GAIN
Green Aquaculture Intensification

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 773330

Valorization of aquaculture side streams
(IV) valorization of sludge

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Salten Havbrukspark waister ANFACO CECOPESCA

Welcome to the fourth part of this unit on the valorisation of aquaculture side streams, prepared by Christian Bruckner, Martiña Ferreira Novio, Johan Johansen & Hallstein Baarset. In part 4 we look at the potential for valorizing sludge from aquaculture production systems.

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Valorization of sludge as feed

Aquaculture sludge is well suited as insect feed.

Presently, commercial application as insect feed is prohibited in EU.

Legislation needs to adapt to meet the ambition of the circular economy.

Black soldier fly larvae fed aquaculture sludge

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Valorization of sludge as bioenergy

Dried aquaculture sludge has good properties as a bioenergy substrate

- Dry matter 93-95%
- Energy 20MJ/kg
- Fat 3.5%

Utilization possibilities:

- Biofuel
- Biogas
- Pyrolysis

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Following separation and processing through the S3 filter/dryer, aquaculture sludge has good properties as a bioenergy substrate with the following characteristics:

- Dry matter 93-95%
- Energy 20MJ/kg
- Fat 3.5%

We see the following utilization possibilities:
- Biofuel
- Biogas
- Pyrolysis

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Valorization of sludge as fertilizer

Sludge characteristics:

- N 47 g/kg
- P 24 g/kg
- Zn 330-360 mg/kg
- Cd 0.45 mg/kg

Maximum levels of heavy metals (mg/kg) allowed in organic fertilizer

Quality grade Annual usage	0 As required	1 0.4 kg/m²	2 0.2 kg/m²	3 none
Cadmium (Cd)	0.4	0.8	2	5
Lead (Pb)	40	60	80	200
Mercury (Hg)	0.2	0.6	3	5
Nickel (Ni)	20	30	50	80
Zinc (Zn)	150	400	800	1500
Copper (Cu)	50	150	650	1000
Chrome (Cr)	50	60	100	150

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Aquaculture sludge has the following chemical characteristics relevant for fertilizer products:

- Nitrogen - 47 g/kg
- Phosphorus - 24 g/kg
- Zinc - 330-360 mg/kg
- Cadmium - 0.45 mg/kg

The table on this slide shows the maximum levels of heavy metals (mg/kg) allowed in organic fertilizer, which groups fish sludge in the fertilizer categories 0 – 2.

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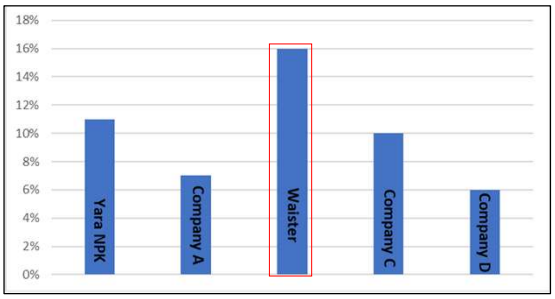
Valorisation of sludge as fertiliser

NIBIO
NORWEGIAN INSTITUTE OF BIOECONOMY RESEARCH



Barley yield using fish sludge from different providers, in comparison with an inorganic commercial fertiliser.

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- Main quality measure:
  - Yield on plant growth
  - Quality grade 1 fertiliser
- Other quality parameters:
  - Odour
  - Volumetric weight for cost-efficient transport
  - Homogeneous particle size
  - Easy to spread in fields
  - Carbon footprint
- Result:
  - Up to 45 % better yield than reference mineral fertiliser on barley

Dried fish sludge have excellent potential as a component in fertiliser for barley

The results from growth experiments at the Norwegian Institute for Bioeconomy Research, indicate that using aquaculture sludge as an organic fertiliser resulted in up to 45 % better yield on barley compared to a reference mineral fertiliser.