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Pheromone-based feeding attractants for sustainable aquaculture

Feeding and growth trials at commercial aquaculture facilities show that attractants based on synthetically produced fish pheromones induce increased feeding activity in species such as the European cod, *penaeid* shrimp and tilapia resulting in higher rate of growth and feed uptake.

Andrew Moore Ph.D., Head of Salmon and Freshwater Fisheries, Centre for Environment, Fisheries and Aquaculture Science, United Kingdom

In 2000, the Centre for the Environment, Fisheries and Aquaculture Science (CEFAS), an Executive Agency of the U.K. Government, formed a Joint Venture with *Kiotech International plc* to develop feeding attractants based on fish pheromones and novel chemical cues that would hopefully play a role in assisting the further development of sustainable aquaculture. The development of the pheromone-based feeding attractants has two principal objectives: firstly, in the short-term, to increase the feeding activity of farmed fish and therefore the uptake of existing fish-based feeds within the aquaculture industry. The principal advantages will be faster growth rates, improved feed conversion ratios and the reduction in the amount of waste from uneaten feed, which results in significant environmental damage. Secondly, in the longer term, the feeding attractants will be used to permit the use of more sustainable forms of proteins within feeds, which are not based on fish oils or proteins. This approach will further conserve and protect wild fish populations and provide a sustainable base for the large-scale expansion of the aquaculture sector.

Trials with Tilapia in Zhouhai, China.
WHAT ARE PHEROMONES?
Pheromones are the molecules used for communication between animals. They are known to be involved in the behaviour of a wide range of animals from ants and moths through to mammals.
The word pheromone comes from the Greek *pherein*, to carry or transfer and *hormôn*, to excite or stimulate. In fish, “pheromone” is defined as substances, or specific mixtures of substances, which are released by individual organisms into the environment where they evoke specific adaptive and largely-innate biological responses in exposed con-specifics.
Pheromones, odorants and chemical cues are considered to play a role in shoaling, fish aggregations, social interactions (dominance), kin recognition, prey detection migration and signalling the presence of predators.
More recent research, which is directly applicable to aquaculture, has demonstrated that a number of pheromones and chemical cues can induce increased feeding activity in a range of freshwater and marine fish species.
In the majority of fish species the pheromones are released to the environment within the urine or across the gills. In all cases the fish receiving the pheromones detect them via the sense of smell (olfaction).
Olfaction is crucial to the detection of the pheromones and so the feeding attractants must be in a soluble liquid form. In most fish species the olfactory organs are well developed and in environments where light may be limited and vision restricted by the clarity of the water the sense of smell plays the major role in communication.
The pheromones and other cues are extremely potent odorants and are detected at very low concentrations. For instance, a number of the known reproductive pheromones are detected by the sense of smell at concentrations as low as $10^{-12}$ M, and so minute amounts of these compounds are required to produce the necessary behaviour in the fish.

“...a number of pheromones and chemical cues can induce increased feeding activity in a range of freshwater and marine fish species.”

DEVELOPING ATTRACTANTS
The development of the pheromone-based feeding attractants for aquaculture involves a number of stages involving a wide range of analytical and behavioural assays and techniques. The main stages involved are:
• Isolation of the pheromone/feeding cue
• Identification of the pheromone/feeding cue
• Production of a synthetic version of the pheromone/feeding cue
• Olfactory bioassay of the pheromone/feeding cue
• Laboratory-based behavioural bioassay to confirm feeding response
• Laboratory-based feeding and growth studies on key species
• Large-scale growth trials under commercial aquaculture conditions.
Once a compound has been confirmed as a feeding attractant then a synthetic version is produced commercially for large scale testing within the aquaculture industry.
As each of the compounds is produced synthetically, the feeding attractants and commercial formulations do not contain any material directly derived from biological matter.

A full environmental assessment of the feeding attractants for aquaculture has been completed and they pass a number of U.K. Government and European Commission Directives relating to the aquatic environment. The principal components of the feeding attractants have a low biological activity and degrade rapidly within the natural environment (half-life < 12 hours). The environmental assessment indicated that the feeding attractants have no harmful effects on the aquatic environment.

**APPLICATION**

The most effective way of applying the feeding attractants within an aquaculture environment is to spray the formulations as a liquid preparation onto the surface of the water two to five minutes prior to the feeding event. This allows the detection of the feeding attractants by the olfactory system and the release of the appropriate feeding behaviour. As a result there is an increase in the general “readiness” of the fish to feed so that on the addition of the commercial pellets the food is readily consumed. This approach has a number of advantages, the most important being that the feeding attractants are not surface coated on the feeds and are therefore not consumed. This reduces the potential for bioaccumulation of the compounds and a significant reduction in tissue residues. In addition, it can be argued that because the fish does not consume the feeding attractants, then they can be considered not to be food additives and as such are not covered by existing legislation.

However, this needs to be confirmed by all the main aquaculture producing countries.

**FEEDING TRIALS**

Feeding attractants and formulations have been developed for a number of key aquaculture species and preliminary commercial feeding trials have now been completed with these products. These fish and shellfish species studies are the European cod (*Gadus morhua*), tilapia (*Oreochromis niloticus*), crucian carp (*Carassius carassius*) and the whiteleg shrimp (*Litopenaeus vannamei*), which have been tested in hatcheries and production facilities in Norway, China and Thailand. The principal findings from the commercial trials are as follows:

**European Cod (Gadus morhua)**

The trial was conducted at the Stolt Sea Farm A/S pre-ongrowing facility at Tustna in Norway over a three-month period. The feeding attractant formulation was applied as a liquid formulation to the tank five minutes prior to feeding. At the end of the three-month study there was a significant difference in the final weights of the different groups of juvenile cod. The feeding attractant group had the highest mean weight (25.8 g) compared to the two control groups (23.2 g) and (23.4 g). The feeding attractant group also had a better growth rate (SGR - 1.95 % day\(^{-1}\)) than the two controls (SGR - 1.85 % day\(^{-1}\) and 1.83 % day\(^{-1}\)). In addition this group required the application of 10% less feed than the control groups suggesting better feed utilization in these fish.

**Tilapia (Oreochromis niloticus).**

The trial was conducted between April and November 2006 at a commercial tilapia
farm in Zhouhai, China. 14,500 juvenile tilapia, (mean size 2.5 cm) were stocked into each of four growing on ponds (6.3 mu) at a density of 1711 fish/mu. Subsequently, every 14 days the mean weight of 30 fish was measured. The application of the feeding attractant produced a 17% increase in the average weight of the tilapia compared to the control pond. It also increased the growth rate of the tilapia allowing the farmer to start harvesting three weeks earlier than the control pond. In addition, it was noted that in the pond treated with the feeding attractant the fish appeared healthier, the water quality was better and the secondary crop of *Litopenaeus vannamei* was significantly higher with less incidence of disease. Overall, the farmer received a 50% higher income from the treated pond compared to the control pond.

**Crucian Carp (*Carassius carassius*)**

The trial was conducted between May and October 2006 at a commercial crucian carp farm in Dafeng, China. A total of 2000 juvenile crucian carp (mean weight 29.5g) were stocked into each of eight growing-on ponds (each pond 2mu). Subsequently, every 14 days the mean weight of 30 fish was measured. At the end of the study the feeding attractant group had the highest mean weight (153.8 ± 2.56g) compared to the control group (130.1 ± 1.75g).

**Whiteleg Shrimp (*Litopenaeus vannamei*)**

The trial was conducted in Tradt, south east Thailand over a 3 month period. Ponds, 4 rai in size, were used for the trial and each stocked with 640,00 post larvae shrimp. The feeding attractant was applied coated to a commercial shrimp feed. The mean weight of 300 shrimp from each of the ponds was subsequently measured on five occasions during the 90 days. The application of the feeding attractant produced shrimp, which were 30% larger on average than the control shrimp and had a significantly faster rate of growth. Mean weight of the treated shrimp was 9.97 ± 1.94g compared to 7.17 ± 1.45 for the control group. In addition, less feed was required in the treated pond probably due to increased feeding by the shrimp. This was reflected in a lower food conversion rate (FCR) at harvest than the control pond.

Although the results of the preliminary growth trials with the feeding attractants appears to be encouraging it should be recognised that there can be significant variations in the growth rates of fish even in similar pond systems. However, further trials are being carried out to replicate the original tests and obtain further information on the efficacy of the pheromone-based feeding attractants for sustainable aquaculture.

This article is based on a presentation by Dr. Moore at 'Aquafeed Horizons', Utrecht, the Netherlands (May 9-10, 2007), an Aquafeed.com Conference. The on-going research and development of the pheromone-based feeding attractants is carried out exclusively at the CEFAS Fisheries Laboratory at Lowestoft, England. The laboratory has an international reputation for its research into the identification and role of pheromones in fish biology. For more about CEFAS, visit their website. Dr. Moore may be contacted by email.
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INFLUENCE OF AQUAFEED PROCESSING ON EXTRUDER DESIGN

The changing needs of the feed processor often drive the development and availability of new extrusion technology

By Doug Baldwin

To make significant and innovative contributions to their customers’ processes, extruder manufacturers must be in tune with trends and demands of the industries they serve. In this article, we will discuss recent developments in extrusion processing of aquatic feeds, and how the development and availability of new extrusion technology is often driven by the feed processors. We will first review the factors contributing to the need of new extrusion technology, and will then discuss the hardware that has been introduced in order to address these requirements.

RAW MATERIAL CONSIDERATIONS

Raw ingredient formulation is one of the independent regions of control that can be exercised in the extrusion cooking process. Raw material utilization and cost-effective formulation are key operational factors. The ability to alter processing conditions and raw material formulations to keep formulation costs at a minimum, while maintaining high quality standards and minimum operating costs is a challenge for every processor.

Ingredient selection has a tremendous impact on final product texture, uniformity, extrudability, nutritional quality, economic viability, and the ability to accept high levels of liquid coatings when desired. Within certain limits set by a nutritionist, the extrusion cooking process can control a wide range of product characteristics including shape, density, rehydration, texture and, to some degree, color. Proteinaceous ingredients are often the most important constituent of aquatic feeds and comprise 20 to 75 percent or more of the formulation.

Not only are proteins important nutritionally, but they can possess functional characteristics such as water absorption, elasticity and binding. Ingredients containing protein can be divided into plant and animal sources. As the demand and prices for fish meal increase, aquatic feed processors are continually looking to replace these proteins with vegetable proteins. Plant protein sources include oil seeds such as soybean as well as wheat gluten and corn gluten meal.

These vegetable proteins contribute greatly to both the structural and nutritional considerations in aquatic feeds. Vegetable proteins generally have the following characteristics:

• high nitrogen solubility index (NSI) or high protein dispersibility index (PDI)
• excellent water absorption and binding characteristics
• low cost
• protein ingredients may also contain significant levels of fat, which are a good energy source
may contribute to ‘die swell’

The excellent functional properties of plant or vegetable proteins require that extrusion moistures increase as the level of these proteins increase in the recipe.

If raw material availability remains constant, and only a narrow range of final products are to be produced, selecting the proper extruder configuration can be relatively simple for someone skilled in the art of extrusion.

However, when faced with the challenges of raw material variation and a broad range of marketable extruded products, configuring the extruder for optimum production across the spectrum can present challenges for even the most seasoned extruder specialist.

**FINAL PRODUCT SPECIFICATIONS AND REQUIREMENTS**

Two areas of focus for this article with regard to final product requirements are textural properties and final bulk density.

Following the preconditioning phase of extrusion, the material discharges directly into the extruder assembly consisting of the barrel and screw configuration. Here the major transformation of the raw preconditioned material occurs which ultimately determines the final product characteristics.

Influencing the textural properties and cell structure of feed pellets is especially important in aquatic feeds that are to be coated with oil after drying. It is critical that these typically sinking feeds have the ability to absorb and hold oil added externally, either through atmospheric or vacuum coating. An aquatic feed’s density is a critical component as it impacts many things including plant capacity, floating and sinking properties, product appearance, and absorption of external coatings. However, the pellets floating or sinking properties are often the most critical functional characteristics as the feed buoyancy impacts both the aquatic animal’s nutrition as well as the aquaculture environment.

The buoyancy of aquatic feed is easily correlated with bulk density as shown in Table 1, above.

Controlling the density during extrusion can often be a challenge due to the many process variables which can be manipulated. A feed’s formulation plays a major role in product density, especially given the challenge of manufacturing high-quality protein, high fat rations with acceptable pellet durability and immersion stability.

Functional characteristics of ingredients such as particle size and flow-ability also play a key role. These characteristics come together in the extruder and contribute to the product’s bulk density. The actual extrusion processing parameters plays an equally important role as well.

### Table 1: Final Product Bulk Density Correlation with float-sink properties for Aquatic Feeds

<table>
<thead>
<tr>
<th>Feed characteristics</th>
<th>Sea water - 20°C (3% salinity)</th>
<th>Fresh water - 20°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast-sinking</td>
<td>&gt;640 g/l</td>
<td>&gt;600 g/l</td>
</tr>
<tr>
<td>Slow-sinking</td>
<td>580-600 g/l</td>
<td>540-560 g/l</td>
</tr>
<tr>
<td>Neutral buoyancy</td>
<td>520-540 g/l</td>
<td>480-500 g/l</td>
</tr>
<tr>
<td>Floating</td>
<td>&lt;480 g/l</td>
<td>&lt;440 g/l</td>
</tr>
</tbody>
</table>
HARDWARE DEVELOPMENTS
In order to address the above mentioned raw material and final product characteristics, one of the primary areas of extrusion flexibility available today is in the ability to vary and control the amount of specific mechanical energy (SME) that the extrudate is subjected to.

Any specific aquatic feed formulation will require a given amount of SME per unit of throughput. Some salmon feeds processed today, for example, will be optimally processed with SME values of up to 45 kWh/MT or more.

Extrusion manufacturers today offer a number of hardware add-ons to compliment the standard extruder. These devices allow manipulation of operating parameters during processing or between production runs. The added value this brings to the extrusion operation includes:

1. Achieve consistent, online target specifications without configuration changes (and without the resulting downtime) that might otherwise occur due to variations in raw materials.
2. Utilize one common extruder configuration for a wider range of final products, eliminating the need for extended downtime required to change extruder screw or other hardware configurations.

The three types of extruders most common in the feed industry are the single screw, co-rotating parallel-shaft twin screw and conical co-rotating twin screw extruders. For the aquatic industry, extrusion capacities of more than 20,000 kg/h are possible. The combination of these high capacities, together with high SME’s required in some cases, have driven extruder manufacturers to design their extrusion equipment to handle main drive power requirements of 1000 kW or more.

A brief review of the typical applications and benefits of each extruder type follows:

SINGLE SCREW EXTRUDER
The single screw cooking extruder has been the industry standard for dry-expanded pet food and other feed industries for over 40 years.

The screw and barrel configurations available today represent many years of analytical design, research, and comprehensive testing.

For both single screw and twin screw extruders, screw elements of single or multiple-flight geometries may be used. Single flight elements generally yield products of higher bulk densities compared to double-flight screws when operating with the same extrusion parameters.

The barrel segments may also be ribbed to alter the function of each specific extruder segment.

TWIN SCREW EXTRUDER
Twin screw cooking extruders have typically found limited utility in the production of feeds.

A major drawback of these extruders is their high capital investment cost and their relatively higher cost of maintenance and operation.

The capital equipment cost of a co-rotating...
twin screw extruder is 1.5 to 2 times the cost of a state-of-the-art single screw extruder with comparable hourly production capacity. Because of the increased costs, only those feed products with strong value added potential are processed via the twin screw extruder. Specific product characteristics or processing requirements where twin screw extrusion systems have found applications are as follows:

1. Ultra-high fat feeds (above 17 percent internal fat)
2. Products which have high levels of fresh meat or other high moisture slurries (above 35 percent).
3. Uniform shape/size product (portioned foods)
4. Ultra-small products (0.6 to 2.0 mm diameter products)
5. Co-extruded products (complex pet food treats)

In those cases where twin screw extrusion for aquatic feeds is justified however, the previously mentioned processing requirements have led extruder manufacturers to design twin screw extruders (Figure 1) and ancillary components capable of covering an extreme range of processing applications. One example of this new breed of parallel-shaft, twin screw extruders is the Magnum ST series, developed by Wenger Manufacturing, Inc.

With maximum speeds up to 1,200 rpm and power levels up to 165 kWh/t SME at volumetric capacity (Table 1), the Magnum ST Series provides optimum extrusion versatility. These economical, high capacity extruders allow processors to utilize a smaller extruder model without sacrificing capacity. Alternatively, the higher SME capabilities can be utilized to meet unique product requirements.

**C²TX EXTRUDER**

Table 1: Technical Data for Wenger Magnum ST Twin Screw Extruders

<table>
<thead>
<tr>
<th>Screw Diameter (mm)</th>
<th>Maximum Volumetric Capacity (kg/h)</th>
<th>Installed Power at Maximum Speed (kW)</th>
<th>Maximum Screw Speed (rpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>57</td>
<td>1,700</td>
<td>185</td>
<td>1,200</td>
</tr>
<tr>
<td>85</td>
<td>4,800</td>
<td>450</td>
<td>1,200</td>
</tr>
<tr>
<td>115</td>
<td>12,000</td>
<td>1125</td>
<td>1,200</td>
</tr>
<tr>
<td>144</td>
<td>22,700</td>
<td>2250</td>
<td>1,200</td>
</tr>
</tbody>
</table>

The C²TX (conical co-rotating twin screw extruder) is the most recent extrusion system introduced to the feed industry (Figure 2). The C²TX’s conical design allows for positive compression in the barrel and reduces possibility of back feeding. Positive compression
yields an efficient manner of imparting mechanical energy into the extrudate. The conical design of the C²TX causes the material to be kneaded and sheared along the screw profile. In traditional twin screw extruders, the melt is kneaded and sheared by shear locks, mixing lobes, or cut-flight screw elements. This “profile kneading” eliminates the need for special screws and locks to provide the appropriate cooking. Extruder shafts and screws can be machined from a single piece of steel, resulting in lower manufacturing costs. Maintenance and down time are also reduced, because a screw profile change is not needed for each different product.

TOOLS FOR EXTRUSION FLEXIBILITY

No matter which of these extruder designs is used, the availability of a wide range of extrusion add-ons and tools available today can assist in maximizing extruder flexibility and efficiency. Obviously, some standard options for extruder flexibility have always been available, such as variable speed main drive motors. More recently though, features and tools have been specifically designed to improve extrusion process optimization. A list of the items covered in this article includes the following:

- Retention Time Control
- Mid-Barrier Valve
- Vented Extruder Barrel (with and without vacuum assist)
- Back Pressure Valve
- Post Extrusion Pressure Chamber
- Die and Knife Design

RETENTION TIME CONTROL

The Retention Time Control system (RTC) provides continuous, online control of material retention time within the preconditioning process, resulting in the following benefits:

- Simplified startup sequence and reduced off-spec product during startup.
- Constant discharge rate of feed during shutdown or product changeover.
- Time and temperature documentation for process verification records for the production of clean feeds.

During startup, the raw material is metered into the conditioning cylinder and is mixed with steam and/or water to begin the hydration and cooking process. The discharge feeder remains off until the mash within the conditioning cylinder has been held for the desired retention time. Then the discharge feeder begins delivering the conditioned mash to the extruder, dramatically reducing the material wasted during startup procedures for standard conditioning cylinders.

An operator no longer must discard the mash while waiting for the conditioning cylinder to reach the operating temperature and moisture content. During shutdowns or product changeovers, the discharge feeding device continues to deliver the conditioned mash at the specified rate. Thus, the extruder continues op-
erating at its optimum capacity until the conditioning cylinder is virtually empty. In traditional systems, the extrusion rate slowly decreases once the raw mash is no longer metered into conditioning cylinder. This in turn reduces the amount of waste material and also reduces the amount of off-spec or contaminated product. Finally, this system allows process documentation of the process time and temperature. This is especially useful for those concerned with pathogen destruction and food safety concerns. Since the retention time is one of the user inputs for the control system, the operator can document with certainty that the mash was held at a given temperature for a specified period of time.

**MID-BARREL VALVE**
A "mid-barrel valve" (MBV) can be installed within the extruder barrel to serve as an adjustable restriction device for controlling shear stress and SME during operation of the system. The MBV can be adjusted from a setting that adds little or no restriction to a setting that can almost completely restricts the passage of the extrudate, and has demonstrated SME increases of 100 percent or more. Insertion of this on-line device greatly enhances the flexibility of the extrusion system without the costly downtime associated with configuration changes. A mid-barrel valve can also be connected to the extruder control system to automatically adjust and maintain the SME value to its desired set-point.

**VENTED EXTRUDER BARREL**
The extruder barrel is normally closed to the atmosphere and the extrudate is subjected to an environment of increasing pressures until it exits the die orifice. High process pressures (0 – 40 bar) result in significant expansion ratios and product densities low enough to produce feeds such as floating aquafeeds. Expansion can be further enhanced by injection of steam into the extruder barrel which increases thermal energy inputs. Where higher product densities are required for certain feeds, the extruder barrel can be configured to include a vent which releases process pressure and reduces product temperature through evaporative cooling. A vacuum assist can be added to the vented barrel (Figure 3) to increase the product density even further by more evaporative cooling and de-aeration of the extrudate. Vacuum assist (up to 0.7 bar) will improve pellet durability, increase piece density, and reduce extrudate moisture. Product fines from the vent and water from vacuum pump will require disposal, or alternatively, these waste streams can be recycled back into the system via a Waste Recycling System, as illustrated in Figure 3.
Final product characteristics such as density can be controlled by extruder die restriction. One device commonly used by feed manufacturers is termed a “back pressure valve” (BPV) which is used to adjust die restriction while the extrusion system is in operation.

By changing the restriction at the discharge of the extruder during operation, the product density can be varied by up to 25 percent without changing the screw configuration or the final die.

The variable-opening BPV is mounted on the end of the extruder prior to the final die assembly (Figure 4).

Specific mechanical energy (SME) and extrusion pressure are process parameters controlled by valve positioning. The BPV provides internal control of shear stress and SME for regulation of important product properties:

- bulk density (Table 2)
- size and uniformity of cell structure
- starch gelatinization
- shape definition
- water and fat absorption (Table 2)

The extrusion process for feeds is reported to be more stable with a BPV, and preconditioning / extrusion process temperature requirements are lower resulting in improved nutrient retention.

The BPV eliminates the need for altering extruder configurations between different

<table>
<thead>
<tr>
<th>BPV (% Closed)</th>
<th>Extruder speed index</th>
<th>Uncoated product density (g/l)</th>
<th>Final product oil after vacuum infusion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>1.0</td>
<td>654</td>
<td>16.2</td>
</tr>
<tr>
<td>55</td>
<td>1.0</td>
<td>628</td>
<td>19.5</td>
</tr>
<tr>
<td>65</td>
<td>1.0</td>
<td>530</td>
<td>23.8</td>
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<td>65</td>
<td>1.3</td>
<td>504</td>
<td>28.4</td>
</tr>
<tr>
<td>70</td>
<td>1.2</td>
<td>420</td>
<td>37.8</td>
</tr>
<tr>
<td>70</td>
<td>1.3</td>
<td>392</td>
<td>40.5</td>
</tr>
</tbody>
</table>

Figure 4: Back Pressure Valve
product families. An integral part of the BPV is a by-pass feature to divert product from the die/knife assembly and product conveyor for service and startup/shutdown procedures which improves sanitation in this area.

**POST EXTRUSION PRESSURE CHAMBER**
Another device available in the industry is an enclosed chamber which surrounds the die/knife assembly and permits control of pressure external to the extruder and die (often referred to as an EDMS or External Density Management System). Desired pressures are maintained in the knife enclosure by a special airlock through which the pressure in the chamber. As pressure increases, the water vapor point increases which reduces product “flash-off expansion” and thus increases density (Table 3). Expanded or partially expanded products which normally exit the extruder die at a bulk density that is lower than desired, can be “densified” with this post-extrusion pressure chamber (EDMS) around the die/knife assembly. One particular challenge in the aquatic feed industry is to produce a fully-cooked feed of sufficient bulk density to sink rapidly and still absorb the required oil during the coating step. Table 4 reflects EDMS pressure adjustment independent of extrusion processing parameters to control product density in a suitable

<table>
<thead>
<tr>
<th>Over-pressure in chamber (bar)</th>
<th>Boiling point of water (°C)</th>
<th>Expected increase in product density (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>0.5</td>
<td>112</td>
<td>10.0</td>
</tr>
<tr>
<td>1.0</td>
<td>121</td>
<td>18.3</td>
</tr>
<tr>
<td>1.5</td>
<td>128</td>
<td>25.0</td>
</tr>
<tr>
<td>2.0</td>
<td>134</td>
<td>28.3</td>
</tr>
</tbody>
</table>

Table 4: Effect of EDMS Over-pressure on Product Density and Oil Absorption

<table>
<thead>
<tr>
<th>EDMS over-pressure (bar)</th>
<th>Uncoated density (g/l)</th>
<th>Density after vacuum coating (g/l)</th>
<th>Maximum oil absorption (%)</th>
<th>Final product oil (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>526</td>
<td>689</td>
<td>21.5</td>
<td>23.4</td>
</tr>
<tr>
<td>0.5</td>
<td>547</td>
<td>705</td>
<td>22.7</td>
<td>24.2</td>
</tr>
<tr>
<td>1</td>
<td>571</td>
<td>737</td>
<td>20.7</td>
<td>22</td>
</tr>
<tr>
<td>1.3</td>
<td>613</td>
<td>726</td>
<td>16.9</td>
<td>20.4</td>
</tr>
<tr>
<td>1.7</td>
<td>640</td>
<td>756</td>
<td>9.8</td>
<td>17.1</td>
</tr>
</tbody>
</table>
product discharges. Compressed air or steam can be used to generate the required range for 17-24 percent total oil in the final product. No other extruder operating parameters were changed except the chamber pressure to achieve this flexibility in product characteristics.

The pressure chamber can be coupled with a BPV to provide additional process controls:
- adjust SME on-line for control of critical product properties
- divert off-spec product during startup from the pressure chamber
- accurate control of product density external to the extruder and die no extruder configuration changes required to make expanded or dense feeds
- increase extruder capacity over vented configurations by 25 to 50 percent

Die design and its effect on expansion, uniformity, and appearance of the final product are often overlooked. The amount of expansion desired in the final product can be controlled by formula manipulation and open area in the die. Unexpanded, but fully-cooked, feeds generally require 550 to 600 square millimeters of open area per metric ton of throughput. Highly expanded feeds require 200 to 250 square millimeters of open area per metric ton throughput.

Other design advancements in die configurations have resulted in “Rapid Change Multiple Dies”, where dies can be changed without stopping the extrusion system. This design reduces setup time by up to 50 percent resulting in smaller lot sizes, easier scheduling, reduced inventory, increased plant efficiency, and increased profitability.

Process flexibility through extruder operating parameters is essential in today’s feed industry to be able to meet the market requirements and to adjust the process to compensate for ingredient and other processing variability.

The manufacturer of the extrusion equipment should be able to assist in providing configurations tailored for the products to be processed. With the right tools available, optimizing your extrusion processing system will allow for the profitable production of aquatic and other animal feeds.

For more information, contact the author: Doug Baldwin, Director Sales & Marketing, Wenger Manufacturing, Inc.
E-mail: dbaldwin@wenger.com
Working together, California Pellet Mill, Roskamp Champion and Beta Raven open a world of opportunity for your operation.

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CPM has you Covered
HAMMER TIP: GO HIGH SPEED TO CONTROL PARTICLE SIZE

While screen size has a major influence on particle size, hammer tip speed is also an important factor

By Scott Anderson

In most cases, feed manufacturers primarily rate a hammermill’s performance on its capacity to grind a certain amount of material in a given time. However, this practice ignores particle size, an important consideration in handling characteristics, pellet durability and animal performance. Traditionally, feed manufacturers who use hammermills to grind grains and other materials control particle size by changing the size of the hammermill screen holes. While screen size has a major influence on particle size, hammer tip speed is also an important factor. Generally, if all other factors are the same, hammermills with higher hammer tip speeds produce a finer grind than those with lower tip speeds.

INSIDE THE HAMMERMILL
To understand how tip speed affects particle size, it is important to know how a hammermill operates. A hammermill grinds by two distinct forces. The first force is impact. As the grain drops into the grinding chamber, it is struck by fast moving hammers and accelerated toward the screen where a second impact occurs. The particles that don’t discharge through the screen immediately form a fluidized bed against the inside of the screen where they are ground by attrition, the second grinding force. With attrition, particles are
ground as they are forced against the screen and against each other. Of the two grinding forces, impact is more efficient. Hammermill manufacturers, therefore, have gone to great lengths to increase the amount of impact that occurs in the hammermill, resulting in steady improvements in grinding efficiency.

One way to increase the amount of impact between hammer and particle is to increase the tip speed of the hammers. According to basic principles of physics, if motor speed is fixed, increasing the diameter of the rotor will increase the speed of the hammer tip. For example, a hammermill with a 44-inch diameter rotor has a tip speed of 20,724 feet (6,317 meters) per minute when operated at 1,800 revolutions per minute (rpm); while a hammermill with a 54-inch diameter rotor has a tip speed of 25,434 feet (7,752 meters) per minute when operated at the same motor speed of 1,800 rpm.

Higher tip speed cannot be achieved by simply increasing the speed of an ordinary hammermill. Special design and material modifications are required to produce a machine that operates safely at rotation speeds of more than 25,000 feet per minute. The rotor shaft and plates are manufactured from materials that withstand tremendous forces. The assembly is balanced to prevent excessive vibration. Engineers and designers must also give consideration to the bearing mounts, hammermill base and frame to maintain proper alignment and support for the heavy rotor assembly.

A hammermill with a higher tip speed will produce a finer grind than one with a slower tip speed, provided the two grinders have the same size screen (Figure 1). If a high-speed hammermill is equipped with a larger hole screen, ground material particle size will be the same for both machines.

Figure 1. Influence of screen size and rotor diameter on particle size
SPEED, EFFICIENCY AND PARTICLE SIZE
Large rotor, high-speed hammermills produce a smaller size particle and are more efficient to operate than slower hammermills equipped with the same size screen. However, the primary advantage of the large rotor, high-speed hammermill is greater grinding efficiency. This is due to its ability to produce the same mean particle diameter as hammermills with slower tip speed while using larger screens. While a number of factors affect the efficiency of a hammermill, all else being equal, the efficiency is directly proportional to the size of the screen opening.

Tests were conducted at a feed mill that had a 44-inch diameter rotor hammermill and a 54-inch diameter rotor hammermill. Both hammermills were operated at 1,800 rpm and therefore, the 54-inch hammermill had a higher hammer tip speed. Samples of postmix ground feed were collected from each grinder for particle size analysis. The 44-inch diameter hammermill had a 6/64-inch (2.4 mm) screen and produced particles with a mean diameter of 378 microns. The high-speed 54-inch hammermill, with an 8/64-inch (3.2 mm) screen yielded particles with a mean diameter of 373 microns. Even though the 54-inch hammermill had a screen with holes that were 33 percent larger than screen holes in the 44-inch hammermill, both machines produced particles of essentially the same size.

Because the large rotor, high-speed hammermills use larger screens to grind material to the same size as slower speed hammermills, they can be operated with lower horsepower motors. This can be a significant economic advantage to feed mill operators.

For example, a hammermill grinds 50 tons of corn per hour through a 1/8-inch screen and requires a 350 horsepower motor that uses 263 kW of electricity. A large rotor, high-speed hammermill grinds the same amount of corn through a larger (10/64-inch) screen. It takes a 300 horsepower motor that uses 225 kW of electricity to operate. By reducing motor size by 50 horsepower, electricity consumption is lowered 38 kW. If a feed mill operated the large rotor, high speed hammer for 5,000 hours and had an electric use charge of $.06 per kWh, the cost savings would be approximately $11,400 per year in favor of the high speed grinder.
In addition to higher grinding efficiency and finer particle size, large rotor, high-speed hammermills also have lower maintenance costs. Because of the greater tip speed, a single impact of the hammer on the grain reduces the grain to a particle size that is smaller than it would be if it were struck with a hammer moving at a substantially slower speed. More grinding is done through impact and less is done through attrition. This causes less abrasion on the hammers and screens, resulting in longer part life.
Large rotor, high-speed hammermills have more hammers than smaller hammermills. However, according to field observations, hammer life in a 54-inch high-speed hammermill is approximately one-third longer than in a smaller, slower hammermill. Therefore, even with more hammers, high-speed hammermills yield more tons of round material per hammer.
Screen life is also longer in high-speed hammermills. In the high-speed hammermill, the screen is doing less work because most of the grinding is done at the point of impact between the material and the hammers. Increasing screen life can mean substantial cost savings. For example, if the life of a set of screens in a typical hammer is 15,000 tons of ground material and the cost of the screens is $177 per set, the operating costs for screens is $.012 per ton. If screen life is increased four-fold in a large rotor, high-speed hammermill, ground material output would be 60,000 tons per screen set. Despite the higher screen cost of $326 per set, the operating cost for screens in the large rotor, high-speed hammermill is $.005 per ton.
Additionally, screens with larger holes often used in high-speed hammermills are usually made from thicker metal. Thicker metal is stronger and more durable than thinner metal. Screens fabricated from heavier stock last longer with lower risk of premature failure. This durability reduces screen replacement costs, labor costs and unexpected down time. Quality is improved because of a significant reduction of whole or very coarse grains in the ground material.

Scott Anderson is sales manager at CPM Roskamp Champion, Waterloo, Iowa, USA. He may be contacted at: sales@cpmroskamp.com.
Leading aquafeed magazine now available electronically

Aqua Feeds: Formulation & Beyond, the aquafeed industry’s premiere magazine, is now available in electronic Format.

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IN THIS ISSUE:

The Story of Stay C
Victor Suresh
A fascinating story of scientific research and commercial application development that holds many lessons for anyone involved in commercial R&D unfolds as Dr. Victor Suresh, Editor of AFFB interviews aquafeed consultant, Tim O’Keefe, on the development of Stay C, the stable form of vitamin C, now manufactured and sold by DSM.

Measuring protein quality in vitro
Daniel Lemos, Marine Aquaculture Laboratory (LAM) Oceanographic Institute, University of São Paulo, Brazil
Using hepatopancreas extracts from shrimp, protein digestibility of feeds and ingredients can be reliably measured bench top.

Application of Enzymes in Aqua Feeds
Koushik Ghosh, Aquaculture Laboratory, Department of Zoology, The University of Burdwan, West Bengal, India and Pratap Kumar Mukhopadhyay, Waste Water Aquaculture Divisions of CIFA, Rahara, West Bengal, India
A summary of findings from studies on enzyme application in aquatic animal feeds and provide other useful information for those who want to consider using enzymes in feeds.

Acidifiers in Aqua Feeds: A Solution for Antibiotic-Free Feeding of Fish and Shrimp
Christian Lückstädt, BIOMIN Deutschland GmbH
Routine use of antibiotics as growth promoters is a matter of debate in the animal farming industry. The EU has banned all antibiotic growth promoters (AGP) from livestock production with effect of January 2006. Alternatives to AGP are sought in a variety of forms. Acidifiers consisting of organic acids and their salts present a promising alternative.
Brill Formulation, from Feed Management Systems, is the leading livestock feed nutrition software tool for the worldwide commercial feed industry. Combining advanced technology, industry expertise and system integration, it is the central repository for all data related to nutrients, ingredients, cost and feed formulas and shares that data across all of your systems. With the most comprehensive set of features, Brill Formulation meets the needs of businesses with one mill or one hundred mills develop the least-cost recipe for a specific formula, based on required ingredients and nutrients.

Brill Formulation Multi-Blend is the production and purchasing decision support tool you need to make the best economic use of limited ingredients. Multi-Blend has helped companies across the globe simplify the acquisition and allocation of ingredients across plants, reduce time in modeling changing scenarios, quickly reformulate in aggregate and make purchasing and selling decisions. Brill Formulation solutions are available from Feed Management Systems or their distributors.

BRILL FORMULATION VERSION 2.0 READY FOR RELEASE
Feed Management Systems has announced it will release Brill Formulation Version 2.0 in Q3 2007. With this exciting release, customers will be able to leverage enhanced access to key information and the ability to make modifications based on different scenarios. Here are just a few of the new features:

- **SmartLists** is an inquiry tool allowing users to utilize pre-defined or custom search criteria, to export formulation data directly to Microsoft Excel. You can now analyze, report and share data in many more formats for faster decision making.
  - Rapid analysis of changes for purchasing decisions
  - Ability to run parametrics on ingredient nutrients
  - Optimization enhancements
  - Easy to navigate documentation
  - More than 50 additional enhancements

"With this exciting release, customers will be able to leverage enhanced access to key information and the ability to make modifications based on different scenarios."
KEY FEATURES OF BRILL FORMULATION VERSION 2.0

Brill Formulation – Core formulation / Batch / Buffer / Professional Nutritionist

- Easy access to information – Included in Brill Formulation version 2.0 is a new inquiry tool called SmartLists that you can use to access your formulation data.
- SmartList allows you to zoom to Brill Formulation windows and export information to Microsoft Excel, making it easier to use and share the data stored in Brill Formulation in many different ways.
- SmartList uses sets of predefined search criteria, called objects, to make searching easy as well as allowing you to instantly create sophisticated searches.
- Some of the criteria within each SmartList object have been used to create a default search, or view, for each object. By modifying the view you can create a variety of customized views.

The following are some of the objects that will be available in Version 2.0 include:
- Ingredients
- Stored Formulas
- Stored Formulas Ingredients
- Archived Formulas
- Archived Formula Ingredients
- Solution Ingredients
- Solution Nutrients
- Run 'zero' ton formulas and make available to the solution report. Customers benefit from this capability to optimize formulas that are seasonal and not being produced at the time the multi blend is run, but will be produced in a month or two (also impacts Multi-Blend).
- The ability to run parametrics on an ingredients nutrient value (also impacts Multi-Blend).

Brill Formulation Multi-Blend
- The ability to quickly update nutrient restriction across multiple formulas in one grid.
• The ability to temporarily change and save nutrient on ingredient.
• Range information now represents the price change for an ingredient in one specific formula not for all formulas.
• Ability to temporarily change and save nutrient on ingredient in Multi-Blend. This would make it much easier for a user to test an opportunity ingredient that might have different nutrient analytical values.
It could also help compare solution results for one ingredient from multiple suppliers where nutrient values are different. This is available in Professional Nutritionist and makes for a significant ROI case for v2.0.
• Ability to add/remove ingredients/nutrients.
• Ability to save prices.
• Ability to save a stored formula to another plant.

Feed Management Systems, Inc. (FMS) is an award-winning software company providing integrated solutions for the global feed manufacturing industry to manage their nutrition, formulation and production needs.
Also offered are real-time, integrated, scalable solutions leveraging the Microsoft technology you are familiar with today.
For over two decades, FMS has helped ensure the safety, quality and affordability of the global feed supply by providing solutions to automate and optimize formulation, pricing, ordering, labeling, delivery, risk management and regulatory compliance.
FMS has a unique position in the livestock feed industry as the single source of integrated solutions that keep thousands of ingredient manufacturers, feed mills and producers around the world working at peak efficiency.
The FMS award-winning solutions link the critical information between feed manufacturers and their suppliers and customers; and have proven to be the lowest-risk solution provider allowing customers to achieve higher margins.

Cargill, Feed Management Systems Announce Alliance

Cargill and Feed Management Systems (FMS) have formed an alliance to market and recommend the technologies of both businesses. With this agreement, FMS and the Consulting Services group, part of Cargill Animal Nutrition will actively collaborate to fulfill the needs of clients and customers for the technology available from both companies.
Through its Consulting Services group, Cargill Animal Nutrition provides a broad array of feed management and animal production expertise and services, while Feed Management Systems is a leader in delivering software solutions to the feed industry.
“This agreement allows us to develop broader and deeper solutions for our clients by providing an even larger portfolio of technology and expertise,” says Mark Knief, Consulting Services general manager.
“It also reflects the respect we have for FMS as a leader in the software solutions area.”
Cargill provides consulting in the areas of feed mill management through its Model Mill program, risk management services, procurement and quality control, animal production, ingredient knowledge and feed formulation.
For more information on this and other Consulting Services offerings from Cargill Animal Nutrition, email consultingservicesinfo@cargill.com.
Learn More Today

Feed Management Systems is the developer of the following integrated solutions: Feed Mill Manager, Feed eOrder, Brill Formulation, Feed Tags and Feed Ration Balancer. Whether you are an existing customer that would like to receive free details on the Brill Formulation 2.0 release, or if you are a feed manufacturer and would like to learn how FMS and its distribution partners can help you achieve higher margins with the lowest risk, register at: www.feedsys.com – Building A Community or email: info@feedsys.com.
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Buhler – your partner for processes and plants in the Aquafeed industry.
At the June 2007 meeting of the EU’s Standing Committee on the Food Chain and Animal Health (SCFCAH), a vote was taken to approve Aquasta natural astaxanthin for use in salmon and trout feed for flesh pigmentation. This follows on from the earlier positive evaluation by the FEEDAP panel and the European Food Safety Authority (EFSA) of the safety and efficacy of Aquasta. Following translation and publication in the European Journal, the EU aquaculture industry will have the opportunity of using a cost effective natural pigment for salmon and trout.

“This is an important milestone in our effort to create a global business. Aquasta has been on the market for several years already in Chile, Canada and the US and consumer trends towards more natural foods have been positive for us. We believe there are customers in Europe who have been eagerly awaiting this decision by the SCFCAH” said Peter Castelli, President of Astaxanthin Partners Ltd., the producers of Aquasta. Aquasta astaxanthin is natural because it is made by Phaffia rhodozyma yeast, a living organism that is found in nature. The yeast is grown in large tanks using traditional fermentation techniques, similar to those that might be used for other food products eg. beer.

The process uses renewable ingredients such as cane sugar, corn and wheat, making Aquasta a sustainable product. Astaxanthin is an important nutrient for salmonids, as well as imparting the characteristic orange-pink colour to the flesh of the fish.

In the wild, salmon obtain a natural source of astaxanthin from their diet of crustaceans which in turn feed upon carotenoid producing algae and plants. A renewable source of natural astaxanthin such as Aquasta can contribute to reducing the pressure on scarce ocean resources and help support future growth of the salmon farming industry. Aquasta is in the same isomeric form as the astaxanthin found in Antarctic krill and as a free non-esterified form it is absorbed very efficiently. This is enhanced by the high bioavailability of Aquasta which is typically around 90% due to the unique natural enzyme process employed to crack the yeast cell wall.

Extensive testing at leading aquaculture research facilities and through commercial use has consistently proven its performance relative to the alternative pigments. Unlike the synthetic options, Phaffia based astaxanthin is also an acceptable way of pigmenting salmon for a number of leading organic certification bodies operating in the aquaculture sector.

“We are excited at the prospect of launching Aquasta to European producers and think we can help farmers to differentiate their salmon and trout offerings and better meet the needs of distribution partners and consumers” said Robert Hodson, Vice President Sales & Marketing for Astaxanthin Partners. Aquasta is marketed by Astaxanthin Partners Ltd., a 50:50 joint venture formed in 2003 between Tate & Lyle PLC and Igene Biotechnology, Inc. Astaxanthin Partners will be exhibiting at Aqua Nor, the international aquaculture show in Trondheim, Norway from 14th-17th August at stand B-101.

Or for more information contact: Robert Hodson.
4B EXPLOSION VENTING PANELS

4B Braime has launched a new range of Explosion Venting Panels. The Explosion Venting Panels which all carry EC-type certification, have been designed as relief devices to rupture at predetermined pressure to allow the flames and overpressure to vent into a safe area in the case of an explosion.

Features include:
- Bursting pressure: 50mbar to 500mbar
- Maximum working pressure: 40% of bursting pressure
- Maximum working temperature: -15°C to +60°C

Available in a range of sizes

The explosion venting panels are the latest addition to 4B Braime’s ever increasing range of ATEX components.

BOLT ’N GO - DROP FORGED CONVEYOR CHAIN

Also just launched by 4B Braime is the new revolutionary Bolt ‘N’ Go drop forged chain system.

The new Bolt ‘N’ Go system is a very flexible system of high strength hollow pins, heavy duty washers and nylock nuts, which enable bolts to pass through to connect the links together and attach flights. There are no circlips to become loose and there is no intricate assembly. There is no welding required on the flights, no need to remove chain from the conveyor for installation, and no issues with strength. Just bolt the links and the flights together. It’s easy, simple and reliable.

The Bolt ‘N’ Go system’s advantages include:
- No more welding of flights
- No need to remove chain from conveyor
- Reliable secured link, pin and flight
- Reduced maintenance cost and down time

Steel or plastic flights

Information on these products can be viewed on the company’s website. Brochures are available on request.

First you add knowledge...

EC EXTENDS APPROVAL OF NEW-GENERATION FEED ENZYME

The European Commission has granted Danisco Animal Nutrition an extension to the approval given to its phytase feed enzyme, Phyzyme XP under EU Regulation 1831/2003.

Liquid and granulate Phyzyme XP is now approved for use in broiler, layer, turkey, duck, sow, piglet and grower/finisher feeds.

Andrea Barletta, Danisco Animal Nutrition’s Marketing Director welcomed the news, and commented: “The EU’s decision is good news for pig and poultry producers. This is the first phytase approved for use across all the main poultry species – including ducks.

Trials have shown that this new generation...
Phytase offers superior value compared to traditional phytases, as it is at least 20% more effective in improving the digestibility of phosphorus and other nutrients contained in cereal grains, oil seed meals and their by-products.

“Phyzyme XP also reduces phosphorus excretion by more than 30%. This environmental benefit is particularly important during a time when concerns about pollution control are increasingly high on the agenda.”

The launch of Phyzyme XP in the EU is complemented by a new service from Danisco Animal Nutrition. As a phytase optimisation tool, Phycheck™ brings opportunities to fully exploit the potential feed cost savings from using Phyzyme XP, without compromising animal performance.

The service employs a unique software model, built on extensive trials, which calculates specific matrix values for phosphorus, calcium, amino acids and energy by taking into account, for the first time, phytase dose rates, dietary phytate level and animal age.

Danisco Animal Nutrition, a division of the leading global food ingredient specialist Danisco A/S (Denmark), pioneered the development and use of enzymes and betaine in animal nutrition. Its products are now widely used by poultry and pig producers throughout the world.

PARADIGMOX GREEN APPROVED FOR ORGANIC AQUAFEE

Paradigmox Green from Kemin, is the first ethoxyquin free antioxidant that can be used as an antioxidant in fish feeds certified for use in organic aquaculture after July 1st 2007 as decided by the Certification Committee for the Soil Association. This certification committee has also allowed the use of Paradigmox Green in fish meal or fish oil as components for pig/poultry feeds certified for use in organic agriculture according to EU regulation 2092/91 (terrestrial livestock agriculture). Paradigmox Green is available in liquid and dry form and it is part of Kemin’s portfolio of ethoxyquin free antioxidant nutricines.

PERSTORP CALCIUM FORMATE PROSID CF30 PRODUCTION BACK TO FULL CAPACITY

Perstorp’s production of calcium formate Prosid CF30 is now back to full capacity following a dust explosion in the group’s production plant in Bruchhausen, Germany, at the beginning of September 2006. Thanks to the efforts of the Perstorp employees, the plant is now running on full speed.

READY-MIX SHRIMP IMS EMULSION IN BETA TESTING

Aqua Bounty Technologies, Inc. a biotechnology company focused on enhancing productivity in the aquaculture market, is developing a new, emulsion-based delivery system for its non-specific immune stimulant, Shrimp IMS. The new formulation is designed to allow direct incorporation of IMS into hatchery feed by end users. Shrimp IMS Emulsion delivers the immune system benefits of IMS in a suspension with salmon and krill oil, attractants, and stabilizers.

Beta testing is currently underway in hatcheries in Panama, Mexico, and Indonesia.

Initial reports have been favorable. Shrimp IMS Emulsion addresses several technical barriers that slowed widespread adoption of the first generation product in the shrimp market:
Formulation of a quality controlled “ready-to-add” IMS eliminates potential sources of error in the preparation of IMS to be added to feed. Currently, clients have to go through several measuring and mixing steps that can diminish product efficacy if done incorrectly. Hatchery operators typically feed a variety of different larval feed brands, to which they can easily mix the Shrimp IMS Emulsion, eliminating the company’s need to fully penetrate the fragmented larval feed sector to deliver IMS through the wide variety of competing products.

Shrimp IMS Emulsion represents a practical and efficient vehicle for applying IMS in hatcheries while removing a logistical bottleneck that could have interfered with IMS treatment protocols. Most importantly, the emulsion is more convenient for hatchery personnel to use.

Pre-treatment of larval shrimp before they are released to grow-out ponds increases the effectiveness of IMS treatment and pre-qualifies prospective clients for the feed-based product form used on production farms.

First generation Shrimp IMS is currently approved for commercial use in Mexico and Ecuador. Fifteen field trials are currently underway and nearing completion in five countries to demonstrate the efficacy and favorable cost-benefit performance of Shrimp IMS under local conditions. The product is designed to increase immune response in shrimp by stimulating production of hemocytes that fight infection.

**CAN PRO INVESTMENTS WILL DELIVER CANOLA MEAL CONCENTRATE FOR AQUAFEE**

Can Pro Ingredients Ltd. has acquired the business assets and operations of Arborfield Dehy Ltd. and will commence construction of a new canola processing facility within the current Arborfield plant. Can Pro also licensed proprietary canola processing technology from MCN BioProducts Inc. to utilize a process that will concentrate canola meal into a high-protein content feed that will find widespread use in the aquaculture industry.

Dave Edwards, General Manager of Can Pro and former General Manager of ADL said, "We were seeking ways to diversify the operations and markets for our plant. We found a home grown canola technology, invented at the University of Saskatchewan and commercialized by MCN, to employ in our dense canola producing region. It was a natural fit."

The company will also manufacture feed grade canola oil which can be used in aquafeeds, animal feeds and biodiesel manufacture.

Can Pro will continue to operate the dehydrated alfalfa business, carried on by Arborfield over the past 36 years and has the ability to combine canola fractions with alfalfa streams to provide new and differentiated product lines.

While it will take a year to construct the new plant and commence commercial production of the new canola protein concentrate, the product has already received significant attention from shrimp, trout, salmon and piglet feed manufacturers looking to replace fish meal in their formulas. Fish meal is an important component of feeds, but supply has not kept pace with rapidly growing demand in the aquaculture industry.

The Company has also attracted attention from biofuels manufacturers who have by-product streams in need of further processing. The company's 'total seed utiliza-
tion' and 'multiple input materials' approach to canola and alfalfa provide a model for economic viability for the biofuels industry.

POLARIS PRIVATE EQUITY ACQUIRES MAJORITY OF HAMLET PROTEIN

Hamlet Protein will strengthen its position as a leading global supplier of soy protein for special-purpose animal feed and with Polaris as a majority shareholder Hamlet Protein plans to double revenue and earnings over the coming five-year period, primarily through increased sales in Europe and the USA.

Hamlet Protein specializes in developing, manufacturing and marketing soy-based proteins for weaning feed. The unique production process gives Hamlet Protein products an attractive taste and high nutritional value that makes them suitable for weaning feed for piglets and calf milk replacers.

In the longer term, the company expects to exploit sales in aquafeed and petfood. Staying on as minority shareholders The two existing shareholders, Managing Director Ole Kaee Hansen and Sales Director Stephen Paul Rose, who have both been with the company from the outset, will remain with the company as minority shareholders. Polaris becoming a shareholder is the first step of a succession process. "Hamlet Protein still offers a lot of organic development potential in the company’s niche for top-quality proteins on the global market. At the same time, the company is currently developing new product types that will enable it to further expand its customer base by customizing products to meet specific customer needs,” said Niels Worning, Polaris partner. Managing Director Ole Kaae

CPM ACQUIRES UK-BASED WOLVERINE PROCTOR & SCHWARTZ

CPM, provider of particle size reduction and pelleting equipment has acquired Wolverine Proctor & Schwartz Ltd. of Glasgow, Scotland. The company will be combined with CPM’s US-based Wolverine Proctor, which was acquired in July of 2006. “This acquisition concludes the reunification of the UK and US based operations of Wolverine Proctor to achieve new levels of global market coverage,” said Ted Waitman, CPM president.

Now operating again as one company, Wolverine Proctor will be a worldwide equipment leader in high-value thermal process applications, including baking, drying, roasting, toasting, flaking and shredding for the food, chemical, tobacco and textile industries.

CPM offers equipment and after-market sales and support for particle size reduction, preparation and agglomeration in feed milling, oilseed processing, ethanol, biomass, pet food, cereal, snacks and compounding industries.

The company also serves the corn wet milling, extrusion, microbrewery and wood industries.

CPM’s business units include California Pellet Mill, Roskamp Champion, Beta Raven, Century Extrusion and Wolverine Proctor.

CPM has more than 500 employees and production facilities in the Americas, Europe and Asia.
AQUAFEED HORIZONS ASIA 2008
TECHNICAL WORKSHOP

WHERE & WHEN
March 6, 2008
QSNCC
Bangkok
Thailand

PROVISIONAL PROGRAM

CHAIRMEN:
• Dr. Dean Akiyama, Senior VP Aquafeed Technology, Charoen Pokphand
  Indonesia
• Dr. Warren Dominy, Director, Aquatic Feed & Nutrition Department,
  Oceanic Institute, Hawaii

SPEAKERS INCLUDE:
• Dr. Juadee Pongmaneerat, Department of Fisheries, Thailand
• Dr. Andrew Moore, Centre for Environment, Fisheries and
  Aquaculture Science, U.K.
• Dr. Peter Coutteau, Inve, Belgium
• Dimitri Sclabos, Sclabos Consulting, Chile
• Galen Rokey, Wenger Manufacturing, Inc., USA
• Joe Kearns, Wenger Manufacturing, Inc., USA
• Will Henry, Extru-Tech, Inc., USA
• Dr. Vincent Fournier, Aquativ, France

TOPICS INCLUDE:
• Aquafeed and aquaculture production and policies in Thailand
• Pheromone-based feeding attractants for sustainable aquaculture
• Promoting animal health through feed
• Improving palatability in shrimp feeds
• Starter diet production technology
• Ingredient trends and effects on extrusion process
• Technical advances in extruded shrimp feeds
• Krill as a feed source for aquaculture

The workshop is the third in the highly successful series of meetings organized by the aquafeed portal, quafeed.com, in association with Victam international.

The meeting will provide invaluable insights for service, ingredient and equipment suppliers, researchers, veterinarians and others whose business depends on understanding the needs of aquaculture and the possibilities offered by advances in aquafeed technology and formulation.

Sponsored by Wenger International, Inc. and supported by the Thai Department of Fisheries

MORE INFORMATION, BROCHURE AND REGISTRATION DETAILS AT WWW.AQUAFEED.INFO

E: conferences@aquafeed.com
Aquafeed binders contained melamine

The U.S. Food and Drug Administration (FDA) alerted the feed industry about a voluntary recall of feed binders made by Tembec BTLSR Inc. of Toledo, Ohio and Uniscope, Inc. of Johnstown, Colorado, because several were found to contain melamine and related compounds.

Tembec, a contract manufacturer for Uniscope, makes AquaBond and Aqua-Tec II, which it distributes for Uniscope. Uniscope makes Xtra-Bond using ingredients supplied by Tembec. All of the products are binding agents that are used to make pelleted feed for cattle, sheep, and goats, or fish and shrimp.

The companies have confirmed that Tembec added melamine as part of the formulation of the products to improve the binding properties of pelleted feed.

Melamine is not approved as an additive for animal or fish/shrimp feed.

The companies have stopped adding melamine to the feed products.

Based on the levels of melamine and related compounds in the initial ingredients, FDA estimated the probable level of melamine and related compounds in livestock feed as less than 50 parts per million (ppm) based on the recommended mix rate of two to four pounds of binding agent per ton of livestock feed. The estimated levels in fish and shrimp feed are less than 233 ppm and 465 ppm, respectively, of melamine and related compounds.

The estimated levels of melamine and related compounds vary in the livestock feed and the fish and shrimp feed because of differing levels of melamine in the binding agents used for each type of feed. FDA advises feed manufacturers and others who mix their own feed not to use these products, and to contact the manufacturers.

ZEIGLER RECALLS PELLETED AND CRUMLED SHRIMP FEEDS

FDA advised feed manufacturers to recall finished feed that is made from AquaBond or Aqua-Tec II due to the estimated levels of melamine and related compounds in the finished products.

Consequently, feed manufacturer, Zeigler Bros., Inc. issued a voluntary nationwide recall of its pelleted and crumbled shrimp feeds at the end of May and recommended to customers to immediately stop feeding them. The recalled products all include the feed ingredient AquaBond.

No other Zeigler products are involved in the recall: only Zeigler pelleted and crumbled shrimp feeds are formulated with AquaBond.

Zeigler extruded shrimp feeds and shrimp larval feeds do not contain AquaBond and are not included in the recall.

Zeigler is working closely with the FDA and with Uniscope, to provide timely product information and immediate recall instructions to its customers to assure product safety. The company said it is not aware of any instances of ill health effects in shrimp fed with Zeigler pelleted and crumbled shrimp feeds.
LITTLE RISK TO HUMAN HEALTH

FDA believes that no recall is warranted of the finished feed made from Xtra-Bond based on the estimated levels of melamine and related compounds in the finished product and based on currently available data and information.

The estimated melamine levels in feed made with these binding agents are similar to the levels discussed in the interim safety/risk assessment of melamine and related compounds made available by FDA earlier this month. In that assessment, federal scientists determined that, based on currently available data and information, the consumption of pork, chicken, domestic fish, and eggs from animals inadvertently fed animal feed contaminated with melamine and its analogues is very unlikely to pose a human health risk.

The interim safety/risk assessment concludes that in the most extreme risk assessment scenario, when scientists assumed that all the solid food a person consumes in an entire day contained melamine and the melamine compound cyanuric acid in equal amounts, the potential exposure is about 250 times lower than the dose considered safe. This is a large safety margin. Translated to consumption levels, this means that a person weighing 132 pounds would have to eat more than 800 pounds per day of food containing melamine and its compounds to approach a level of consumption that would cause a health concern.

FDA is encouraging domestic feed suppliers to be vigilant in quality control in their supply chain and to monitor for any improper additives, including melamine and its analogs.

The Tembec and Uniscope products also reportedly contain a urea formaldehyde resin-type ingredient, a raw ingredient used to make the binding agent in these products.

MELAMINE RESOURCES

GC-MS Screen for the Presence of Melamine, Ammeline, Ammelide and Cyanuric Acid (Version 2.1) [FDA Update]

Determination of Melamine Residues in Catfish Tissue - Laboratory Method

The FDA CFSAN has issued Laboratory Information Bulletin No. 4396 on Determination of Melamine Residues in Catfish Tissue for the rapid dissemination of laboratory methods which appear to solve a problem or improve an existing problem.

Full text of the bulletin for details on the methodology.

Questions may be directed to the lead author the FDA bulletin, Wendy Andersen: email.

Melamine fact sheet from Zeigler (PDF)

FDA safety/risk assessment on melamine and analogues

FDA is investigating this use of the urea formaldehyde resin-type ingredient in the Tembec and Uniscope products, and says it will take appropriate regulatory action if warranted.
CP PRIMA WINS DIPASENA FOR $76 MILLION
Indonesian aquaculture firm PT Central Proteinprima and its parent company, Charoen Pokphand, operating under the Neptune consortium banner, have won the tender for the sale of Southeast Asia's largest shrimp farming firm, PT Dipasena Citra Darmaja. State Asset Management Company (PPA) president Syahrial said that the consortium had bid Rp 688.12 billion (US$76 million) for Dipasena, exceeding the minimum bid of $53.5 million set by the government. The winner is also required to invest Rp 1.7 trillion on developing Dipasena.

CANADIAN FOOD INSPECTION AGENCY DEMANDS CERTIFICATE OF ANALYSIS FOR VEGETABLE PROTEIN CONCENTRATE PRODUCTS AND AMINO ACIDS
The Canadian Food Inspection Agency (CFIA) has announced that it now requires a certificate of analysis for melamine and cyanuric acid. While requirements were in place for Chinese products, no stipulations were placed on other countries of origin. Now, CFIA is requiring that vegetable protein concentrate products and amino acids have a certificate of analysis from an acceptable laboratory using an acceptable method of analysis, regardless of country of origin. 
more...

BLUE LIMIT AS SECURES FIRST EQUITY FINANCING FROM SARSIA SEED AS.
Blue Limit AS (BLAS) has been established by Dr. Anders Aksnes and Sarsia Innovation AS to develop, document and sell a new special feed for Shrimp Lar-
vae (Post Larvae stage). The company is based on more than thirty years of aquaculture special feed R&D at Fiskeriforskning Bergen. Sarsia Seed AS together with Sarsia Innovation has agreed to invest up to 3 mnok during the next 12 months to initiate the commercial documentation and product roll-out internationally. more...

FISH LEARN SURVIVAL SKILLS
A project being funded by the Murray-Darling Basin Commission’s Native Fish Strategy is helping researchers to teach survival skills to fish reared in hatcheries for restocking programs. more...

ANTIBACTERIAL COATING IMPROVES FISH YIELD
Japan - June 6, 2007 - The Fuji Trout Hatchery at the Shizuoka Prefectural Research Institute of Fishery and Kobe Steel, Ltd. have commercially applied an antibacterial coating that improves the sanitation of fish hatchery equipment to control parasitic water mold. more...

PFIZER TURN UP THE HEAT OVER VIAGRA OYSTERS
Australia - June 3, 2007 - A NSW oyster farmer has been feeding his crop Viagra to make the ultimate aphrodisiac - but now the drug’s maker is threatening to take him to court. more...

June FEED OUTLOOK: 2007/08 U.S. Corn Ending Stocks Increase This Month
U.S. 2006/07 corn exports were decreased 50 million bushels, reflecting the slowing pace of shipments and increased competition from South America. Changes in U.S. corn and barley trade projections for 2006/07 raised 2007/08 stocks. Corn ending stocks were up 50 million bushels, and barley ending stocks were up 5 million bushels. USDA National Agricultural Statistics Service (NASS) will release the first survey-based estimates of 2007/08 crop acreage at the end of June and barley and oats production in July. Full report: text, tables and graphics (PDF).

Glimpse the future of the world’s foremost aquafeed market

Aquafeed Horizons Asia 2008


March 6, 2008, Bangkok, Thailand.
www.aquafeed.info
**EVENTS FOR FEED AND AQUACULTURE**

**August 20 - December 14, 2007- web based**

**Fish Genetics Online Course**
The Aquaculture Program of Kentucky State University offers Fish Genetics, undergraduate (BIO 407 or AQU 407) and graduate (AQU 507) Internet courses, in the fall semester 2007.

Instructor: Dr. Boris Gomelsky, KSU Associate Professor: e: boris.gomelsky@kysu.edu

This course is for anyone who
- wants to add a course on Fish Genetics into his/her present university curriculum.
- already has a degree in biology or in some area and is interested in aquaculture or fisheries.
- wants to get credit hours without attending a traditional classroom.
- presently works in aquaculture or fisheries and needs knowledge of fish genetics for his/her professional development. Details.

**August 23-25, 2007**

**Tilapia 2007: Technical & Trade Conference and Exposition on Tilapia - Kuala Lumpur, Malaysia**
An international forum for industry leaders, policy makers and planners, aquaculturists and producers, export-processors and importers, investors and suppliers of inputs and services.

e: infish@po.jaring.my website

**September 5, 2007**

**An International Training Course on Fish Nutrition and Diseases**
The Course will take place at The Islamic Azad University Ghaemshahr Branch, School of Fisheries, Iran. This Training Course is organized with the cooperation of Islamic Azad University Ghaemshahr branch, Institute of Marine Research in Bergen-Norway and The International Sturgeon Research Institute. The Aim of this Training course is to learn more about the advanced techniques used in fish Nutrition with emphasis on Probiotics and fish health.

Subject Areas: Fish Nutrition; Fish Diseases; Lactic acid bacteria vs. pathogenic bacteria in the gastrointestinal tract of fish; Bacterial translocation and pathogenesis in the digestive tract of fish: What happens and what are the consequences? Probiotics in Aquaculture.

Registration: e: sandbankgroup@gmail.com website

**October 22-25, 2007**

**2007 Forum on Fishery Science and Technology - Qingdao, China**
For more information contact Ms. Chen Xinran, Ms.Yu Rui, Mr. Fang Ping

Forum Secretariat, Chinese Academy of Fishery Sciences e: 07forum@cafs.ac.cn

**October 15th – 18th 2007**

**IFFO Conference - Sydney Australia**
The traditional annual reunion of the fishmeal and fish oil producers will take place this year in Sydney, Australia. In addition to producers (owners as well as managers), those attending include traders and shippers, agricultural and aquacultural feed producers, oil refiners, analytical laboratories and consultants, nutritional supplement suppliers, banks and insurers, among others.

Titled "Future Horizons" the conference program has a strong aquaculture content.
For more information see the IFFO website

**October 24-27, 2007**

**Aquaculture Europe 2007 deadlines approaching – Istanbul, Turkey**
Meeting in Turkey will include an aquaculture conference, an industry forum and an exhibition more...