CONCEPTUAL DESIGN PROPOSAL

New extruded Aqua Feed Plant

Capacity:

25,000 tons/year

&

50,000 tons/year

Estonia

Project number: 220126-01

Skanderborg 30-08-2022

EMKF RAKENDUSKAVA 2014-2020

Euroopa Liit
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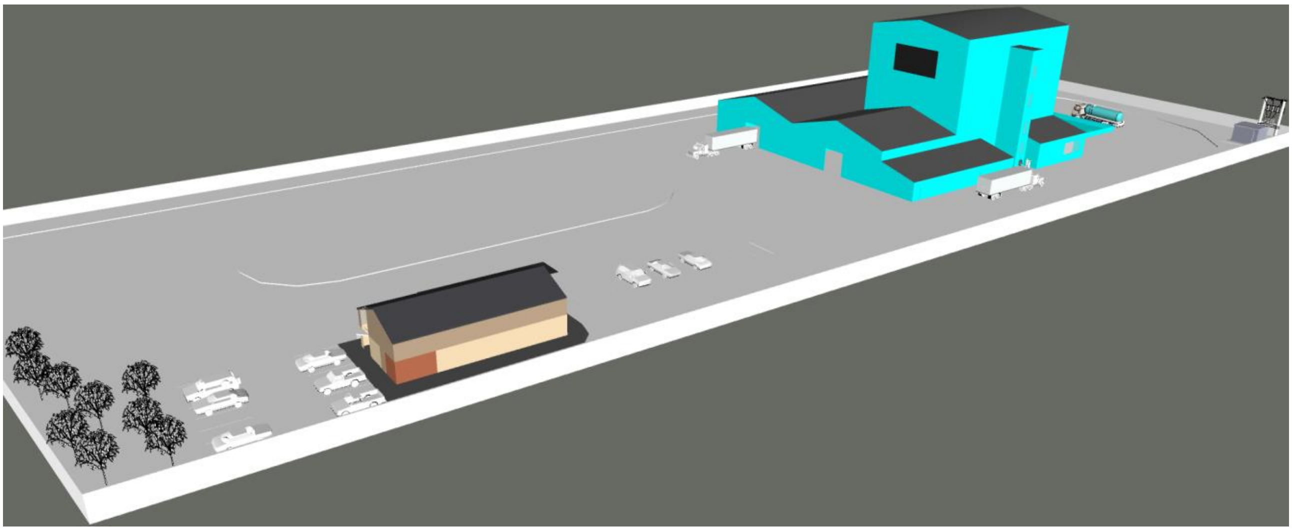

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INTRODUCTION

Process Integration ApS hereby takes pleasure in presenting our conceptual design proposal for a Greenfield Aqua Feed Plant for production of extruded feed.

The Study is based on information provided by Center of Food and Fermentation Technologies (TFTAK): document no. 245481 dated January 19th, 2022, and correspondence between Hans Boon, Aquaculture Experience and Process Integration.

The design of the plant is based on the following products and two volume requirements:

Extruded fish feed, sinking type

Yearly capacity: 25,000 tons 50,000 tons

FACTORY CAPACITY

Based on above feed requirements we have calculated the factory capacity as follows:

	Max. monthly requirements (August)	Max. monthly production hours	Effective capacity requirements without storage
Scenario 25,000 t/y	2,500 tons	30 days x 24 hours = 720 hours	3.5 tons/hour
Scenario 50,000 t/y	5,000 tons	30 days x 24 hours = 720 hours	7.0 tons/hour

The overall equipment effectiveness (OEE) is calculated as follows:

OEE = Availability x Performance x Quality. For a plant and a product mix as stated above the OEE factor can be estimated to be 70%. Consequently, the design capacity of the plant should be 3.5 TPH/ 0.70 = 5.0 TPH.

Secondly 7.0 TPH / 0.70 = 10 TPH

MASS BALANCE

25,000 tons per year

Amount in kg/h	Total	Dry matter	Fat/oil	Water/steam
Input extruder	5.000	4.200	400	400
%		84	8	8
Addition in conditioner	1.625		250	1.375
%	33		5	28
Addition in extruder barrel	100		0	100
%	2		0	2
Output extruder	6.725	4.200	650	1.875
%		62	10	28
Evaporation in dryer	1.345			1.345
%	20			20
Output dryer	5.380	4.200	650	530
%		78	12	10
Oil addition in coater	1.076		1.076	
%	20		20	
Output coater	6.456	4.200	1.726	530
%		65	27	8
Output after sifting	6.391	4.158	1.709	525
%	100,0	65,1	26,7	8,2

50,000 tons per year:

Amount in kg/h	Total	Dry matter	Fat/oil	Water/steam
Input extruder	10.000	8.400	800	800
%		84	8	8
Addition in conditioner	3.250		500	2.750
%	33		5	28
Addition in extruder barrel	200		0	200
%	2		0	2
Output extruder	13.450	8.400	1.300	3.750
%		62	10	28
Evaporation in dryer	2.690			2.690
%	20			20
Output dryer	10.760	8.400	1.300	1.060
%		78	12	10
Oil addition in coater	2.152		2.152	
%	20		20	
Output coater	12.912	8.400	3.452	1.060
%		65	27	8
Output after sifting	12.783	8.316	3.417	1.049
%	100,0	65,1	26,7	8,2

The feed will contain 20% oil in the finished product in average.

Other feed types contain oil up to 25% or even higher (salmon feed) in the final product and in these cases the output increase.

For a diet with lower oil addition the capacity will be lower and during production of pellets below ø 4.0 mm the capacity of the extruder will be lower.

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STORAGE CAPACITY OF RAW MATERIALS:

Scenario 25,000 t/y	Tons
Raw materials in outdoor silo storage:	0
Raw materials in indoor dosing bins:	1,090
Raw material in warehouses:	100
Oil tanks:	80
Total:	1,270

Scenario 50,000 t/y	Tons
Raw materials in outdoor silo storage:	0
Raw materials in indoor dosing bins:	1,650
Raw material in warehouses:	200
Oil tanks:	160
Total:	2,010

Note:

Above is an estimate and does not taking the mapping and logistic review of the raw materials into consideration.

FINAL STORAGE CAPACITY:

Final products will be stored in big bags 500 and 1,000 kg however a semi-automatic bagging unit is also included for small bags 20/25 kg.

Medicated feed is excluded from the design of the plant.

We have estimated the final product warehouse storage capacity based on approx. 1.4 tons per m^2 warehouse area. This figure depends how the bags are stored in the warehouse, but usually 2 @ 1,000 kg big bags can be stored on top of each other. Utilization rate is estimated 70%.

Final product in warehouse 1,000 ton equals 715/0,7 ~ 500 m^2 Expected size of finished product ware house.

Approx. 100 m^2 is dedicated for storage of packing materials.

LOCATION

The site will be located in Estonia.

INFRASTRUCTURE

No information is available at this stage; however, the site will need to have good access to road connections and located close to port facilities.

As the project is a "green field" site, all internal infrastructures have to be developed.

- Roads
- Domestic water connection
- Drainage / Sewage (including oil separation)
- Telecommunications
- Electricity/power (3 - 4 MW will be required)
- Gas supply

POWER SUPPLY

Power supply will be 3x400 V and 24 VDC as control voltage.

Power consumption in process sections is estimated as follow:

Scenario tons per year:	25,000	50,000
• Extruder and dyer section	0.8 MW	1.0 MW
• Grinding/ mixing section	0.5 MW	0.6 MW
• Vacuum coating and cooling section	0.3 MW	0.5 MW
• Auxiliaries	1.0 MW	1.2 MW
Total	2.6 MW	3.3 MW

Main consumers are as follows:

	25,000 t/y	50,000 t/y
Single main machine power requirements	Power consumption in kW	Power consumption in kW
Fine grinder hammer mill	300	400
Extruder	300	450
Dryer	250	350
Coater	100	100
Product cooler	150	250

GAS

Gas will be available as natural gas.

Main consumers of gas will be the dryer and the steam boiler.

WATER

Fresh water is needed both as process water, cooling and cleaning purposes.

A total supply line of 5 m^3/h is estimated, however various water savings solutions will be included in the process.

STEAM

Steam is used in the process mainly for direct addition into the conditioner and extruder and other purposes. A steam boiler with a capacity of 3,000 kg/hour is required.

Furthermore, steam will be used for heating of oil and other liquids for process purposes and for maintaining the storage temperature.

BUILDINGS

The estimated building requirements are shown on the site layout drawing

Building sizes and other areas are as follow:

BUILDING	FOOTPRINT M^2
Office building	200
Truck intake	100
Raw material silos	0
Precleaning tower, height 25 m	50
Raw material warehouse	200
Dosing silo building	130
Process building, height 28 m	700
Packing material warehouse	100
Finished product warehouse	600
Boiler room	100
Workshop	50
Tank yard	150
Parking	300
Road	TBD
Total	2,680

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CONSTRUCTION DETAILS

It is proposed that the process building is constructed in concrete up to approx. level 12 m followed by a steel construction. The process building needs to be insulated whereas the raw material building, and final product building could be un-insulated.

The building construction is planned to be standard industrial level.

Oil leakage from oil storage tanks is prevented by designing an accumulation area around the tanks.

RAW MATERIALS

The following raw materials will be consumed during one production year:

Product name	Requirement			
	Tons per year			Storage
	25000	50000	%	
Wheat	3750	7500	15	Dosing silo
Maize gluten	250	500	1	Dosing silo
Soybean meal-48%	2500	5000	10	Dosing silo
Sunflower meal	2500	5000	10	Dosing silo
Beans	1250	2500	5	Dosing silo
Blood meal	1000	2000	4	Big bags main scale
Feather meal	2000	4000	8	Dosing silo
Fish meal	4500	9000	18	Dosing silo
Poultry by-product meal	3700	7400	14,8	Dosing silo
Rapeseed oil	1375	2750	5,5	Oil tank
Fish oil	1750	3500	7	Oil tank
Limestone	25	50	0,1	Micro silo
Monocalcium phosphate	250	500	1	Big bags main scale
Lysine	25	50	0,1	Micro silo
Methionine	25	50	0,1	Micro silo
Premix	50	100	0,2	Micro silo
Yeast	50	100	0,2	Micro silo
	25000	50000	100	

Raw materials are divided in to 3 groups: macro and micro ingredients and liquids.

Macro ingredients are foreseen to be delivered by truck as bulk or in big bags. Micro ingredients to be delivered by truck, in small bags. Liquids to be delivered by tank lorry.

Weighing bridge is included in the project for weighing in and outgoing trucks.

INTAKE

Macro ingredients - dry

1 pc. truck intake is planned for macro ingredients, 100 tons/hour (200 m^3/h).

The intake system will be provided with a dust aspiration system to minimise dust emission when unloading.

From the truck intake system, the raw material will go by a mechanical conveying system into a cleaning system before being conveyed to indoor dosing silos.

Gluten products will be received in bigbags and conveyed to the dosing bins via the main intake.

Micro ingredients - dry

Micro ingredients are received in small bags 20-25 kg and stored in the warehouse before usage.

Bags will be emptied on top of the micro silo straight into the micro silo, each with a capacity of 1.0 m^3

Liquids

2 pcs. liquid intake is planned outside the tank yard. The capacity will be approx. 25 - 40 tons/hour depending on product and tank lorry.

STORAGE

Macro ingredients - dry

The total storage capacity foreseen for macro ingredients is equal to 1,090 tons (25,000 t/y) 1,650 tons (50,000 t/y).

The dosing silos will be corrugated and in mild steel and partly painted.

Micro ingredients - dry

The storage facility for bagged micro ingredients will mainly in the raw material warehouse of approx. 200 square meters, equal to 100 – 300 tons.

Liquids

The total storage capacity for liquids is planned to be 80 tons (25,000 t/y) and 160 tons (50,000 t/y).

Above is an estimate and does not taking the mapping and logistic review of the raw materials into consideration.

The tank capacity is as follows:

2 tanks each 40 m^3 / tons (25,000 t/y)

4 tanks each 40 m^3 / tons (50,000 t/y)

EQUIPMENT AND PROCESS

The process is split up into different process areas. The areas are as follows and will be briefly described below:

- Weighing / dosing
- Grinding
- Mixing
- Extrusion
- Drying
- Coating
- Cooling
- Sifting and transport to finish product silos
- Finished product packing
- Liquids distribution

WEIGHING/DOSING

The dry ingredients will be dosed according to the recipe. Production takes place batch-wise and can be traced from dosing through the whole process.

Dosing takes place by means of several scales in different sizes to ensure proper accuracy. The scale sizes are selected based on the raw material list and is an estimate only. Once the a product list is provided, this setup can be subject to change.

The batch size is designed as: 1,000 kg for 25,000 t/y and 2,000 kg for 50,000 t/y.

A separate dosing and weighing system is included for the micro ingredients.

GRINDING

Grinding will take place as post-grinding. This means that unground raw material will be dosed and transported to the grinding system where various raw materials will be mixed in a pre-mixer to ensure uniform material composition and optimum utilisation of the grinders.

The grinding system consists of a hammermill system, exact size of grinder will be determined during the detailed engineering phase. Total power requirements will be based on a capacity of 6 TPH and 12 TPH (to ensure sufficient capacity for screen change etc.), and material being ground at 40 kg/kWh (standard raw material is within the range of 35-60 kg/kWh). On this basis total required grinding power will be 150 kW / 300 kW.

The grinder will make fine grinding on 1.0-1.5 mm screens.

MIXING

From the grinding system the batch will be transported to the main mixer where micro ingredients will be added, and the complete batch will be mixed into a highly uniform meal mixture.

EXTRUSION

The extruder will be equipped with a loss-in-weight feeding system to ensure high accuracy dosing into the extrusion process. This means that the liquids can be added automatically with high accuracy to ensure high and uniform pellet quality.

Before the meal enters the extruder, it passes through a conditioner, where steam, oil, and water can be added. In the conditioner, the temperature is raised to 85°C - 95°C. This process also increases the starch gelatinization.

Extrusion is planned to take place on an extruder with proven technology that can produce at a capacity of 5-6 TPH dry meal (25,000 t/y) or 10-12 TPH (50,000 t/y).

Steam, oil, and water can be injected into the extruder. In combination with control of pressure and cooling of the barrels this makes it possible to control product density and product quality. Control of the combination of all parameters is the key to making a high-quality product and makes it possible afterwards to add a high quantity of oil into the product.

The required capacity and pellet sizes determined the choice of extruder to be either a single or a twin screw type. At this point a single screw type is included in the project.

Capacity may of course be influenced by the recipe and the raw materials composition.

DRYING

A good extrusion process requires water content in the product during extrusion of 24-28%.

Therefore, after extrusion the product goes into a dryer which can be compared to big oven where the water content is reduced to 6-8%.

The dryer is divided into several independent drying zones, each one having its own temperature and air circulating system to ensure a well- balanced drying process. Both vertical and horizontal dryers exist on the market.

In the first zone of the dryers the drying air temperature is relatively high, and surface moisture evaporates. In the following zones the air temperature is reduced. The pellets need retention time in the dryer, allowing the water from the core of the pellets to evaporate. If the temperature at this stage is too high, the surface of the pellets may become crispy, which will result in breakage and dust generation.

As the last stage a cooling zone is recommended to obtain a pellet temperature out of the dryer of 50°C-60°C. If the pellets leave the dryer at a higher temperature, condensation in the transport equipment may occur, resulting in possible bacteria growth. A too high pellet temperature out of the dryer may also cause the remaining water in the pellet to boil during the vacuum coating process.

Removal of so much moisture from the product requires a large air system. Even though a considerable quantity of air is recirculated in the dryer to reduce energy costs, a large air volume must be exchanged to remove the moisture. The air leaving the dryer contains a high level of odor units, and the air should be cleaned (depending on local regulation and standards).

Heating of the air is typically done by direct gas burners. Alternatively, steam heat exchangers can be used.

VACUUM COATING

After drying the pellets are be transported into a vacuum coating system. To remove any dust generated, the product will be sifted before it enters the vacuum coater. A batch will be weighed and dosed into a vacuum coater, and based on the exact quantity of pellets, the liquids will be dosed and added to the batch.

The liquids are typically fish and vegetable oil. For high fat products a topcoat may be added. This topcoat will make a seal on the surface of the pellet that prevents the oil from leaking. In this project the top coating system is excluded, but can be added at a later stage, if required.

COOLING

In the cooler the remaining heat in the pellets will be removed. This is done to minimize bacteria growth and to eliminate the risk of condensation in the finished product silos, and hereby ensure that extended storage time does not affect the product. The product temperature after cooling should be 5°C above incoming air temperature.

Cooling is done by ambient air, and therefore the pellets temperature will vary accordingly. The cooling air needs to be drawn from the coldest side of the process building.

As for the air from the dryer, the air from the coolers also contains smell and therefore should be treated

TRANSPORT TO FINISHED PRODUCT SILOS

After cooling the product will be conveyed to the finished product silos. This transport must be a gentle conveying system to ensure none or least breakage of pellets. The final product bins are equipped with a gentle filling system.

SIFTING AND FINAL PRODUCT PACKING

Pellets from silos will be transfer with vibrating feeder to a sifter for removing lumps, fines and dust. Finally, the product will be bagged into 500 kg or 1.000 kg big bags and small bags 20 – 25 kg and stored in the warehouse.

REWORK HANDLING SYSTEM

Remix or rework consists of fines and pellets collected from the production lines prior to fat coating. Especially the cyclones and the sifters produce rework, which needs to be reintroduced into the production line.

The dry remix is handled in totes and manually transferred to the macro silos or bigbags via the bag raw material intake.

Alternatively, a mechanical transport system can be added to collect dust from the process.

Oily rework is here defined as the dust, fragments and broken pellets produced during post-coat screening which may also include finished product that has failed QC. Oily rework from the final product sifter will be transferred to containers (totes) and by forklift brought back to the bag/intake system connected to the macro/midi dosing bins

Optional:

CRUMBLING AND SIFTING OF SMALL SIZE PRODUCTS

As handling of small size pellets below ø2.2 mm requires a special setup of the extruder line and following handling in transport systems, dryer, coater and cooler, one solution can be to add a separate crumbling line to the process.

Pellets from after the cooler is diverted to two holding bins, crumbled and size sifted in 4 sizes each stored in a bin for later packing. The different sizes, i.e. 1,200, 1,000, 700 and 400 my will then be packed separately in the small bags packing machine.

LIQUID DISTRIBUTION

The following liquids are handled in the process:

- Fish oil
- Vegetable oil
- Special liquid

The bulk transfer pumps are located in the tank yards whereas heat exchangers to heat the liquids are located in an oil room in the production building.

Fish oil and vegetable oil can be mixed in varying ratios before being added to the pellets in the vacuum coaters.

Special liquid can be mixed with fish or vegetable oil before being added to the pellets in the vacuum coaters.

Measuring devices are tank scales or alternatively mass flow meters which measures the flows to the vacuum coater batch mixing tanks.

Special liquid is handled in IBC tanks and this way most flexible to inclusion into the process.

AUTOMATION AND CONTROL SYSTEM

The main control room is proposed to be situated close to or in front of the extruder at the second floor of the process building.

General control of the complete factory takes place via SCADA software.

The automation and control system will include:

- Administrative network
- Management information system
- HMI system
- In-Touch control system

It is estimated that 1 operator will be stationed in the control room and 1-2 conducting product sampling during production, alarm handling etc.

TRACEABILITY

According to EU feed legislations a system of documentation is established to ensure traceability identifying all raw material supplies and intermediaries of incoming feed to the aqua feed factory and to where the incoming feed has been supplied.

There is a trace-back and a trace-forward of finished feed if actual or potential health problems have been identified which could be referred to the feed.

FINAL PRODUCT HANDLING

Finished product handling will be in big bags and small bags and stored in the warehouse.

The most important aspect of handling of aqua feed pellets is gentle material handling by keeping the product velocity low and ensuring well designed conveying and discharging systems.

Conveying the product from the process to the finish product bin will be done by means of gentle mechanical conveying systems. Before the pellets leave the process line fines and broken pellets are removed by sifting the product.

HYGIENE AND GOOD HOUSE KEEPING

A good hygiene plant design of the facility will be applied including:

- Establishment of zoning (separation of clean and “dirty” areas)
- Protection of the feed against contamination from birds, rodents, and other *Salmonella*-carrying animals in a closed system
- Protection of feed against condensation and moisture, which is especially important after heat treatment (use of insulation and heat tracing)
- Avoiding cross contamination and mixing of raw materials with finished products (zone separation again)
- Paying attention to service and cleaning-friendly design (space around machines)
- Preventing dust from escaping from silos and machines by selecting the right equipment and installing dust spot filters
- Selecting technology and equipment that are as self-cleaning as possible (in certain dedicated areas stainless steel is preferred)

Further issues that should be considered as part of any program to improve housekeeping and hygiene includes:

- Maintaining good inventory control to avoid waste of raw materials
- Ensuring that employees are aware of the environmental aspects of the company`s operations and their personal responsibilities
- Keeping the work area tidy and uncluttered to avoid accidents
- Training staff in good cleaning practice

WATER

The use of water for production or cleaning purposes should be limited as much as possible by re-circulation, CIP techniques, or “dry cleaning methods”. To further minimize the environmental impact of discharged water, a division into three main categories will be made:

- process water discharge (water that has been in contact with the product)
- sanitary water discharge (water from toilets, showers etc.)
- surface water (water from gutters and surface water)

Process water should be discharged through a fat and oil separation system before being released into the municipal sewing system.

Sanitary water should be discharged to the municipal sewing system in accordance with local regulations, which would also be the case for surface water.

Fresh water consumption will vary between 150 lt. pr. ton feed produced and up to 600 lt. pr. ton.

NOISE

Noise from aqua feed manufacturing is generated by several sources such as truck traffic, aspiration systems, fans, hammer mills, compressors, extruders etc. with noise levels often as high as 80-110 dB(A). Noise reduction is best carried out by selecting equipment with low noise levels and installing noise reducing materials.

Noise is not expected to be a major issue, as the area where the factory is to be placed is selected for industrial use.

EMISSION TO AIR

The most serious environmental issue from aqua feed production is the odour emissions.

Although odour is not considered to impose serious health and/or environmental risks and mostly is a local problem, it is covered by the definition of pollution.

The international accepted units of odour are Odour Units per cubic metre (OU/m^3).

Regulations are known to vary between 7 and 15 OU at the nearest neighbours – but future regulations are expected to be a low as 5 OU/m^3.

The air emissions from the plant are preliminary estimated as follows:

25,000 t/y:

Source	Exhaust volume	Temp.	Rel H.	Odor Conc.	Odor Conc.	Odor Emiss.	Odor Emiss.	Odor Emiss.	Odor Emiss.
Specification	m³/h	°C	%	OU/m³	OU/m³	OU/h	OU/h	OU/sec	OU/sec
				Min	Max	Min	Max	Min	Max
Intake filter	30.000	10 - 30	30 - 70	2.000	5.000	60.000.000	150.000.000	16.667	41.667
Hammer mill filter	8.000	25 - 45	10 - 50	4.000	10.000	32.000.000	80.000.000	8.889	22.222
Flash-off air from extruder	5.500	60 - 90	70 - 100	40.000	100.000	220.000.000	550.000.000	61.111	152.778
Dryer exhaust	22.000	60 - 80	40 - 70	15.000	50.000	330.000.000	1.100.000.000	91.667	305.556
Product cooler	17.000	30 - 50	10 - 50	5.000	30.000	85.000.000	510.000.000	23.611	141.667
Total	82.500					727.000.000	2.390.000.000	201.944	663.889

50,000 t/y:

Source	Exhaust volume	Temp.	Rel H.	Odor Conc.	Odor Conc.	Odor Emiss.	Odor Emiss.	Odor Emiss.	Odor Emiss.
Specification	m³/h	°C	%	OU/m³	OU/m³	OU/h	OU/h	OU/sec	OU/sec
				Min	Max	Min	Max	Min	Max
Intake filter	30.000	10 - 30	30 - 70	2.000	5.000	60.000.000	150.000.000	16.667	41.667
Hammer mill filter	8.000	25 - 45	10 - 50	4.000	10.000	32.000.000	80.000.000	8.889	22.222
Flash-off air from extruder	5.500	60 - 90	70 - 100	40.000	100.000	220.000.000	550.000.000	61.111	152.778
Dryer exhaust	32.000	60 - 80	40 - 70	15.000	50.000	480.000.000	1.600.000.000	133.333	444.444
Product cooler	27.000	30 - 50	10 - 50	5.000	30.000	135.000.000	810.000.000	37.500	225.000
Total	102.500					927.000.000	3.190.000.000	257.500	886.111

Various odour treatment system is available in the market. However, at this stage we have excluded an air treatment system, until the actual requirements are known.

OTHER EMISSIONS AND SOURCES

Raw materials arrive at the aqua feed plant by truck. The main source of emissions here is the loss of product during unloading of dry materials such as fish meal and vegetable meals. Care has been taken to avoid any raw materials drifting with the air while unloading from trucks as the intake is fitted with aspiration filters. Raw material unloading may be a major source of fugitive dust and odours while this process goes on. Furthermore, the process may cause some sudden noise.

Raw materials are stored in closed tanks and silos, which will normally not cause a lot of emissions.

Flue-gas emission from steam boiler is not considered a major issue in relation to emission of NOx and CO2.

NOTE ON MICRO PELLETS PRODUCTION:

The initial design of the plant is based on ø3mm to ø12 mm fish feed pellets production. In some cases, the requirement for micro pellets below ø2.2 mm is present from initial startup of the plant. In this quotation an optional price for make crumbled feed is indicated, which fulfil the need for small pellets and can be added to existing process line at any time.

However, a better and more flexible solution is to produce extruded micro pellets at the required size on the extruder and hereby not needing to make crumbling. The crumbling process has a negative impact on the pellet surface and water stability of the fish feed pellets, which is eliminated with extrusion technology.

To be able to make extruded micro pellets as small as ø0.8 mm, some parts of the process must be able to handle small sizes products.

Grinding process must be able to fine grind at 95% below 180 my, 99% below 250 my, which require a double grinder setup or a pulverizer. After the grinding process a sifter must ensure that oversize particles are removed from the material going to the conditioner, to avoid blocking of the die plate in the extruder.

At the extruder a small die plate results in a dramatic reduction in capacity, due to smaller open area.

All extruder dosing systems must be sized for the lower capacity as well as the maximum capacity on large pellets.

It is recommended to use a pneumatic air lift system to transport the small pellets to the dryer inlet, to avoid lumps and loss of product.

Internally in a horizontal dryer a special bed belt must be installed to reduce pellets dropping through the lamellas and end up in the dust system. Alternatively, a vertical dryer can be a good solution for micro pellets handling, but the layout of the plant must be designed for this type of dryer from the start.

In the coating process the distribution of oil is important to avoid white pellets. The added amount of oil in the small pellets are normally on a low level and therefore the design of the dosing system must be able to handle these small volumes.

Cross contamination of different sizes of pellets in the transport system is a challenge and therefore a separate system to the packing plant must be established and to be sure cleaning in between micro sizes can be a requirement.

Conclusion is that the plant can from the start be designed to produce micro pellets using extrusion technology, but for most startup plants the business plan and payback of the additional investment is not good, as the demand for micro pellets is very small. At the same time the production has a huge impact on the plant output, due to the reduction in capacity, as well as change over time / down time for cleaning is a factor when producing micro pellets.

If required a budget including the ability to produce micro pellets can be made based on the actual needs and requirements.

Budget estimate +/-20%:

25,000 tons per year	**Price in EURO**
Raw material intake	380,000.-
Dosing silos	985,000.-
Macro dosing	465,000.-
Grinding and mixing	795,000.-
Extrusion	825,000.-
Drying	817,000.-
Vacuum coating and cooling	545,000.-
Sifting and packing	630,000.-
Liquid system incl. tanks	400,000.-
Steam boiler system incl. pipes and condensation	395,000.-
Electrical and control system	1,815,000.-
Compressed air system incl. piping	86,000.-
Engineering	850,000.-
Freight	460,000.-
Installation	730,000.-
Total price Process incl. auxiliaries, el and controls	**10,178,000.-**
Process building incl. auxiliary buildings and workshop	*3,500,000.- (*)*
Offices, locker rooms and canteen	*500,000.- (*)*
Raw material and finished product inventory, logistics	*2,800,000.- (*)*
Environmental requirement costs (internal and external)	*850,000.- (*)*
Other costs	*1,500,000.- (*)*
Option: crumbling line Excl. from the total price	*(500,000.-)*
Total budget price +/-20%	**19,328,000.-**

(*) based on estimates only, not valid pricing.

Budget estimate +/-20%:

50,000 tons per year	**Price in EURO**
Raw material intake	380,000.-
Dosing silos	1,480,000.-
Macro dosing	645,000.-
Grinding and mixing	960,000.-
Extrusion	1,020,000.-
Drying	1,140,000.-
Vacuum coating and cooling	715,000.-
Sifting and packing	805,000.-
Liquid system incl. tanks	685,000.-
Steam boiler system incl. pipes and condensation	520,000.-
Electrical and control system	1,920,000.-
Compressed air system incl. piping	86,000.-
Engineering	850,000.-
Freight	545,000.-
Installation	921,000.-
Total price Process incl. auxiliaries, el and controls	**12,672,000.-**
Process building incl. auxiliary buildings and workshop	*3,800,000.- (*)*
Offices, locker rooms and canteen	*500,000.- (*)*
Raw material and finished product inventory, logistics	*3,400,000.- (*)*
Environmental requirement costs (internal and external)	*850,000.- (*)*
Other costs	*1,500,000.- (*)*
Option: crumbling line Excl. from the total price	*(500,000.-)*
Total budget price +/-20%	**22,722,000.-**

(*) based on estimates only, not valid pricing.

The above budget overview is based on historical prices and estimates and can only be used as guidance, not an actual quotation.

Estimates marked (*) are all based on a general model for average building cost in western Europe and can variate a lot from country to country.

The cost of land purchase is excluded as this is very unpredictable as location and sizes has a big impact on the final cost.

Choosing the right equipment for the plant is normally a compromise between cost and performance and in the above process equipment cost the selection is made to match industry standard medium range, not the cheapest, nor premium equipment. In focus has been a good price performance ratio and this can of cause be changed according to actual requirements for the final plant.

Process Integration ApS

Lars Johansen / Peter Sønderskov