

# Valorization of aquaculture side streams treatment and valorization of mortalities

Christian Bruckner, Martiña Ferreira Novio, Johan Johansen & Hallstein Baarset



Welcome to the fifth and final part of this unit on the valorisation of aquaculture side streams, prepared by Christian Bruckner, Martiña Ferreira Novio, Johan Johansen & Hallstein Baarset. In this last part we look at methods for treatment and valorization of fish mortalities from aquaculture production systems.

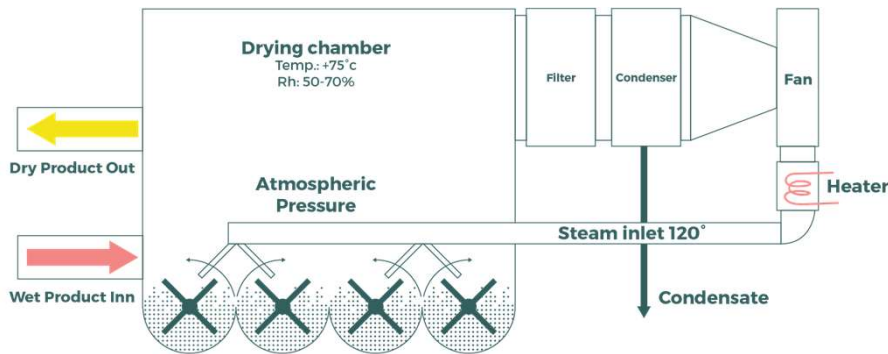
## Innovative method for disposal of mortalities



- “Validation of mortalities drying at the fish farm, ensuring safe transport and handling without formic acid, as a preferred method of mortality disposal.”

This slide shows the three simple steps of drying mortalities (collection, drying, storage), instead of using formic acid for the treatment.

## Innovative solution for mortality disposal



- The energy-efficient and robust process of drying mortalities is based on mechanical fluidisation and superheated steam
- With the in-situ drying technology from Waister, GAIN investigates an innovative and sustainable solution.
- Calculated annual operating expenses (OPEX) for a fish farm with  $\approx 2\,000$  tons of annual feed: € 5 214 (drying) vs. € 30 118 (ensilage)  $\rightarrow$  Return on investment (ROI)  $\approx 2$  years

This slide presents in-situ drying technology from Waister AS: The energy-efficient and robust process of drying mortalities is based on mechanical fluidisation and superheated steam.

The GAIN project conducted an evaluation of this innovative and sustainable solution. The calculated annual operating expenses (OPEX) of a mortality treatment system for a fish farm with  $\approx 2\,000$  tons of annual feed, was: € 5 214 (drying) vs. € 30 118 (ensilage). A return on investment (ROI) would therefore be achieved within around 2 years for the drying system.

## Value for the fish farm

### ➤ SAFETY

- Elimination of formic acid treatment hazards:
  - Workers safety (skin injuries, gas exposure, explosion risk)
  - During transport (e.g. road accidents)
  - Leakages to environment (local, during transport and storage)
- Compliance with government regulations on mortalities disposal
  
- With an additional automated mortalities feeding system to dryer:
  - No manual handling of fish outside each zone in the fish farm → reduced contamination risk between zones
  - Savings on manual handling

## What are the benefits for fish farms?

### ➤ FINANCIAL VALUE

- Attractive ROI typically 2 – 4 years (depending on amount of mortalities)
- Cost of disposal significantly reduced
  - Reduction of weight and volume compared to amount of ensilage ≈ 85 %
- Daily 30 minutes savings on mortality handling

The drying of mortalities offer a number of benefits for fish farmers.

Firstly, it increases SAFETY, compared to mortality treatment with formic acid due to elimination of formic acid treatment hazards e.g.:

- Workers safety (e.g. skin injuries, gas exposure, explosion risk)
- During transport (e.g. road accidents)
- Leakages to environment (local, during transport and storage)
- Compliance with government regulations on mortalities disposal

Secondly, the dryers have an automated mortalities feed system which means:

- No manual handling of fish outside each zone in the fish farm
- reduced contamination risk between zones
- Savings on manual handling

Lastly, the drying of mortalities is cheaper than treatment with formic acid with:

- Attractive returns on investment, typically 2 – 4 years (depending on amount of mortalities)
- Cost of disposal significantly reduced
- Reduction of weight and volume compared to amount of ensilage ≈ 85 %
- Daily 30 minutes savings on mortality handling

## Value in a circular economy perspective

- Potential use of mortalities as a circular economy product
  - Booster for increased biogas production in biogas plants
  - Replacing fossil fuels in industry, e.g. the cement industry → improving carbon footprint
  - Substrate for biochar / black carbon production (pyrolysis)
- Potential new areas of safe use within EC Regulation No 1774/2002 (animal by-products not intended for human consumption):
  - Bio-energy production
  - Technical applications
  - Fertiliser
  - Feed for fur animals
  - Feed for zoo and circus animals
  - Other non-food producing animals
- The outcome: A proven circular economy solution for mortalities disposal with a dry, stabilised product becoming a resource for other industries
- Input to future government regulations in Europe on safe mortality disposal

How can we make a value?

What to do with this resource?

Dryer mortalities have a great potential as a product in a circular economy perspective:

- Booster for increased biogas production in biogas plants
- Replacing fossil fuels in industry, e.g. the cement industry @ improving carbon footprint
- Substrate for biochar / black carbon production (pyrolysis)

Potential new areas of safe use within EC Regulation No 1774/2002 (animal by-products not intended for human consumption) include:

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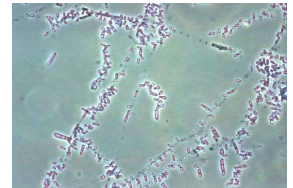
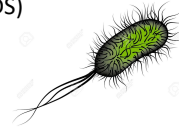
The drying of mortalities represents a proven circular economy solution for disposal of mortalities with a dry, stabilised product becoming a resource for other industries. This deserves further attention with respect to future government regulations in Europe on safe mortality disposal.

## Safe handling in a circular economy perspective

Organism	Method	Amount [log/g]
Aerobic microorganisms	NMKL 189	3,6 - 4,5
Anarobic microorganisms	NMKL 189	4,3 - 4,5
Mould	Ph-Eur 2.6.12	2,3 - 3,8
Yeast	Ph-Eur 2.6.12	<2,0 - 3,0

## Is it safe to transport and handle dried mortalities?

- Adjustment of process parameters to secure lower count of microorganisms in the dried product:
  - Higher dry substance level (increase from typically 78–90 % DS → >90 % DS)
  - Higher exhaust temperature (typically 65 °C → >72 °C)
- Further analysis to determine type of microorganisms present
- When transported and handled in closed bags, dried mortalities can be safely transported to biogas plants or industrial plants



We have adjusted several process parameters to secure a lower count of microorganisms in the dried product:

- Higher dry substance level (increase from typically 78–90 % DS -> >90 % DS)
- Higher exhaust temperature (typically 65 °C -> >72 °C)

When transported and handled in closed bags, dried mortalities can be safely transported to biogas plants or industrial plants.