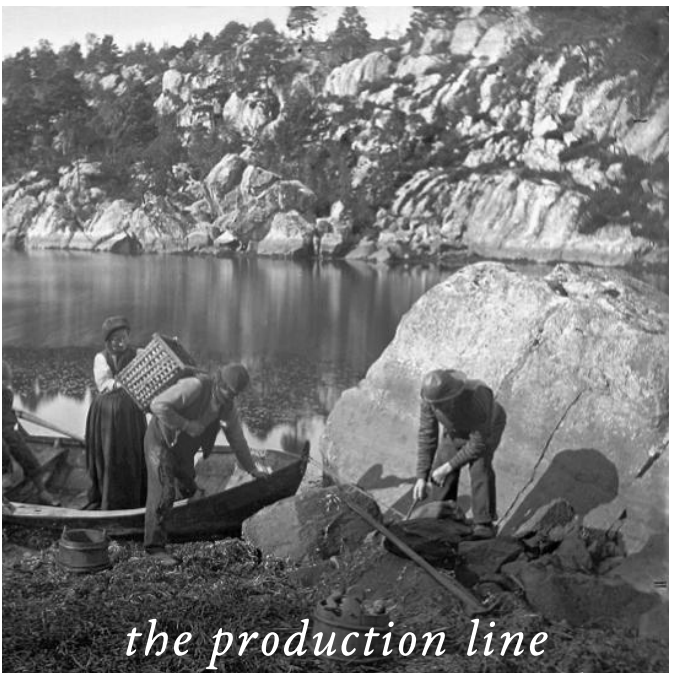


the production line

functions and equipment

Mina-Matilde Håøya / Maria Højgaard Molden

Salt water treatment machine

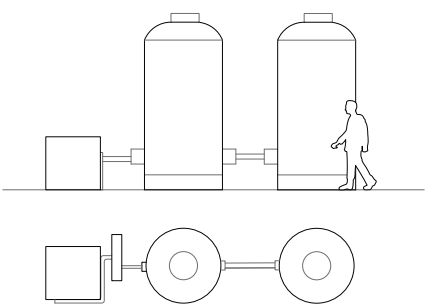
An essential part for a good hatchery is constant flow of fresh seawater.

The optimale water temperature for seaweed is 10 °.

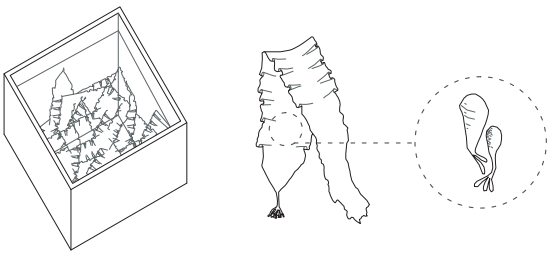
For a stabile and cold temperature, salt water it pumped into the facility from about 60 m below sealevel.

The salt water runs throng a membran filter to remove particles and UV treated to avoid contamination before its lead through pipes to growing rooms and a room with fertile seaweed

For the temperature to be stabile its good to locate these rooms close to the machine



Fertile seaweed

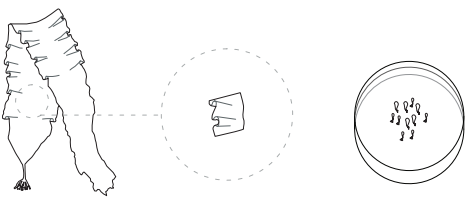


To grow seaweed you need spores from fertile seaweed

Storage for fertile seaweed need a separate room to avoid contamination between different processes (growing room)

The room need space to store bulk containers with fertile seaweed, controlled light and temperature conditions, and constant supply with treated salt water

Indusing spore release



sori indusing spores

For this process the worker needs a workbench with vacume ventilation

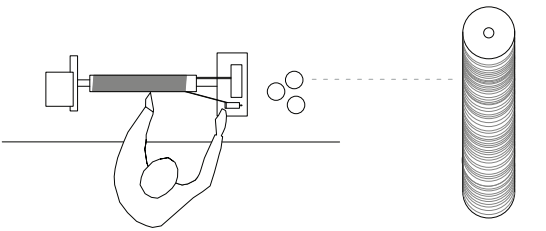
On the fertile seaweed its dark reproduction patches called sori, this is where the spores are located

The fertile seaweed gets sterilised before small parts from the sori is taken out, dried, washed an left in a cold storage (10°) over night

In this process, together with the correct light conditions to simulate winter season, the seaweed will releases the spores when you add water again

With a microscope the researcher count the spores and calculate the concentration before they are sprayed onto spools.

Spools



spinning machine

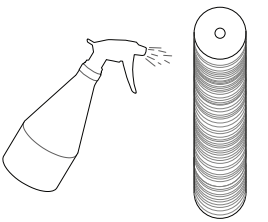
finished spool

To make the spools, a spinning machine apply thin culture string (1,2mm) onto drain pipes

The finished spools are left in freshwater for a few hours to realise oil from the tread

They are washed in a washing machine at 70° before they are dried and ready for the spores to be applied

Spraying cultures onto spools

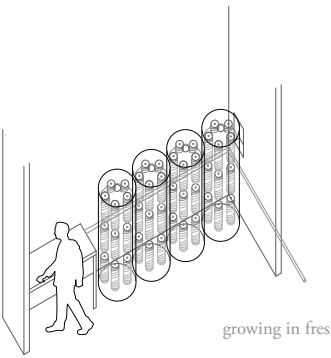


Attaching spores onto spools requirers a closed room

The researcher distribute the spores evenly by spraying them onto the spools

Collective production

Growing room



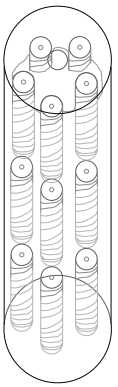
growing in fresh seawater

Growing rooms need controlled light and temperature conditions, and constant salt water supply for the spores to grow into sporophytes

The room need space for growing cylinders and a small workstation to examine the growth

We have 3 growing rooms in our facility

Plexiglass cultivation cylinders



growing cylinder

The spools with seeded strings are arranged inside the cylinders

Cylinders are arranged along the walls inside the growing rooms

Each cylinder is 150 cm high and 60 cm diameter

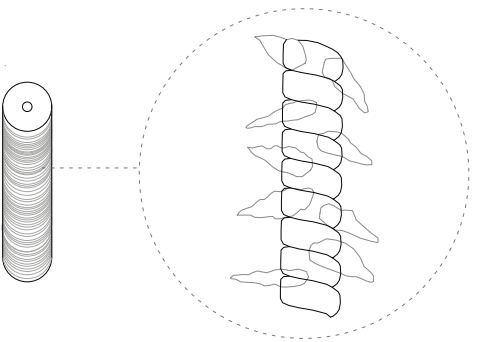
The cylinder is translucent with light installations inside and outside for optimale growth conditions

Salt water supply to each cylinder gives an even flow of fresh cold salt water

Each cylinder has the capacity of about 5500 m cultured strings

We have 4 cylinders in each growing room

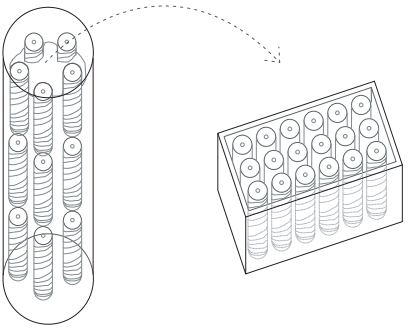
Cultivation time



The cultures strings stay inside the growing rooms for 30-35 days for the spores to grow into 1-2 mm long sporophytes

Now they are ready to be transported out to the growing fields in the archipelago

Transportation to growing field

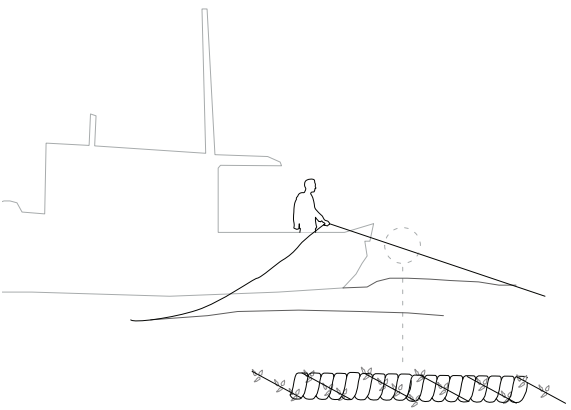


The spools are removed from the cylinders and moved to transportation containers

The spools gets covered with wet paper towels to not dry out

Now they are ready for transportation to the growing fields in the archipelago

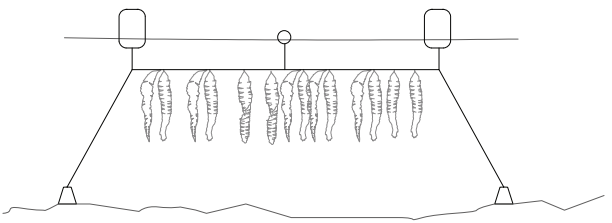
Culture string



The culture string is 1,2 mm diameter, and this is what the sporophytes are growing on

When the sporophytes are ready for deployment of shore, the culture string is brought to the growing field and twisted around larger ropes in the water

Growing field



Fixed to the seafloor by anchors or bolts, growing fields of floating frames are located at various locations in the archipelago

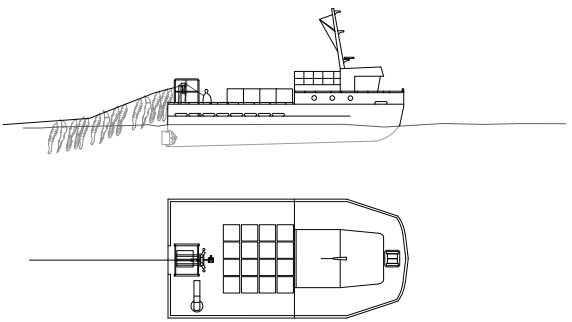
The field consists of thick framing ropes located 1–2 m underneath the water surface, floating by larger corner buoys

The buoys are the only visible part of the growing fields above water

Each growing field covers 150 x 400 m with small buoys each 50 m keeps the ropes on a stabile hight when the seaweed starts to grow

The growing field is divided into 16 units of 50 x 75 m, making it possible to harvest the seaweed systematically from the outside of the growing field.

Vessel



catamaran to collect seaweed

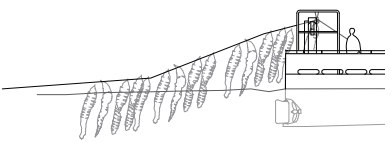
Two different vessels are needed

A small vessel for transporting/attaching cultured strings in the growing field and observation

A catamaran for harvesting the seaweed. The vessel has a system for collecting/ pulling the rope , a crane and space to stack harvesting bulk containers

The catamaran is 15 x 8 m, and can fit 32 containers (1000 l)

Harvesting



A harvesting rig (A frame) is installed at the back of the boat

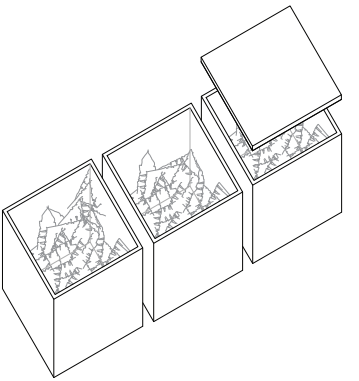
The rope with seaweed is pulled up by a winch and through a hock

The seaweed is removed from the rope by the hock before it falls into a harvesting bulk container

The rope is collected and cleaned/dried on shore.

When drying hanging seaweed in a drying hall its collected and transported when still attached to the rope.

Harvesting bulk containers



Bulk containers are used for transporting the seaweed from the growing filed to the processing facilitie

The capacity of each bulk container is 1000 l, and this volume can fit around 250 kg seaweed

The seaweed is transported without adding salt water to the containers

A lid is put on to protect the seaweed from sunlight to not dry out. It can stay in the container for 2-6 hours before it need to be be processed or moved to a cold storage.

Harvesting cycles

The seaweed is harvested within 3-4 months(march- June)

Its intens and requires a lot of manual labor

Its preferred to wait as long as possible to increase the volume of the seaweed, but fast enough to not ruin the quality of the seaweed when the temperature of the water rices

The dock

At the dock, the harvesting bulk containers are lifted by a crane onto rails on shore

One side of the dock is organized to optimize the transportation from the sea to the processing facility on rails

This space is for the machines, the workers, the industry

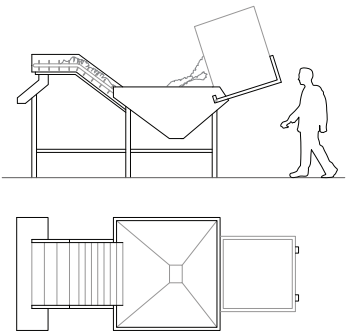
The other side is dedicated to the community, for recreation and observation

A spatial dock with good overview is important for safety

Rails

For safer and less labor demanding work, the heavy bulk containers with fresh seaweed is transported from the dock into the processing space on rails

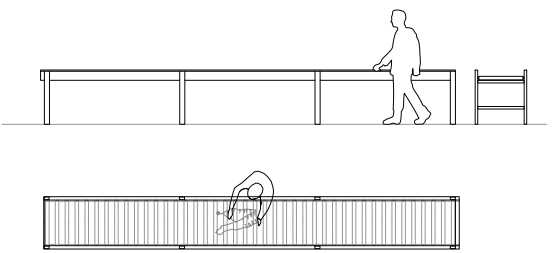
Tilter for bulk containers



The bulk tilter tilts the seaweed into a larger container with fresh seawater to clean it

Cleaned seaweed is transported with a short conveyor belt to spread it out and remove excess water before further processing

Conveyor belt



From the bulk tilter, the seaweed is transported to a conveyor belt, through a metal detector, before its manually inspected by 3-4 people on each side

This belt is also used for fish processing.

Chopping machine - medium

The machine is chopping the seaweed before its vacuum packed or smoked

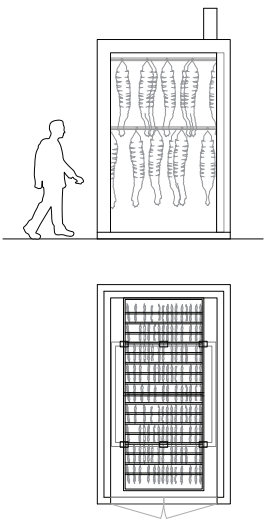
Vacuum packing

A work bench with scale and vacuum packing machines

Fresh seaweed gets vacuum packed (120 g portions) and then frozen

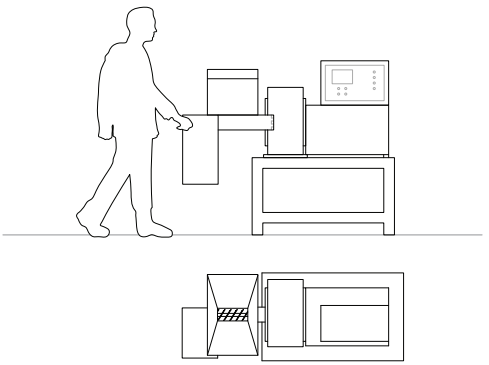
The same equipment will be used for fish processing

Industrial smoker



A closed room to smoke seaweed and other resources

Grinding machine



The seaweed is grinded before fermentation or to be dried in a drying room with convey belt

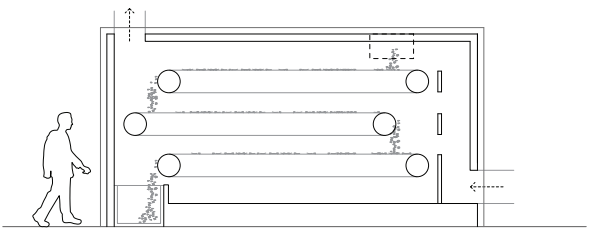
Fermentation

A 1000 l closed bulk containers for fermenting the seaweed

Fermented seaweed is not for food consumption

Seaweed not good enough for food processing is fermented and used as organic fertiliser for the local farmers

Drying room with conveyor belt



In a closed room, grinded seaweed is dried on a convoy belt with slow speed

Seaweed is supplied from the top, and transported trought the room into a container for dry seaweed at the bottom

The drying process takes a few hours

After being dried, its stored in a dry storage until its packed

This is mainly used to make seaweed spices

Drying hall- hanging seaweed

To satisfy today requirements for food processing industry in Norway, the seaweed need to be dried in a controlled climatized environment

Ropes the seaweed was growing on is directly hanged onto hooks every 3 meters

Its important to avoid to long of a span so that the rope will stay straight between the hooks and the seaweed gets even airflow from all directions

Seaweed for food consumption should be dried at 35 degrees celcius as this temperature is optimal to preserve the best flavour and quality

By supplying dry heated air into the drying hall from several installations in the floor, the seaweed will dry evenly

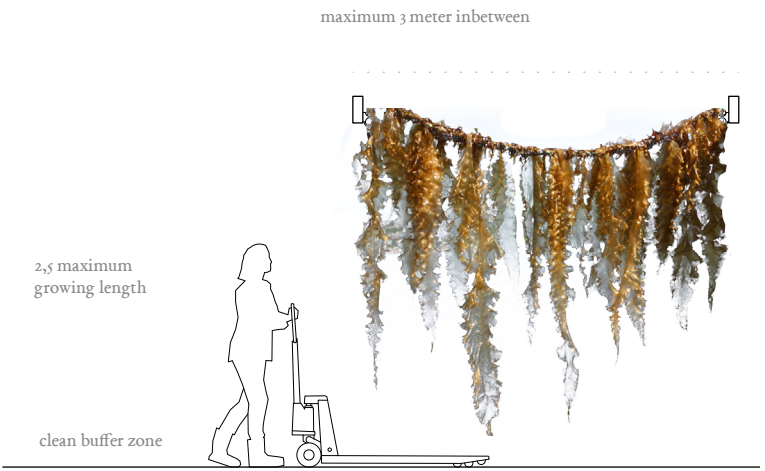
The seaweed will reduce its water content with 90 %, and to optimise the space for drying hanging seaweed, a draining system in the floor is necessary

By hanging two levels of seaweed in a 180 sqm space, you can dry 3,5 tonns withins 48-72 hours

The maximum growing lengt of the seaweed sugar kelp is 2,5m

We need 2,5 m hight for one level of seaweed, and additional 0,5 m buffer zone from the ground and up to the seaweed.

When hanging the seaweed in two levels, we need a minimum hight of 5,5 m in the drying hall


maximum 3 meter inbetween
2,5 maximum
growing length
clean buffer zone

Storage

In the facility we need frozen, cold and dry storages

To optimise the use of the storages, depending on what kind of resources being processed, all storages has the possibility to be, frozen, cold or dry storage

and the storages are located along a loading/unloading area for further distribution by truck

equipment

Transport

Pallet truck
inside the facility

Truck
A truck with maximum length of 8m so that the truck can turn on the property of small farms and suppliers of local resourses

the production line

Mina-Matilde Hiøya / Maria Højgaard Molden