1. DUE MILJØ; Products and Applications
2. MEMBRANE PROCESSING; Refine BioMarine Materials
3. LAB and PILOT TESTING; Bring Possibilities to Manufacturing.

Eddy G. Torp, MSc, MBA, CEO DUE MILJØ AS
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1. DUE MILJØ Business,
Processing Liquids and Environmental challenges into Sustainable Products.
We provide IPR Membrane Separator Technology that put Customer Molecules to Work!
**DUE MILJØ Focus: Industrial Molecular separation**

- **Liquids:** Water, Pharma, Food, Milk, Process Oil
- **Liquify**
- **Heat exchangers**
- **Pumps**
- **Tanks**
- **Molecular separation**
- **Controls**
- **Evaporators**
- **Ingredients**

**Red text – DUE MILJØ Products**

**Materials**

**DUE MILJØ**
**DUE MILJØ coop** with MMS, EMET, SEPROSYS, CFR and GE WPT, world leading Industrial Molecular Separation;

Principles & Analysis + Lab & Pilot Plants = Complete Plants

**RO, NF, UF and MF** can separate:
Water, Salts, Sugars/amino acids, Proteins/polysaccarids, Particles...

**Chromatography and ED** separates < 1000 dalton and ions.

Lab. - and pilot tests, engineer, provide, Instal and start up of Industrial plants. We finance, operate and offer service. MORE YIELD => LESS WASTE
2. Membrane Processing to Refine BioMarine raw materials;

* Process objective; Remove y, concentrate z,…
* Needed: Analysis, molweight-distribution etc.
* Process; Pre-treat, Step 1,2,? Post-treat,…

**Components**

<table>
<thead>
<tr>
<th>Components</th>
<th>%</th>
<th>% of solids</th>
<th>KGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>2.70</td>
<td>36.23%</td>
<td>540</td>
</tr>
<tr>
<td>Fines</td>
<td>0.80</td>
<td>10.73%</td>
<td>160</td>
</tr>
<tr>
<td>Oil</td>
<td>0.40</td>
<td>5.37%</td>
<td>80</td>
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<tr>
<td>Peptides</td>
<td>2.40</td>
<td>32.20%</td>
<td>480</td>
</tr>
<tr>
<td>Ash</td>
<td>0.50</td>
<td>6.71%</td>
<td>100</td>
</tr>
<tr>
<td>Salt</td>
<td>0.65</td>
<td>8.72%</td>
<td>130</td>
</tr>
<tr>
<td>TVN mg/l</td>
<td>0.00</td>
<td>0.04%</td>
<td>1</td>
</tr>
<tr>
<td>TS</td>
<td>7.45</td>
<td>100.00%</td>
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</tbody>
</table>

Molekylær fordeling
How to Refine Raw Materials Functionalities

- Degree of hydrolysis (%DH)
- Solubility
- Water-holding capacity
- Antioxidant effects
- Emulsifying properties
- Foaming properties
- Fat absorption
- Sensory properties
Understand molecular size, form, loading etc. => Valuables Process
Molecular Fractionation and Separation of BioMarin Proteins.

See video:
www.duemiljoe.no
Illustrated difference between Evaporation vs a combination membrane / Evaporation plant; the patented FPI® Process.

Figures based on 5% feed and membrane conc.25%. The feed salt 33 g/L.

A reduction of above 83% of both salt and water and biogen amins.

Lodde; Salt 55.3, TVN 49.1
The FPI® consumes 1/3 less energy than Evaporation when feed TS 5% and final TS 80%.
Typisk Protein Membran Fabrikk – Syd- Amerikansk FPI® Lisens
New Membrane Technology gives New Value Chains

* Seafood Processors provided with FPI®- plants to refine Fresh BioMarine Rest/Raw Materials to Semi-finished HFPI Proteins & Peptides, Oils, other Ingredients to

* Productifiers/Distributors as advanced Ingredients for Value-added Human nutrition/functional food and Animal/Pet feed.
3. DUE MILJØ offer Analysis, Lab and Pilot Tests to Plants

BioMarine Fractionation- Lab. Tests

1. Lab. Report: Acidified

December 2015
Membrane Filtration Systems – Lab Tests

### Key Features Triple System

- Rapid screening of up to three polymer flat sheet membranes simultaneously
- Speed control of circulation pump for variable membrane crossflow velocity
- Cooling/heating jacket on tank for temperature regulation

### Typical test Volumes and Times

- Lab. tests 10-20 kg  1 - 3 weeks
- Pilot tests 1 - 5 m³  2 - 5 weeks
Lab. Test Results

<table>
<thead>
<tr>
<th>Feed</th>
<th>Retentate</th>
<th>Permeate</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF1 Permeate</td>
<td>VCR 8</td>
<td>Flatsheet z kDa</td>
</tr>
</tbody>
</table>
Pilot tests

1. Pretreatment

2. Hydrolysis

3. Membranfiltration

4. Evaporate/Dry
Then DEMO or Factory Manufacturing of Ingredients


Raw materials owner

Users of Ingredients

Stick-/Process Water or By-catch/Cuttings/HG Hydrolyse, Silage or other at Refiner

DEMO/Factory Membrane Container

Rental/Own Evaporator + Drier at Refiner/Contractor
BioMarine Refining => Increased BioMarine Ingredients for Nutrition

(SJØ = LAND PRODUKSJON – I DAG UTGJØR SJØ KUN 3% AV WW ERNÆRING)