



Application Note AN-PAN-1031

Effectively monitoring hydrogen peroxide online in salmon farms

Salmon farms have become more popular in the past several years. Our ever-growing population has increased the demand for salmon which influences their cultivation. In these aquatic farms, the fish live in limited space in open net cages. Parasites such as salmon lice can multiply quickly due to the high density of fish. One possibility to combat lice infestation is to use baths with dilute concentrations of hydrogen peroxide (H_2O_2) as a delousing agent. The salmon are treated in these baths for up to 20 minutes until the lice detach and die.

While it is true that hydrogen peroxide decomposes

relatively quickly, it can be deadly for salmon in high amounts. The concentration must therefore always lie within strict specifications during treatment.

This Process Application Note details the online analysis of H_2O_2 in the salmon treatment bath. The 2060 TI Process Analyzer from Metrohm Process Analytics requires less than two minutes per titration analysis. This online process analyzer helps keep the salmon healthy and safe during treatment by permitting more concentration determinations in less time than manual analysis and always guaranteeing the correct H_2O_2 dosage.

INTRODUCTION

The industrial farming of plants and animals for human consumption is nothing new, although generally this is done on land (agriculture). Aquaculture is the equivalent to agriculture in terms of growing animals and plants for food, but farmed from water sources. Salmon farming has grown in popularity over the years, from the coasts of Norway and Scotland to as far away as New Zealand, Chile, and Alaska [1]. The process of growing salmon is contained either in a net or pond and is controlled

from egg to market (**Figure 1**). An unfortunate side effect of holding such a large volume of fish in a contained area is the proliferation of salmon lice (*Lepeophtheirus salmonis*), which must be killed off (delousing) for a healthy population of fish to survive. The parasites attach to and feed off of the salmon, causing anemia and even death. The lice can spread quickly during the grading and harvesting processes because of the large disturbances caused.



Figure 1. Illustration of the Atlantic salmon production process at an aquatic farm (repurposed from [1]).

One of the salmon delousing treatments available is hydrogen peroxide (H_2O_2). A diluted bath of H_2O_2 is prepared in which the fish are introduced for up to 20 minutes, and this removes the attached parasites, which can then be filtered from the water. The benefits of using H_2O_2 are numerous – it is easy to purchase, it is a non-medicinal treatment, and it rapidly degrades into water and oxygen as byproducts.

Challenges remain regarding the efficiency of dosing, mixing, and the distribution of H_2O_2 in the salmon

treatment tank to prevent overdosing, which can cause oxidative stress in the fish, the bleaching of skin/scales, and even death. Therefore, quick analysis and response times are critical. The Metrohm Process Analytics 2060 TI Process Analyzer (**Figure 2**) can monitor the concentration of H_2O_2 and be used to control the dose rate accurately into the salmon treatment tank, ensuring that the delousing treatment process runs within specifications. These online process analyzers are currently in use at several salmon farms.



Figure 2. 2060 TI Process Analyzer used for online monitoring of hydrogen peroxide in salmon delousing baths.

APPLICATION

The H_2O_2 concentration is measured titrimetrically with cerium (IV) using a Pt-ring electrode and reference electrode (Ag/AgCl/KCl) to determine the endpoint with dynamic endpoint titration (DET). The

analysis frequency is fully optimized, and the typical analysis time is less than two minutes, ensuring timely control of the H_2O_2 concentration in the bath.

Table 1. Hydrogen peroxide concentration range used in the delousing process at salmon farms.

| Parameters | Concentration [g/L] |
|------------------------|---------------------|
| H_2O_2 | 0–2500 |

REMARKS

Other process applications are available for this industry including the determination of alkalinity,

calcium, water hardness, free fatty acids (in fish oil), iron, phosphate, and many more.

CONCLUSION

A wide range of hydrogen peroxide concentrations in salmon farm delousing baths can be measured online quickly and reliably using the Metrohm Process Analytics 2060 TI Process Analyzer. Furthermore, this

analyzer can provide automated analysis results for the salmon treatment tank, avoiding overdosing, which can cause oxidative stress in the fish, skin/scale bleaching, and death.

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[AN-PAN-1054 Online monitoring of hydrogen peroxide during the CMP process](#)

[AN-PAN-1055 Monitoring quality parameters in](#)

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[AN-T-025 Hydrogen peroxide content in aqueous solutions](#)

[AN-NIR-095 Quality Control of Hand Sanitizers](#)

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BENEFITS FOR ONLINE ANALYSIS OF DELOUSING

- Detect treatment upsets quickly (e.g., incorrect chemical dosing) via automated analysis
- Improved manufacturing efficiency (avoid lower fish yields and harvesting disturbances)
- Monitor multiple treatment baths (up to 10) for more savings per measurement point and results



REFERENCES

1. *Salmon Farming Industry Handbook 2021*; Mowi Industry, 2021.

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CONFIGURATION



2060 Process Analyzer

The 2060 Process Analyzer is an online wet chemistry analyzer that is suitable for countless applications. This process analyzer offers a new modularity concept consisting of a central platform, which is called a «basic cabinet».

The basic cabinet consists of two parts. The upper part contains a touch screen and an industrial PC. The lower part contains the flexible wet part where the hardware for the actual analysis is housed. If the basic wet part capacity is not sufficient enough to solve an analytical challenge, then the basic cabinet can be expanded to up to four additional wet part cabinets to ensure enough space to solve even the most challenging applications. The additional cabinets can be configured in such a way that each wet part cabinet can be combined with a reagent cabinet with integrated (non-contact) level detection to increase analyzer uptime.

The 2060 process analyzer offers different wet chem techniques: titration, Karl Fischer titration, photometry, direct measurement and standard additions methods.

To meet all project requirements (or to meet all your needs) sample preconditioning systems can be provided to guarantee a robust analytical solution. We can provide any sample preconditioning system, such as cooling or heating, pressure reduction and degassing, filtration, and many more.