Mechanical durability and relaxation times of dried extruded fish feed

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Introduction

Scope
Establish relation between structural properties and mechanical durability

Drying parameters

Quality defining processes?

Structural properties

Final technical quality

Measurements
- Durability
- Density
- Dextrinity

Outcome
Optimize drying parameters to improve technical quality

Experimental study

STRUCTURAL PROPERTIES FROM TEXTURAL ANALYSIS

Textural analysis are conducted to elucidate on rheological details in fish feed pellets.

From graphical analysis different structural properties of the pellets can be quantified and correlated against measurements of mechanical durability.

DURABILITY ASSESSMENT

When subjected to an amount of mechanical stress, a portion of pellets will break into fines

STRUCTURAL BEHAVIOR FIT TO MECHANICAL MODELS

Assessment of properties in terms of material mechanics is done by fitting the recorded behavior of the pellet to different constitutive structural mechanics models

Results

IDENTIFICATION OF STRUCTURAL BEHAVIOR

The viscoelasticity of a pellet is bound to have some importance. Pellets will have a high durability when able to relax the force applied at the surface so deformations in non-elastic type behavior.

From above observation on elasticity and cohesiveness, and from fitting data to theoretical mechanical models, it is suggested that the structural behavior that promote durable feed pellets:

- is viscoelastic, and possess a relaxation time, which will allow the pellet to return to its equilibrium state.
- have a total relaxation time of around 7 seconds.

5 seconds waiting time was initially used in the practical assessment of cohesiveness. If durable feed pellets truly is characterized by exhibiting viscoelastic behavior, the response of the cohesiveness-durability correlation should improve when increasing the waiting time in TPA.

JUSTIFICATION OF RELAXATION TIMES

After the waiting time was changed from 5 to 15 seconds, a better response was obtained in the cohesiveness-durability correlation. This demonstrates that durable pellets possess viscoelastic behavior.

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Conclusion

- Durable extruded fish feed pellets possess viscoelastic structural behavior, promoting stress relaxation and apt reversible deformation.
- A relaxation time of ca 7 seconds exists in the viscoelastic feed pellets.
- Structural behavior and the existence of a relaxation time in the feed is justified:
  - The response and regression of the cohesiveness-durability correlation was significantly improved, by increasing the waiting time in the TPA test.
  - Pellets exposed to a repetitive mechanical stress pattern could be more prone to fail when the applied frequency is below the relaxation time.
  - All of above should be accounted for in the selection of drying parameters, once the connection between drying parameters and viscoelasticity is established!

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