The role of food processing equipment design in sustainable food production

Dr Eirin Bar, 12 May 2016
SINTEF Fisheries and Aquaculture
Technology based sustainable development of processing equipment/methods

Profitable food resources/raw materials

Automatic quality-based sorting and grading
Adaptive processing equipment
Fully automated food processing for optimal use of raw material
Slaughter on demand from real market pull
Automated washing of equipment

Processing

Attractive food products for consumers

Food processing equipment and food production
Relative contribution of processing equipment in the value chain
50% Reduction of total env. impact from food processing equipment

Reduction of environmental load of 1kg edible farmed salmon filet to wholesaler, Paris
Reducing loss by 5% in processing

Reduction of environmental impact due to increased utilization of salmon filet

Increasing yield will be 5 times as effective as halving the main environmental contributors in fish food processing equipment.
Effect from processing equipment on environmental impact of salmonid food products

![Graph showing CO2 emissions and potential reduction](image)
The design paradox
(Developed from Lindahl et. Al. 2000)
Drivers for development of FPE

• Automation:
  • reduce production costs, i.e. predominantly reducing the use of manual labour through automation,
  • increase production throughput
  • increase product quality

• New fish food products for consumers/customers

• Comply with national and international regulations:
  • animal welfare directive
  • hygienic standards/requirements

• Environmental issues NOT a driver
Inhibiting factors for inclusion of environmental requirements in FPE design

• Buyers dictate product requirements
• Producers rely on product acceptance
• Developers in weak financial position to undertake internal product improvement/development
• Lack of awareness and knowledge on how environmental performance of FPE is affecting the seafood value chain by the buyers, producers, and developers.
• Lack of feedback on environmental performance from buyers of FPE to producers
Enabling factors for inclusion of environmental requirements in FPE design

- Regulation of environmental performance
- Reduction of production cost
- Mutual commitment between producers and buyers of FPE
- Sharing of knowledge between producer and buyer and other actors within the value chain
- Environmental design tools relevant to the FPE industry
- Environmental performance seen as important
<table>
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<tr>
<th>Equipment attributes</th>
<th>Design guidelines</th>
<th>Order of priority</th>
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| **Function (part in the production of end product)** | • Minimize yield loss of main product from raw material  
• Facilitating optimal utilization of rest raw material for human consumption; facilitate a full utilization of co-streams  
• Aid production process flow within the processing plant | 1 |
| **Cleaning** | • Reduce need for washing agents and disinfectant  
  o Design for clean-ability  
  o Easy to dismantle  
  o Reduce contact points between equipment and product to avoid contamination  
  o Smooth nonstick surfaces for easy transportation of product and residue away from the machine  
• Minimize water consumption | 3 |
| **Material selection** | • Recyclable materials and pure material fractions  
• Materials that are easy to clean  
• Durable | 6 |
| **Assembly/Disassembly** | • Easy to disassemble, in particular care should be taken for parts that needs to be changed frequently such as conveyers | 9 |
| **Production** | • Reduce heat generation from motors and electronic components (Energy transformed into heat needs to be removed by the use of more energy due to temperature requirements within the processing plant) | 10 |
Conclusions

- Environmental design requirement of food processing equipment is linked with the food product value chain.
- Processing equipment design plays an important role in utilization of food products, as well as byproducts.
- A systems approach is needed in order to capture core environmental design requirement.
Publications in CYCLE

- **2014**
Publications in CYCLE

• **2015**
Further work:

• 1. Article from the whitefishindustry togther with Henrik Egelyng –Work starting in june 2016

• 2. "Meta artice" studying the CYCLE project what we have acheved and how we feel about it. Studying interactions between WPs and how synergies between industry and research has effected the outcoem of this 4years research project

• Participation in the Food Factory of the Future conferance in Laval, France Oktober 2016
Total utilization of raw materials in the supply chain for food with a bio-economical perspective

Thank you for your attention!