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.

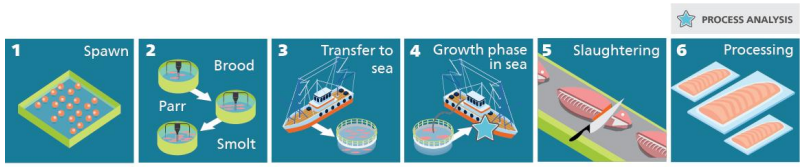

Figure 1. Illustration of the Atlantic salmon production process at an aquatic farm (repurposed from [1]).

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.

RELATED APPLICATION NOTES FOR THE FOOD & BEVERAGE INDUSTRY

AN-PAN-1029 Peracetic acid (PES) as disinfectant for PET bottles
AN-PAN-1054 Online monitoring of hydrogen peroxide during the CMP process
AN-PAN-1055 Monitoring quality parameters in standard cleaning baths
AN-T-025 Hydrogen peroxide content in aqueous solutions
AN-NIR-095 Quality Control of Hand Sanitizers

RELATED DOCUMENTS

Brochure: Fishery & Aquaculture – reliable online, inline, and atline analysis systems for optimizing aquaculture plants
Brochure: 2026 Hydrogen Peroxide Analyzer

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

2060 Process Analyzer 是一在湿化学分析,用于无数用。此程分析提供了一个新的模化概念,由一个称«主机»的中心平台成。

主机由部分成。上部包含触摸屏和工算机。下部含有柔性取部,其中放有用于分析的硬件。如果主取部容量不足以分析挑,那主机可以展多四个外的取部机,以保有足的空来最具挑性的用。附加机的配置方式使每个取部机可以与具有集成(非接触式)液位的合使用,以增加分析的正常行。

2060 Process Analyzer 提供不同的湿化学技:滴定法、舍滴定法、光度定、直接量和准添加入法。

足所有目要求(或足的所有需求),可提供品理系,以保分析解决方案可靠。我可以提供任何品理系,如冷却或加、和脱气、等。