FOSS

ROUTINE ANALYSIS FOR FISH AND SHELLFISH FARMING, SMOKING AND PROCESSING

Oil • FAT • PROTEIN • MOISTURE • AQUEOUS SALT

ANALYTICS BEYOND MEASURE

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Typical Fish Processing Applications

1. Introduction

This document contains information about the typical analytical needs in the fish and shellfish processing industry, and how the FoodScan™ 2 and other FOSS analysers can deliver benefits and value for today's fish processors. The document lists different user cases and describes how FoodScan 2 is currently being used in the industry. The list is not complete, and we recommend that you contact your local FOSS representative for more information.
We have other instruments delivering analysis of oils, fat and pigments in fish oils and flesh.

For more information, visit **www.fossanalytics.com**

2. Typical user situations and analytical needs

Analysis is primarily a necessity for processing of oily fish types such as salmon, herring and mackerel. However, compositional analysis for process control of lean fish such as tuna and surimi is often required, and occasionally even for shellfish.

What are your analytical needs?

2.1 Herring

The most important parameter to measure is the **fat** content of each shipload. The fat content in herring varies from approximately 10-12% up to 22-24% depending on the season and the size of the fish. Herring with a high fat percentage (22-24%) is in high demand in certain countries such as Holland, where the herring will be sold classified as Matjes Herring, which obtains a significantly higher price than herring with a lower fat content.

For each landing, the fish are sorted according to size, and analysed to determine the fat content in each size category (3-4 size categories). Generally, the fat content increases with the increasing size. Analysis is performed on both filets with skin and filets without skin, as some of the fat comes off as a result of the de-skinning.

The FoodScan™ 2 is used to measure the fat content of herrings at landing and thereby to classify the quality of a herring shipload.

The fat content is also used to calculate the correct brine/pickle ratios for the cured product.

The pickled herrings are analysed to determine fat content (documentation needed to meet end-customer specifications) as well as salt, acidity or pH and total solids.

One of the key reasons to apply rapid analysis methods is that traditional laboratory analysis has previously proven to be a bottleneck. At peak season, the number of analyses (six times fat per landing + analyses on end products) exceeds the analytical capability, and it is costly to employ more skilled staff. Another benefit is smoother production and less time wasted on waiting for results. This also leads to improved product quality, as fresh fish is a perishable product that depends on a short turnaround time.

2.2 Mackerel

The important parameter to measure is the **oil/fat** content of each shipload.
The mackerel is a "group fish", so normally the fish in the same load/landing will have approximately the same fat percentage. The fat percentage is used for segregation of the mackerels (for different processing).

Assessing the oil content prior to smoking is very important as this will affect the smoking conditions to give an optimum product.

Normally, the mackerel has the highest fat content in spring and pre-summer; consequently, the price is higher at this time of the year. Some fishermen will store the mackerel until this season in order to sell the mackerel at a higher price. Therefore a test for fat percentage of the load will show if the load has the desired high fat percentage to match the high price.

2.3 Salmon (smoked salmon)

The important parameters to measure are content of **oil/fat** and **salt (aqueous salt)**. Salt is critical in the smoking and curing process – both for hot and cold smoking. Additionally, it is important for legal and food safety purposes, to calculate the amount of aqueous salt in the smoked salmon. A minimum level of aqueous salt is required to ensure that the food safety and shelf life of the product is not compromised.

The fat percentage may be used for segregation of the salmon (for different processing) or as a simple intake check. Assessing the oil/fat content prior to processing is very important, as this will affect the smoking conditions to ensure an optimum product, along with more consistent nutritional values, taste and texture. As samples are generally required to be taken from several sides throughout the smoking batch, rapid testing is important to ensure that further processing is not delayed. It may also be possible to test in a non-destructive way, thus avoiding high material waste costs. See further about this topic below.

2.4 Sardines

The important parameter to measure is **fat** content – but only for quality control purposes.

2.5 Surimi

The are many types of surimi made all over the world. A certain part is made using Alaska pollock, a white meat fish which mainly lives in the Bering Sea. After the fish is skinned and cleaned, the filets are frozen into blocks. The frozen block of filet is the raw material for pollock surimi. Most of the pollock surimi is made in Alaska, although Russia has started producing pollock surimi in recent years and small volumes are also being produced in China and Korea.

Moisture control is one area where pollock surimi manufacturers can potentially achieve savings. Analysis of moisture content should be made in production prior to freezing and the results can be used to adjust moisture levels in the product.

Fat control is also used for segregating the final products into different fat classes.

The surimi manufacturer also needs to control the **protein** content of the raw fish meat to secure an optimal surimi production. If the protein content is too low, the manufacturer can add protein to reach the desired level. When the protein content is correct, the fish meat has the right binding ability, so it is possible to mix, form and cut the surimi. Also, pH and salt are of interest to check.

The FoodScan™ 2 can be used to analyse samples of the defrosted raw material, whereas the ProFoss™ is recommended for process control.

2.6 Tuna

In tuna processing the high-quality tuna are used for sashimi products (high value) and the lower quality are used for canned tuna (lower priced products).

The important parameters to measure are **moisture** and **protein** content.

The process for producing canned tuna is usually as follows:
Whole frozen tuna is defrosted. The defrosted tuna is pre-cooked using steam (tuna hanging). The pre-cooked tuna is cut and de-boned and the tuna-meat is portioned and canned. The tuna cans are then filled with brine (either sunflower oil or water) and soya protein is often added (to bind water). Finally, the cans are heat treated.

The biggest challenge in the production process is to measure/predict the tuna meat's brine absorption ability. The more brine that can be absorbed, the bigger the "drain weight" of the product, which is what the customers focus on (one extra gram gained = MONEY).

The analytical needs in the process described above are:

- Sampling at landing point to check moisture content (provides information about the freshness of the tuna)
- Sampling after pre-cooking to check protein content (if too low: protein to be added in process) and to check if the heating process is optimal (getting the protein and moisture content right, results in reduced waste of meat in the cutting process). It is assumed that there is a certain relation between the protein content in the pre-cooked tuna and the yield.
- During processing: control of histamine and salt (histamine regulations: Ecuador: 50 ppm; US: 100 ppm)
- Declarations: typical chemical parameters to declare by law on consumer cans/packaging: fat, protein, salt/sodium, carbohydrates, saturated fat, fibre, cholesterol

3. Manufacturing of processed and coated fish products, white fish and scampi

For raw material quality assurance, i.e. assessment of the fish quality prior to processing, the main application of interest is **fish content**.

The fish content of a raw fish sample is calculated by determining the **nitrogen** content (i.e. protein/6.25), and then incorporating the nitrogen content into an industry standard equation. The fish industry has an agreed set of fish factors for each individual species of fish and in some cases specific cuts of fish (i.e. fillet or loin etc.). The fish content will then be used to determine which product type each sample can be used for, i.e. coated fillets, fish fingers, fish pies or ready meals. In scampi processing where the processed product (i.e. not the "whole tail" product) is used for coated scampi, this is very important, as it is an excellent indicator of the quality of the scampi product.

4. Detailed analysis of pigments and fats in fish flesh (salmon/trout)

Of interest to fish farms and processors alike, a different analyser is recommended for detailed analysis of pigments and fats in fish flesh. More information about the NIRS™ DS2500 – already well known by fish meal processors, can be found in the separate document – Analysis of fish flesh with the NIRS™ DS2500.

5. Analysis of fish flesh using NIRS™ DS2500

FoodScan has been providing the fish processing industries with standard, routine analytical solutions for many years. However, requests from industry and fish farms, in need of more detailed analysis of pigments and oils in fish flesh, has led to further developments using the **NIRS™ DS2500** analyser as an alternative to the FoodScan 2, which was not suitable for this specific purpose due to its narrow wavelength range.

The **NIRS™ DS2500** NIR analyser is a monochromator-based scanning system using reflectance measurements to generate the spectrum. The wavelength range is 400–2500 nm. This wavelength range covers both the visible and near infrared parts of the electromagnetic spectrum, providing the potential to investigate and predict a wide range of different parameters.

The NIRS DS2500 is suitable for compositional analysis of fish flesh.
The correct sample presentation for the NIRS DS2500 is achieved by using the FOSS quarter cup and ideally all samples should be homogenised prior to analysis. Multiple scans are taken during the analysis with results in just 50 seconds.

6. Analysis of smoked salmon – non-destructive testing

Recently, further efforts have been made to develop a method of analysing without destroying the side of salmon during sampling. This is now possible with the ProFoss™ analyser, which can be used to analyse a section of the salmon side without cutting out a sample and homogenising it. This is a valuable new method as it is not only quicker but also saves the cost of the salmon side, which can then be used for further processing. The parameters oil, protein, moisture and salt (aqueous salt) can be determined in less than 30 seconds.

7. Analysis of scallops for detection of "soaking"

Scallops are an expensive shellfish that may be subject to fraudulent adjustment of the meat content by "soaking" the scallop, so it absorbs additional water. This "adjustment" increases the weight and reduces the quality of the natural product. To overcome this, a test has been established to check the moisture/protein ratio. Typically, this ratio should be below 5 for a good, natural product. In France, this ratio can be enforced through prosecution. The traditional moisture/protein ratio test uses wet chemistry which is both time consuming and costly. The FoodScan calibration developed specifically for scallops ensures very robust and repeatable test results.

8. About the FoodScan™ 2

The FoodScan 2 analyser is a fast, accurate and easy to use NIR instrument with results in just 25 seconds. With Foodscan 2 you can analyse all stages of fish production from checking incoming raw material to final product control. It is pre-calibrated to analyse all key parameters including fat, moisture and protein.

Officially approved for meat analysis, FoodScan 2 has received AOAC approval for the analysis of moisture, fat, and protein in meat and meat products. The approval allows food producers to exploit the leading meat analytical solution with full confidence in an officially approved method.

Three versions of the FoodScan 2 are available: FoodScan 2 Lab, which needs to be connected to a PC; FoodScan 2 Lab TS which has an integrated touchscreen for operator interface and needs less space, and FoodScan 2 Pro, another touchscreen version which is IP65 rated, and can be situated in the production environment.

Please see the FoodScan 2 Fish Analyser brochure for more information.

FOSS fish analysers offer many advantages over alternative methods:

Proven accuracy and reliability

- Measure a range of key quality parameters
- Unique measuring principles and ANN calibrations offer the highest accuracy available

Robust construction for production area testing

- Instant results for rapid feedback on production
- Very easy to operate and maintain

Cost effective

- Pre-calibrated and ready to use – no calibration costs
- No extra costs from chemicals and consumables. Test as often as required

9. Conclusion

FOSS is a global leader in the design and manufacture of rapid analytical instruments for the food and agricultural industries. Processing of fish and shellfish is one sector where FOSS can deliver added value to the industry.

For more information visit **www.fossanalytics.com**

Or contact your local FOSS Office **www.fossanalytics.com/en/contact-us/find-foss**

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