

Ship-shape and up-to-date

Collaborators **Ida G Aursand**, **Hanne Digre**, **Lars T Kyllingstad** and **Karl-Johan Reite** delve into the details of their development of fishing technology and the implementation of new systems



IDA G AUSSAND

Could you begin by introducing the project and the reasons behind its inception?

Sustainable harvesting of wild fish is one of the most important challenges in the global picture. Norway is far ahead in terms of technological equipment development and application of new capture concepts, but there are still significant challenges, particularly in the interface between new technology and catch handling. Development of the technological knowledge base necessary to provide new approaches has significant industrial interest. The present project aims to improve competence and develop methods to optimise onboard catch handling with regard to environmental impact and the quality of raw materials. The aim is to summarise the results and put them into the appropriate mathematical models that describe the processes. These models will be suitable as a basis for tools for the optimisation of the systems, and contribute to increased understanding of the important links between installed equipment, catch regime, operational profile and the value of raw materials.

How would you describe Norway in terms of its fishing industry and the role it plays as an exporter of seafood?

The Norwegian fisheries and aquaculture industry currently supplies seafood to consumers in about 150 countries worldwide. It is one of Norway's foremost export industries and is vital to communities along the Norwegian coast. It provides employment and has widespread effects on trade and industry, as well as on R&D. Norway controls some of the world's most productive marine environments, and the Government places great emphasis on gaining knowledge of fish resources, the ocean environment and how the interplay between species functions. There is also comprehensive regulation of fishing resources to ensure a sustainable management.

However, the Norwegian fish processing industry experiences strong competition from Asian countries such as China. To maintain a sustainable industry in Norway, with high labour costs, we must have a strong focus on efficient production and automation of processes both on board vessels and in land-based processing.

Storage and refrigeration of fish on vessels is a concern for those involved with the fishing industry. Is your team looking to enhance or develop storage systems that already exist, or create new techniques for tackling this issue?

The main challenges on board fishing vessels are to handle large amounts of catch in a limited time and maintain a high catch quality. It is crucial to keep fish live until bled and gutted. Stunning of live catch will allow more rapid bleeding, gutting and rinsing of the fish. Electrical stunning has been identified as a fast and efficient method to render fish unconscious and desensitised; this also

facilitates the handling of fish by fishermen, thus reducing the burden of manual work further down the line. We are introducing these new techniques which allow for good quality processing. Furthermore, it is of high importance to keep the cold-chain intact. Slurry systems are one of the refrigeration methods for preservation of seafood products at sub-zero temperatures (-3 to -0.5 °C). Another technology investigated is Cells Alive System (CAS), where fish are frozen in a magnetic field.

Could you elaborate on the team's investigation into alternative electrical stunning methods?

To handle live fish is a challenge because of heavy manual work and potential wrong cutting by machines. Therefore, electrical stunning is implemented to immobilise the fish. The technique enables the processing of live fish as soon as the catch is transferred from sea to deck. Through use of this technology we have observed a higher product quality (allow rapid bleeding, whiter fillets), improved safety conditions for the fishermen and a more efficient production process.

Which moments during the project would you highlight as being particularly successful?

The establishment of a close 'triangle'-collaboration between equipment vendors, end users (vessels) and SINTEF has led to development and implementation of new technology on board vessels helping the Norwegian fishermen to become more efficient and to deliver a high quality product. Electrical stunners are being installed in the vessels; a win-win situation for users and vendors, with the promise of better quality/bleeding of fish and a positive economic impact.

Fisheries fit for the future

Norway enjoys a rich fishing heritage, which is integral to its social and cultural fabric. DANTEQ is conducting research into the development and assessment of technology for the improvement of fishing operations and fish quality

AS THE FOUNDATION for settlement and employment, fishing is intrinsic to everyday life across the Norwegian coast. Technological advancements, improved fishing methods and superior vessels are responsible for the current peak in fishing efficiency: today, the fisherman catches, per head, larger quantities than ever before. It is therefore necessary to develop effective processing lines onboard to ensure high product quality.

The direction of development in the fishing industry has been towards fewer, more efficient fishing boats. Yet Norway remains to some extent diverse in its range of vessel sizes and types of fishing equipment, and sustainable resource management and industry research is therefore fundamental to Norwegian fishing policy.

The central environmental issues regarding contemporary Norwegian fishing activities are those of energy consumption in relation to catch volume, and the energy consumed due to the operation of vessel engines and the refrigeration of fish. It is widely known that raw material quality and catch value depends greatly on the onboard processes of harvesting and production, and in today's competitive international market it is essential that Norwegian-caught fish be of the highest possible quality. However, compared with land-based processing there are limitations that

come with processing systems on spaceboard fishing vessels, due in large part to the high cost of oil-powered engines used in the production of electrical energy.

IMPROVING OPERATIONS

Based at SINTEF Fisheries and Aquaculture, Ida Grong Aursand and her team have created the research project DANTEQ: 'Development and Assessment of Novel Technologies improving the fishing operation and on board processing with respect to Environmental impact and fish Quality'. The central aim of the project is to improve the operations of fishing vessels – the energy system design and the on board fish processing – to optimise fish quality and minimise environmental impact, as Aursand outlines: "We are focusing on live fish handling, stunning and chilling of catch as well as energy consumption during the fishing operation and catch processing".

Working closely with fishermen and equipment vendors, the research team has been developing efficient systems for improved handling of fish. They have been developing onboard automated catch handling technologies geared, not only towards maintaining fresh fish quality, but to ensure the safety of the fishermen in accordance with the fishermen's Health, Security and Environment (HSE) standards.

The group believes that improving onboard refrigeration will improve both fish quality and energy consumption. Another goal is to collect a foundation of data that allows for accurate quantitative analysis of onboard energy systems and efficiency of related machinery, along with other parameters.

MULTIDISCIPLINARY APPROACH

DANTEQ intends to pursue these aspects of study in a unified system model that reflects the inherent interconnectedness of the different areas. At its core the project is multidisciplinary: "Extensive involvement of the industrial partners in the project both from the fleet side, equipment suppliers and ship designers, whose daily experience the challenges addressed in the project, are helping to fulfil the aims," Aursand underlines.

ONBOARD DATA COLLECTION

Improving our knowledge base of current and potential fishing systems is essential to developing ecological and economically sustainable advancements in the industry, notes Aursand: "If we are to improve the energy efficiency of fishing vessels, we will require much more information about the ships' current energy systems than what is currently available". It is necessary, for example, to know just how much energy is



being produced, where is it being consumed and how energy flow is affected by internal factors (such as the manner of operating the vessel), or by external factors (eg. weather conditions). Collection and analysis of a broad range of data will elucidate areas in need of improvement.

MEASURING DIFFERENT PARAMETERS

DANTEQ has developed a data collection system, which has been deployed on a few commercial whitefish trawlers. The system facilitates the measurement of many different parameters, including fuel consumption, engine speed, electrical power output of generators, the power consumption of the ships' various electrical systems, and GPS and weather data. Unique to this project, the team also records information from the onboard factories, such as the quantity of fish and the speed at which it is processed; fish taxonomy; and the distribution of the product in the freezing plant, to give a few examples. "The information is automatically transferred wirelessly to a shore-based server, ensuring that we always have the latest data available for analysis," Aursand observes. If this system is run over a long period of time on many vessels, the collected data bank will be large enough to enable thorough and productive analysis, allow identification of the problem areas in depth and subsequently establish what those potential improvements should be.

In the long term, these analyses will allow the researchers to make fishing vessels more energy efficient by design. More immediate benefits of implementing these systems are also possible, as Aursand elaborates: "Live collected data will be presented directly to the ship crews, helping them to take immediate action to ensure the most effective operation of the ship at any given time and situation". This interactive and practical method of research is at the crux of the DANTEQ project.

EXPECTING POSITIVE OUTCOMES

The team is greatly interested in the future of fishing vessels and how new processing technology will potentially ensure efficient production and high quality products.

They expect their research to lead to new industry measures, such as the implementation of new live fish handling systems, electrical stunners, and new chilling and freezing technologies for high quality frozen products, as well as a better understanding of how to operate the vessel more efficiently in terms of energy consumption and catch quality.



It is widely known that raw material quality and catch value depends greatly on the onboard processes of harvesting and production

Aursand outlines a central focus as being the gentle handling of live fish until processing: "This involves the transferring of live fish; the development of automatic multi-species handling systems; automatic continuous processing and storage systems and the handling of all raw material on board". The team expects the increased monitoring of consumption fishing operations and implemented controlled processing to keep energy use as low as possible. In these ways, DANTEQ looks set to have manifold positive economical and environmental impacts. The extensive knowledge base provided by the research could also potentially be used for further studies into the fishing industry.

INTELLIGENCE

DANTEQ

DEVELOPMENT & ASSESSMENT OF TECHNOLOGY IMPROVING FISHING OPERATION & ON BOARD PROCESSING WITH RESPECTFULLY TWO ENVIRONMENTAL IMPACT & FISH QUALITY

OBJECTIVES

The main goal is to improve the fishing vessel operation, energy system design and the on board fish processing with respect to fish quality and environmental impact.

Sub goals:

- Develop novel on board automated catch handling systems safeguarding the initial fish quality as well as the fishermen's Health, Security and Environment (HSE)
- Improve refrigeration onboard a fishing vessel with regard to fish quality, installed equipment capacity, space requirements and energy consumption
- Provide the foundation for quantitative analysis of the on-board machinery and energy systems for a fishing vessel defined by its operational profile (including refrigeration and handling system loads) and physical parameters

PARTNERS

Wärtsilä Norway • Seaside • MMC Kulde • Melbu Systems • Finnmark Havfiske / Aker Seafood • Eros • Nordnes • Roaldnes

KEY COLLABORATORS

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