# The importance of feed for water quality in RAS

**SIS FeedCtrl**: Tor Andreas Samuelsen, André Sture Bogevik, René Alvestad, Andre Meriac and Turid Synnøve Aas



Andre Meriac Researcher











INCREASING control over production environment, by DECREASING water exchange



Fish tanks

Bregnballe, 2022

Mechanical filter

UV treatment





## SIS FeedCtrl: Building competence along the feed-fish-waste axis

• Creating a **toolbox** to link feed production with water quality and sludge properties.



**1. Ingredient** characterization & **feed** optimization.



2. Measuring effects of feed on fecal properties.



**3.** Investigating **interactions** of fecal properties with the **production environment** in RAS.



**4.** Evaluating effects on **sludge** properties, **valorization potential** and overall nutrient **balances** in RAS.









Tor Andreas Samuelsen

André Sture Bogevik

Turid Synnøve Aas

#### Nutrition and feed technology





René Alvestad

Andre Meriac

**Production biology** 

Aquafeed Technology Centre, Bergen

Photo: Eivind Senneset, Nofima

Total of **26 feeds** produced and tested in fish trials

Research Station for Sustainable Aquaculture, Sunndalsøra

Man -

Photo: Helge Skodvin, Nofima



## Feed pellet stability

- Water stability index
- Distek rapid stability test (2h)
- In-vitro stomach model
- Pellet durability/hardness
- Measuring viscosity profiles in different assays





## **Fecal properties**

- New fecal stability assay
  - Logging turbidity during disintegration while stirring
  - Fast, works with small samples (~1 g FW)
  - Calculating regression
- Results consistent and comparable between trials
- Highest stability in guar gum and fish meal diet



# **Fecal properties**

- Comparing methods: Stripping, dissection and spillbox collection
- Viscosity (fore-/midgut)
- Settling velocity
- Sieving / size fractionation
- Carbohydrate/fiber analysis
- Carbon bioavailability (BOD/COD)





## **Performance in RAS**

- Water quality: TSS, turbidity, TOC/DOC, TAN, NO2-N
- Sludge collection from drum filter effluent (50-60% fecal OM)
- In-situ biofilter capacity test, high consistency of results
- Microbiological analysis of biocarriers and water (Ida Rud)
- **But:** Health concerns in experimental fish group, results must be evaluated carefully



## **Key findings: Feed and feces**

- Stability tests and in-vitro stomach model predict high pellet stability: >95% collection efficiency in spillbox
- No correlation of pellet hardness & water stability, viscosity is a potential proxy
- Guar gum, guar protein and fish meal appear most stable
- 50-60% of sludge collected in RAS, amounts determined by digestibility rather than fecal properties
- No obvious diet effect on WQ or biofilter performance, but fish health status affected variation between systems



## **Summary and conclusions**

## **Development of toolbox for feed-fish-waste-axis**

- ☑ Infrastructure, procedures and competence
- Key methods established to measure physicochemical properties
- Contrasts can be measured, characterization and ranking before full-scale testing

Integration of 3 years of results across all work packages: Which differences do we see? Why? Are they relevant?

#### Work smarter, not harder!

- In-vitro pre-screening with the right tools
- Full-scale testing with less treatments and more replicates
- More work on standardization for full-scale testing

