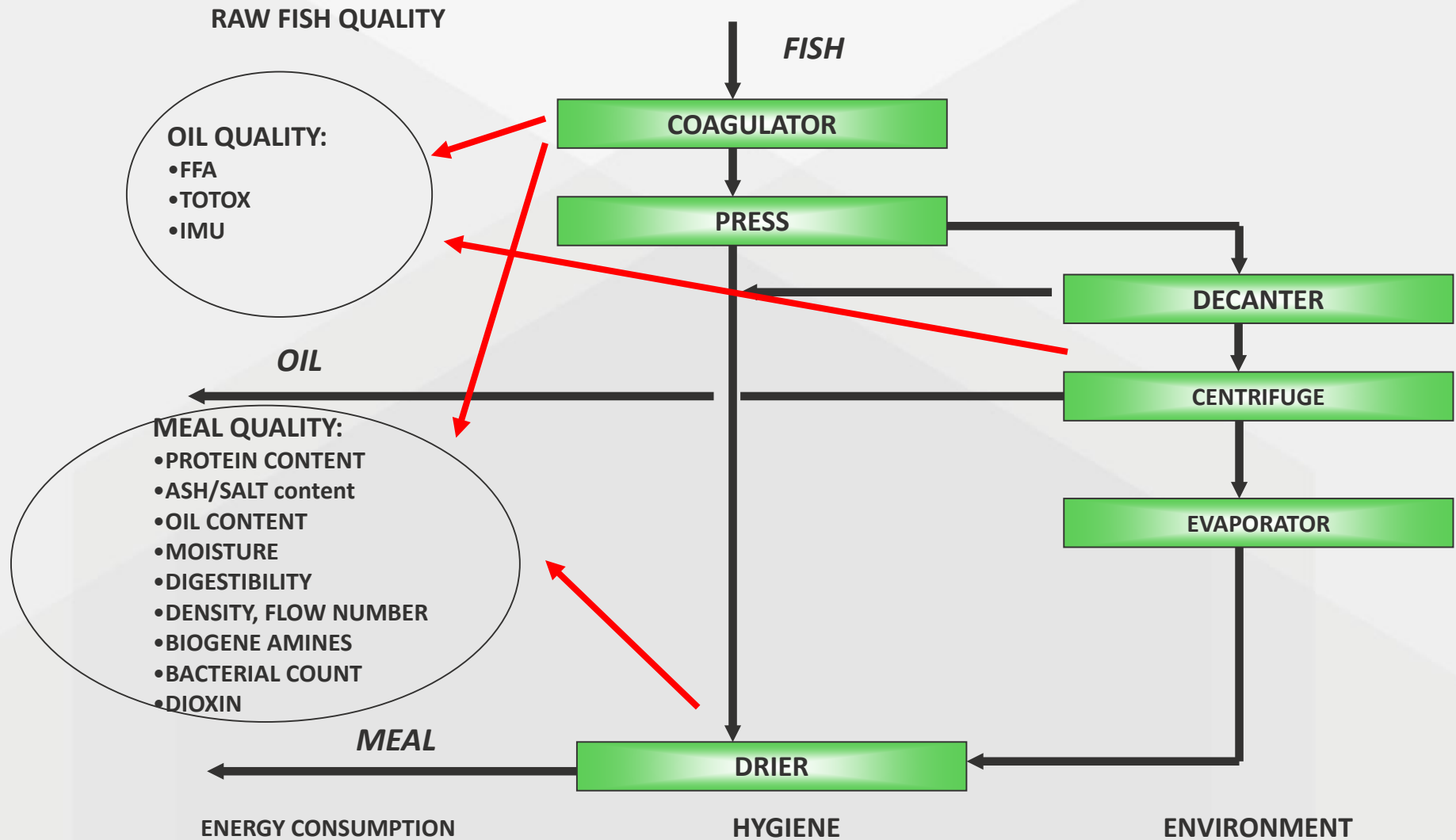
Split at 40 % moisture between driers

- Evaporation
- Evaporator 14.0 t/h
- Disc Drier 3.9 t/h
- Hot air drier 3.7 t/h
- Consumption
- Coagulator steam: 4,750 kg/h
- Disc drier steam: 4,480 kg/h
- Evaporator steam: 2,080 kg/h
- Hot air drier fuel: 355 kg/h gas

Drier	Evaporator	Energy consumption Drier. kg fuel/kg evaporated	Energy consumption Evaporator kg fuel/kg evaporated Wh/kg evaporated	Energy consumption Coagulator Kg fuel/kg fish	Total fuel consumption kg/h
Steam drier Atm.	WHE	0,090	0	0,0106	1000
Vacuum Disc drier	WHE	0,087	0	0,0106	975
Hot air drier, drum	SHE, MVR	0,087	0,030 kg/kg 30 Wh/kg	0,0106	1395
Superheated steam, drum	WHE	0,097	0	0,0106	1050
Steam Drier+ hot air drier	75-80 %, TS split, WHE	0,090	0	0,0106	1000
Steam Drier+ hot air drier	60-65 % TS split, WHE+MVR,SHE	0,090	0,030 kg/kg 30 Wh/kg	0,0106	1125
Flash Drier, Air	MVR, SHE	0,087	0,030 kg/kg 30 Wh/kg	0,0106	1395

- What is the cost difference between the low energy consumption plant and the high consumption plant for a 30 t/h Fish plant?
- 420 kg Fuel/h
- 1,470 tons fuel/year
- 500,000 €/year

3500 operation hour/year



Which parameters can we control

MEAL QUALITY:

- OIL CONTENT
- MOISTURE
- DIGESTIBILITY
- DENSITY, FLOW NUMBER
- DIOXIN
- BACTERIAL COUNT

OIL QUALITY:

- FFA
- TOTOX
- IM

Comparison of degree of conversion

Temp 100°C

Retention time 60 min

Temp 70°C

Retention time 60 min

Temp 100°C

Retention time 1-2 min

It is relatively easy to adjust the equipment for temp reduction compared to adjust for the corresponding retention time reduction.

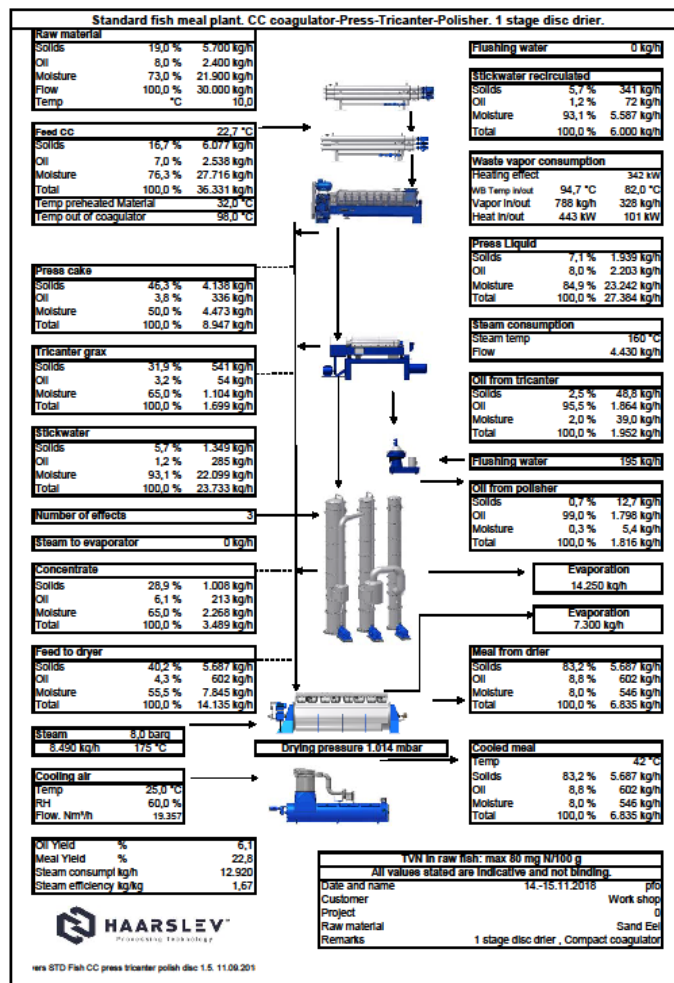
Drier	Evaporator	Energy consumption Drier. kg fuel/kg evaporated	Energy consumption Evaporator kg fuel/kg evaporated Wh/kg evaporated	Energy consumption Coagulator Kg fuel/kg fish	Total fuel consumption kg/h	Bulk Density	Mink Digestibility, %
Steam drier Atm.	WHE	0,090	0	0,0106	1000	Low	85-90
Vacuum Disc drier	WHE	0,087	0	0,0106	975	Very Low	90-92
Hot air drier, drum	SHE, MVR	0,087	0,030 kg/kg 30 Wh/kg	0,0106	1395	High	90-93
Superheated steam, drum	WHE	0,097	0	0,0106	1050	High	85-90
Steam Drier+ hot air drier	75-80 %, TS split, WHE	0,090	0	0,0106	1000	Medium to High	88-90
Steam Drier+ hot air drier	60-65 % TS split, WHE+MVR,SHE	0,090	0,030 kg/kg 30 Wh/kg	0,0106	1125	High	90-93
Flash Drier, Air	MVR, SHE	0,087	0,030 kg/kg 30 Wh/kg	0,0106	1395	High	92-96

- Bulk Density kg/m³

- | | |
|--------------------------------|---------|
| - Disc dried meal atmospheric: | 450-500 |
| - Disc dried meal vacuum: | 400-450 |
| - Hot air dried meal | 500-550 |

Superheated steam drying advantages compared to hot air drying

- **Energy consumption reduced**
- **Better hygiene control (product temp ~100 °C)**
- **Oxygen content in drying gas reduced**



- Evaporation
- Evaporator 14.3 t/h
- Drier 7.3 t/h
- Steam consumption
- Coagulator: 4,430 kg/h
- Drier: 8,490 kg/h



- Short retention time, high Capacity
- Mincing of fish and short retention time reduces oil content in meal approx. 1-2 %.
- or
- Recirculation of stickwater (15-25%) reduces oil content in meal approx. 1-2 %.
- The combined effect of short retention time and stickwater recirculation is totally approx. 2-3 %.
- Mink digestibility is 1-2 % higher in CC cooked meal compared to meal processed in a screw cooker.
- TOTOX and FFA in oil is very low compared to oil from a screw cooker process.

Drier	Evaporator	Energy consumption Drier. kg fuel/kg evaporated	Energy consumption Evaporator kg fuel/kg evaporated Wh/kg evaporated	Energy consumption Coagulator Kg fuel/kg fish	Total fuel consumption kg/h	Bulk Density	Mink Digestibility, %
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Disc drier Atm. CC/WHCC	WHE	0,090	0	0,0098	950	Low	87-91
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Flash Drier, Air	MVR, SHE	0,087	0,030 kg/kg 30 Wh/kg	0,0106	1395	High	92-96

Is high digestibility obtained at high energy consumption or?

High product quality may be obtained even at low energy consumption