Oceanic Institute

Biofuels Co-Products Workshop

Extrusion Process for Aquatic Feeds

Joseph P. Kearns, Wenger, USA

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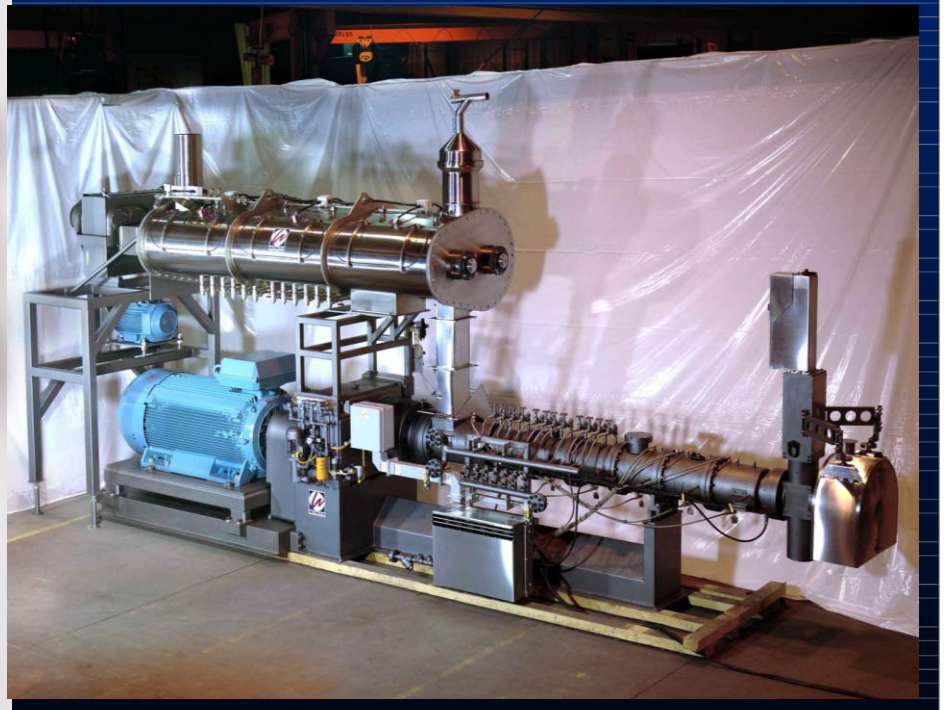
Aquatic Feeds Made by Extrusion



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Floating: Catfish, Carp, Tilapia

Coated and Uncoated Salmon and Trout Feeds

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SALMON FEED

DENSITY BEFORE COATING

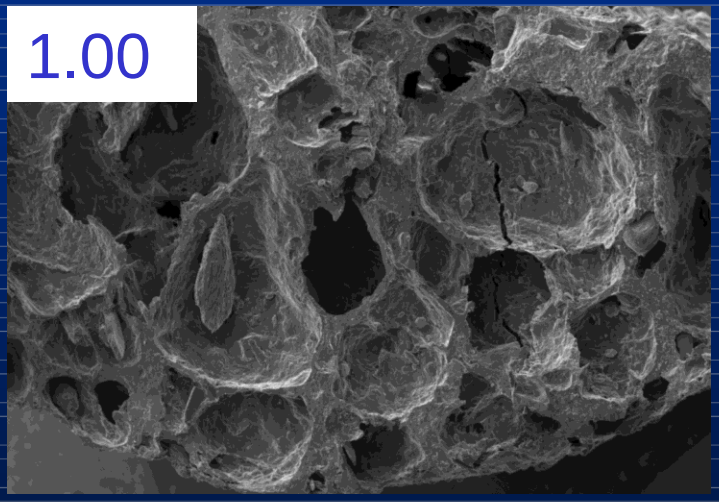
654 g/l	628 g/l	530 g/l	504 g/l	420 g/l	392 g/l
					

DENSITY AFTER COATING and TOTAL FAT %

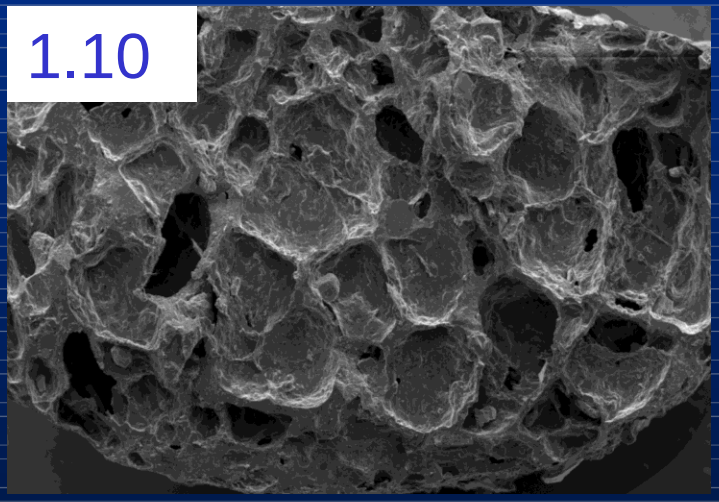
679 g/l	690 g/l	672 g/l	640 g/l	617 g/l	626 g/l
16.2 %	19.5 %	23.8 %	28.4 %	37.8 %	40.5 %

EFFECT OF SME ON CELL STRUCTURE SIZE
(SME Units = kWh/t)

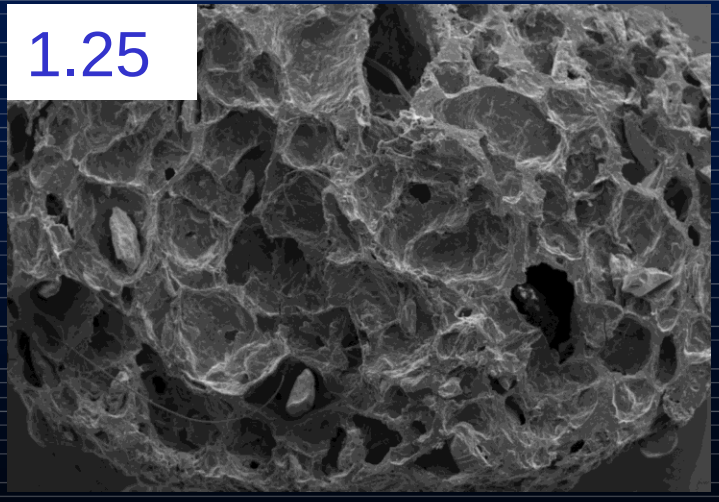
1.00



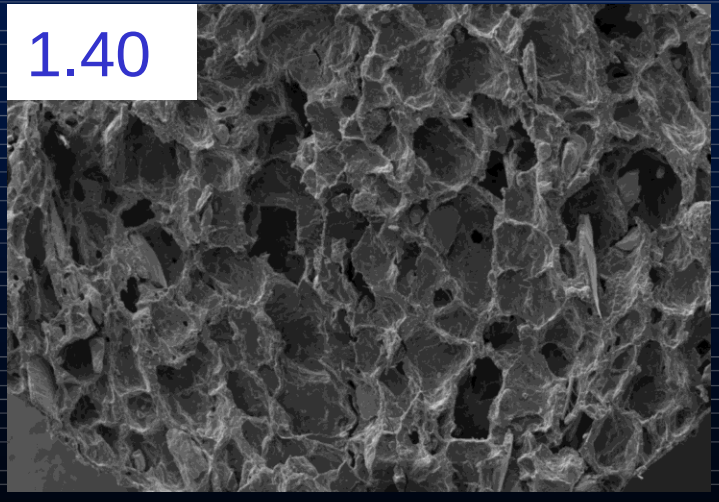
1.10



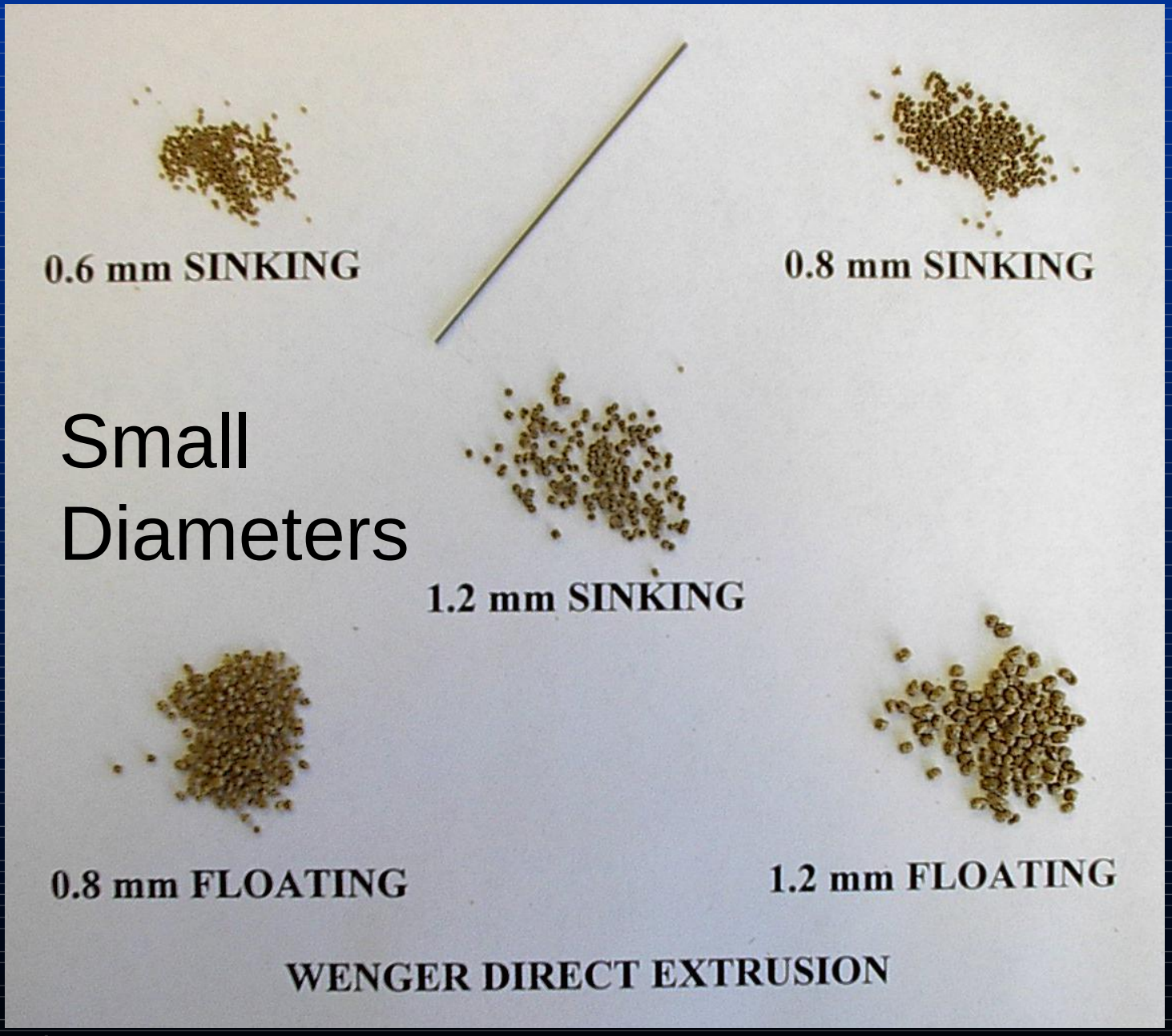
1.25



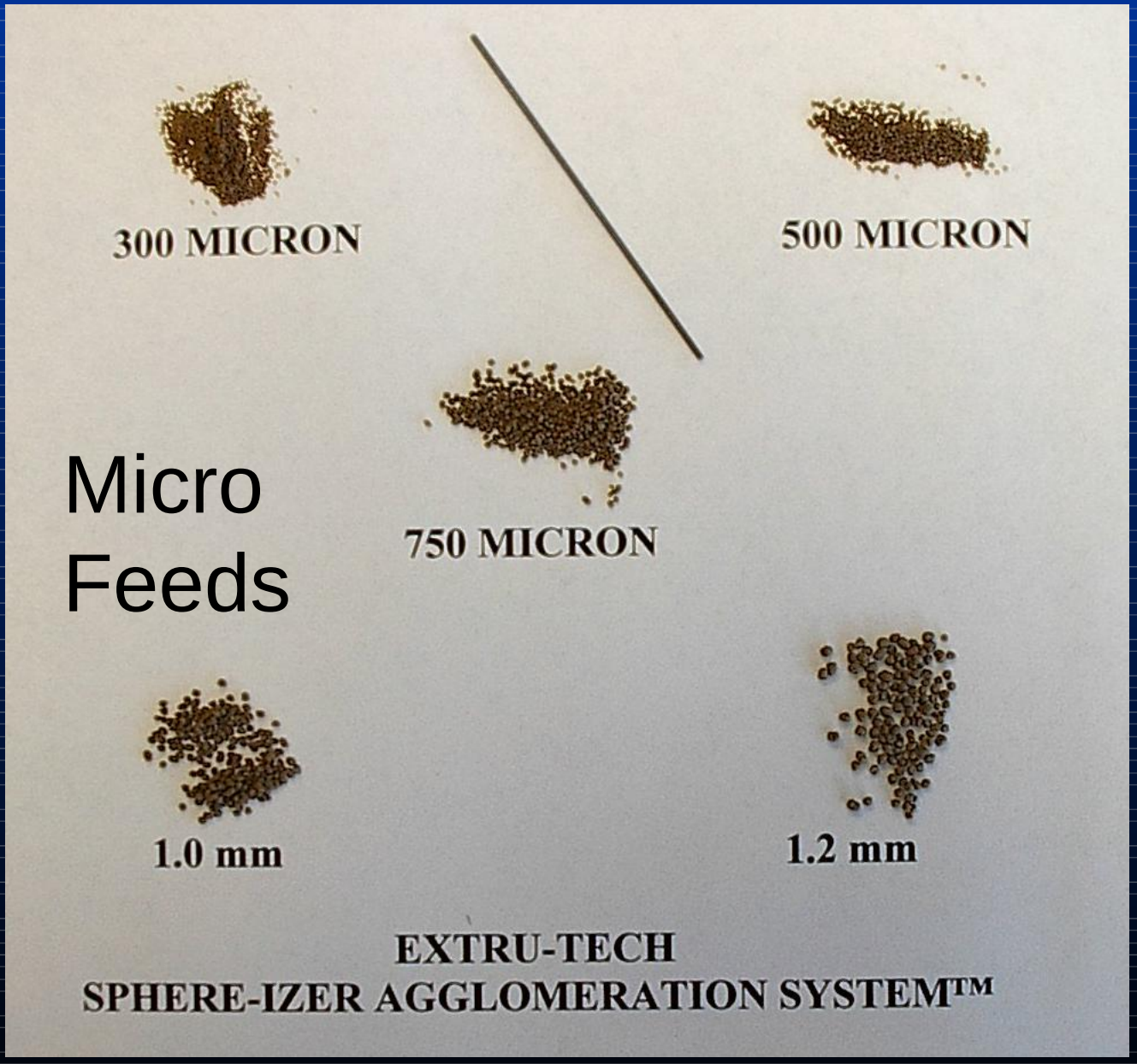
1.40



SME is expressed as a ratio to the control


0.6 mm SINKING
0.8 mm SINKING
Small
Diameters
1.2 mm SINKING
0.8 mm FLOATING
1.2 mm FLOATING
WENGER DIRECT EXTRUSION

Micro Feeds


300 MICRON
500 MICRON
750 MICRON
1.0 mm
1.2 mm
EXTRU-TECH
SPHERE-IZER AGGLOMERATION SYSTEM™

Big Fish Feeds

Semi Moist Feeds

WENGER SEA URCHIN FEED

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Abalone Semi Moist Feed

Abalone Style Feeds

Shrimp Feeds

Sea Bass Sea Bream Feeds Sinking medium fat content

SINKING AQUATIC

SHRIMP
YELLOW TAIL
SALMON
FLOUNDER
SEA BREAM
COD
SEA BASS
HALIBUT
TROUT
MOI
MAIMAI
TURBOT

FLOATING AQUATIC

TILAPIA
EEL
CATFISH
FLATFISH
MILKFISH

Diversity in Aquatic Feeds

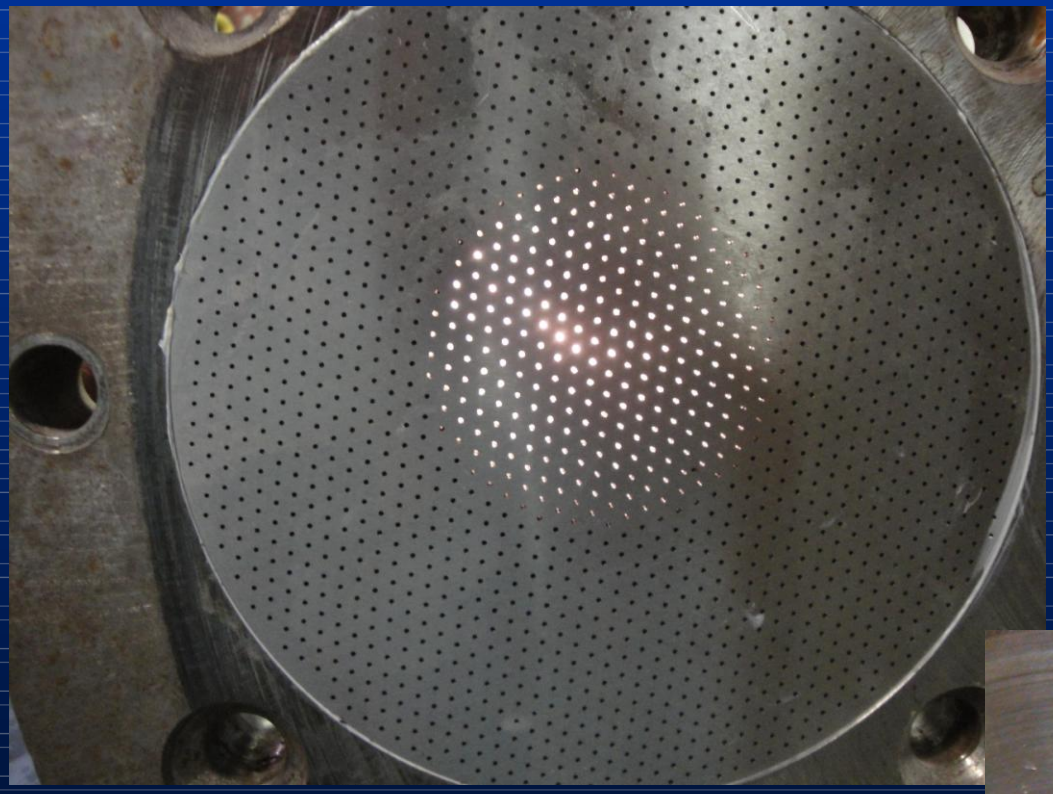
Pellet Characteristic	In sea water @ 20°C (3% salinity)	In fresh water @ 20°C
Fast sinking	> 640 g/l	> 600 g/l
Slow sinking	580-600 g/l	540-560 g/l
Neutral buoyancy	520-540 g/l	480-520 g/l
Floating	< 480 g/l	< 440 g/l

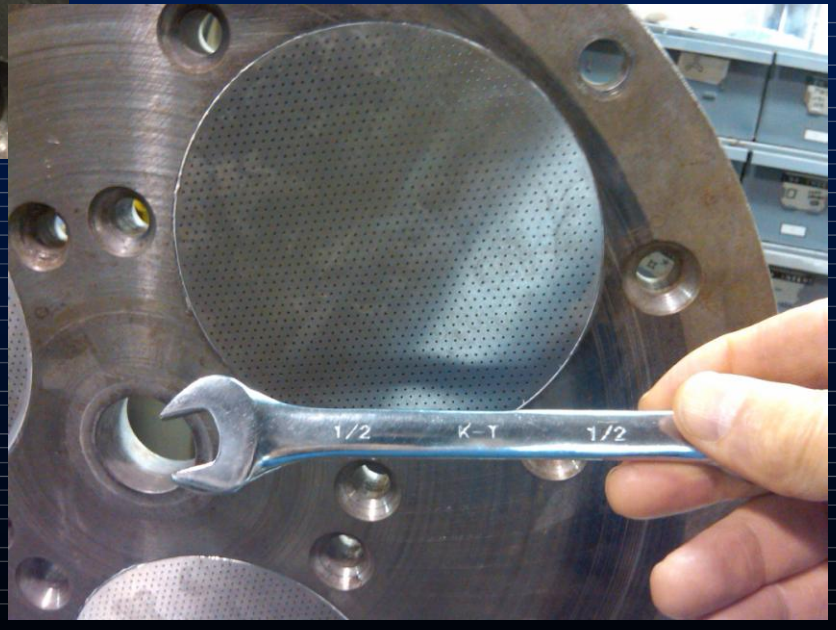
Four Main Areas To Evaluate/Organize an Aquatic Feed Extrusion Project

1) Raw Materials
2) System Configuration (Hardware)
3) Processing Conditions (Software)
4) Final Product Specifications

Former Limitations for Products Smaller than 3mm Diameter

1) Final die open area was the limiting factor in production capacity of micro-aquatic feeds and other products smaller than 3mm diameter





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Single Screw, Sinking

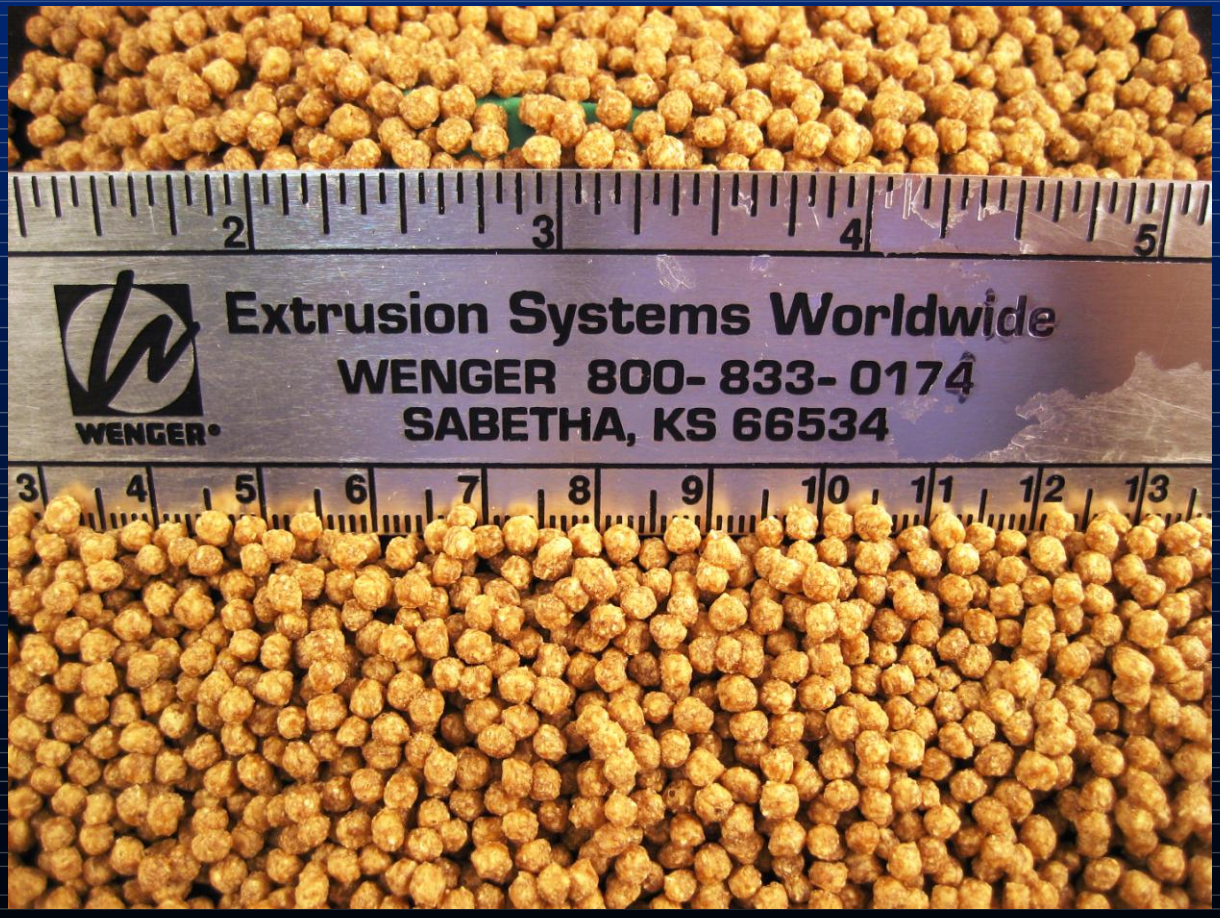

Twin Screw, Floating

Value of this Technology for Floating and Sinking Products

The major advantages of the diverging cone screw are:

- 3-5 times the rates over what we have been able to do in the past due to overcoming die limitations in open area
- Smaller diameter floating products have a higher % of floating due to the close proximity of the die to the cone screw.
- Smaller diameter for sinking is increased capacity
- VFD on main extruder drive required

Initial Floating Product: 5 times normally expected capacity



Initial Sinking product, notice product uniformity also at 5 times normally expected rates

Sanitary X-165 With HIP Conditioner

Application of High Intensity Preconditioner

Sample off preconditioner:

- 50% fresh meat slurry
- 11.5% steam
- 3.4 minutes retention time
- 35% moisture

Comparison of particle size off preconditioners with 75% fresh meat slurry

New High Intensity Preconditioner

Original DDC Preconditioner

Recent Testing

Made a product with die opening of 0.8 mm at high rates on a Single Screw Extruder

0.4mm Sinking via Extrusion

Why Fluid Bed or Rotary Dryer?

Indigenous Ingredients

As ingredients come forward we have seen additional or better preconditioning is required. SBM requires additional moisture at elevated levels. Same for other vegetable proteins.

Fishmeal Replacement Blend Via Extrusion Cooking

- Work has advanced by Stuart Romes of Agronomic Trading of Cyprus, Wenger Mfg. and Dr. Addison Lawrence of TA&M. An engineered liquid solution containing limiting Amino Acids when compared to fish meal is used in conjunction with a Wenger extruder to improve the AA profile of vegetable proteins.

Plant Proteins – Fish Protein Replacement

- Problem: Essential Amino Acids (EAA) not optimal in Plant Proteins
- Problem: Optimization of EAA using crystalline amino acids limited
- Solution: Chemically bind EAA to plant protein
- Problem: Process to bind EEA to plant protein is expensive and not cost effective

Dr. Addison Lawrence, Texas A&M University

Plant Proteins – Fish Protein Replacement

Solution: Exciting new technology utilizing proprietary chemical mixture with desire mixture of EAA and extruding with any plant protein in a feed grade ingredient

Result:

Increase digestibility of plant protein

3 to 10 fold fortification of one or more EAAs of choice

3. >99% of EAA bound

Dr. Addison Lawrence, Texas A&M University

Plant Proteins – Fish Protein Replacement

Test results:

1. Crystalline methionine bound to soybean protein in 44% soybean mea

Methionine level in 44% soybean meal increase a minimum of three-fold (times)

Greater than 99% of methionine bound

Growth rate of bound methionine equal to that of crystalline methionine with L. vannamei

Dr. Addison Lawrence, Texas A&M University

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