

SINGLE SCREW MULTIPLE MARKETS

SINGLE SCREW EXTRUSION SYSTEM OPTIMIZES FLEXIBILITY AND MARKET OPPORTUNITIES



AQUA FEED



PREMIUM PETFOOD



PETFOOD SNACKS

Optimize the return on your capital investment with a single screw extrusion system. Buy one system and cost-effectively deliver product to multiple market opportunities.

- One system capable of economy up to super premium fresh meat petfood
- Aquatic feeds that range from floating to sinking shrimp feed
- Capitalize on high margin petfood treat opportunities
- Significantly lower operating cost per ton versus competitive systems

As the chart below demonstrates, an Extru-Tech Single Screw Extrusion System provides all the flexibility and production efficiencies at around half the cost of competitive extrusion systems with high operating costs.

	Extru-Tech Solution	VS	The Competition
Capital Investment	1.0		2.5
Operating Costs	1.0		1.60
Ingredient Flexibility	Excellent		Excellent
Complexity	Low		High
Operating Cost (\$/M Ton)	1.08		2.80

KEEP IT SINGLE.

Contact Extru-Tech today at 785-284-2153 or visit us online at extru-techinc.com



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EQUIPMENT SOLUTIONS for Market Flexibility and Sustainability


WELCOME LETTER

WELCOME, AND THANK YOU FOR YOUR CONTINUED INTEREST IN THE EXTRU-TECHNICIAN.

In this issue, the discussion will focus on equipment solutions for market flexibility and sustainability. We target single-screw extrusion advancements and their uses for producing dry expanded multi-colored products. We will begin by defining two specific equipment advancements and then offer brief insights into their capabilities when used for multi-colored products.

Challenging the standards for single-screw innovation, Extru-Tech has made specialty pet treats possible using the Multi-Color/Multi-Shape (MCMS) Die Assembly and the Mid-Barrel Valve (MBV), further enhancing Extru-Tech MCMS Die Assembly versatility, all from a single extruder. The E525 MCMS provides necessary avenues toward sustainability, allowing the production of complex products within a single point of operations (two extruders for co-extruded products are no longer required).

As always, we hope you find this issue of *The Extru-Technician* informative as we share our expertise and experience regarding single-screw extrusion developments and the attributes they bring to multi-colored, multi-shaped companion animal products and treats.

 To learn more about our pet food manufacturing solutions, visit us at the Pet Food Forum 2024 April 29 – May 1, 2024, in Kansas City, Missouri.

Please continue to share your comments and thoughts with us; we appreciate the feedback and look forward to offering solutions.

Sincerely,

Rachel Cardwell
Marketing Specialist

EQUIPMENT SOLUTIONS for Market Flexibility and Sustainability



Continuation of Single Screw Evolution

Since its establishment in 1985, Extru-Tech Inc. has implemented single-screw extrusion solutions around the globe for pet food, aquatic feed, human food and animal feed. Our engineering team works to create high-yield extrusion cooking systems that deliver top-quality products while meeting food safety standards.

Throughout the decades, we have made continuous improvements to our extrusion systems to better meet the diverse needs of the pet food industry. This article reviews the evolution of our single-screw system over the past two decades to produce much more than dry expanded kibble, with particular focus on:

- our Multi-Color, Multi-Shape (MCMS) system, which facilitates the production of mixed-color kibbles and bicolor treats

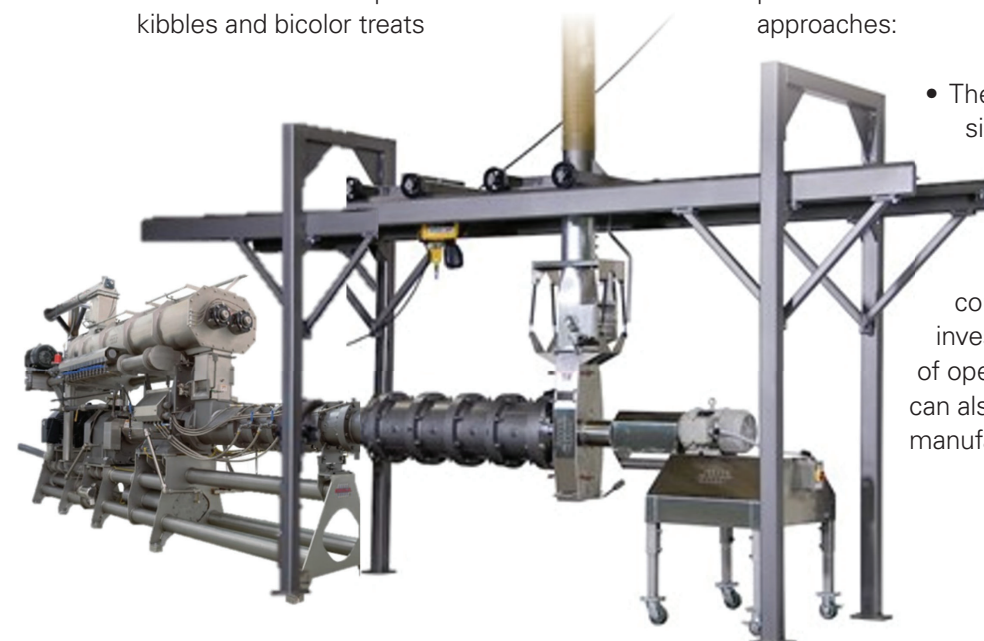
- the Mid-Barrel Valve (MBV), an alternative to cumbersome screw configuration adjustments when switching between products that need different levels of mechanical shear OR individual processing zones within the barrel are required

Multi-Color, Multi-Shape System

Back in the early 2000s, Extru-Tech sought to make our single-screw cooking extrusion system more flexible for the pet food industry. The focus was to provide a solution that allowed our clients to broaden their production base without breaking the bank. Specifically, we wanted to help pet food manufacturers produce dry-expanded multi-colored complete diet offerings using one extruder.

Traditionally, pet food manufacturers seeking to produce a multi-colored mix have used one of two approaches:

- They run multiple extruders simultaneously—one for each color and shape—and then combine the kibbles from the different extruders together into a mix. This, of course, requires a huge capital investment in machinery. The cost of operating so many machines can also be prohibitive to smaller manufacturers.



Example of an Extru-Tech E750 Cooking Extrusion System with the 4-Color MCMS and Over-Head Rail System

The **Extru-Technician** brought to you by **Extru-Tech, LLC**



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- They utilize one extruder to make the various colors and shapes, with a different color/shape run in each batch. Each batch is set aside until all batches are complete, and then they are mixed together to create a multi-color, multi-shape mix.

We wanted to provide a more flexible solution to pet food manufacturers. With that in mind, we designed and released the Multi-Color Multi-Shape (MCMS) system for our high-capacity E750 extrusion line, which has a capacity of 4,400 to 17,600 pounds (2,000 to 8,000 kilograms) of pet food per hour.

The MCMS system allows the creation of up to four shapes and colors during a single batch on a single extruder. Extru-Tech's engineering team accomplished this by dividing the flow inside the barrel into two, three or four separate streams, which can be colored differently. They can then be directed to specific quadrants in the die that have different shapes.

The MCMS system makes operation simpler for the producer. It also means lower capital and labor expenses than a multi-extruder system.

However, it is important to note that the MCMS system does have some limitations in comparison to a multi-extruder arrangement. Principally, this has to do with the limited range of kibble ratios that can be produced on a single machine. In a multi-machine or multi-batch system, manufacturers can blend differently shaped or colored kibbles into the final mix at any ratio desired. A kibble with two shapes—a circle and a square, for example—could have a ratio of 62 percent circles and 38 percent squares, 57 percent squares and 43 percent circles, or any combination of numbers that adds up to 100.

In the MCMS system, each number in the ratio must be divisible by 25 when the stream

is divided into quadrants (for example, a 75-25 ratio, a 25-25-50 ratio or a 50-50 ratio). When the stream is divided into thirds, each number in the ratio must be divisible by 33.3 (for example, a 66.6-33.3 ratio).

Expanding into bi-color treats

In addition to using the MCMS system in the production of multicolor, multi-shape mixes, the industry has pushed the capabilities of the MCMS into the bi-color arena. For the newcomers, bi-color refers to individual kibbles or treats that have two colors (see photos).

In the creation of bi-color products, two streams move through the extruder and converge at the die. Bi-color products require a more complex die configuration. In addition to multiple colors, the option of varying texture within a single kibble or treat also becomes available.

This greatly expands the options of manufacturers to produce bi-color treats such as marbled bacon-style treats, filled tubes and steaks, as well as crunchy treats with semimoist centers—and much more.

Flexibility and sustainability

In the past few years, the industry at large has had a greater focus on flexibility and sustainability. With



supply chain disruptions and commodity markets that are extremely volatile, producers may need to switch ingredients because of high cost or lack of availability. Equipment also needs to be flexible to handle different formulations and products. Extru-Tech has worked to meet the demands of the industry for flexibility and sustainability by creating a single piece of equipment that can be used for multiple products and multiple production runs.

Although we initially planned to focus on using the MCMS system with our high-capacity E750 extrusion line, it became apparent that smaller producers also needed a more economical and flexible solution to manage the onslaught of small-volume specialty product labels, which make up a significant number of the around 300 new products that hit the pet food and treat market annually.

For this reason, we made the MCMS system available on our E525 line of Advanced Feature Extrusion Cooking Systems, as well. The E525 line handles volumes of 1,760 to 7,500 pounds (800 to 3,400 kilograms) of pet food per hour. This move solved multiple problems. First, this provided an option for our clients to evaluate and prove their new products on the E525 extruder located at our pilot facility. And second, facilities that currently operate E525s specifically for treats now have the capability to almost double their production capacity and capability.

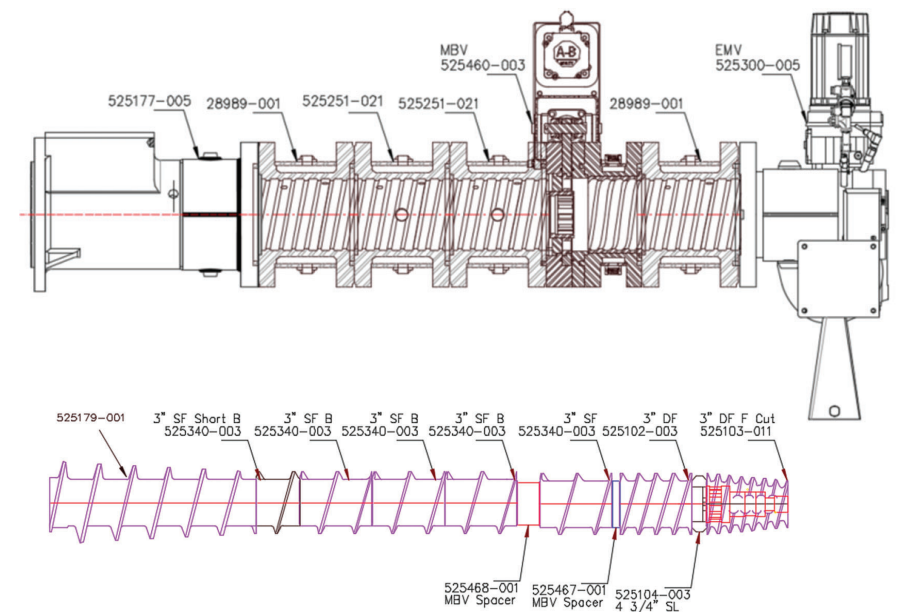
The need for even more flexibility also led Extru-Tech to create the Mid-Barrel Valve (MBV) system. Like the MCMS system, the MBV system allows a single machine to create multiple types of products with less downtime. But it accomplishes this goal in a different way—by allowing a wider range of ingredient ratios. Moreover, the MCMS and MBV systems can be combined for even greater flexibility.

Creating high shear with the MBV

For specialty pet food and treats, it is often necessary to introduce high levels of energy and shear at specific steps in the cooking process. Doing this can allow for greater densification, as well as inclusion of a broader variety of ingredient ratios.

To achieve these higher energy levels with our single-screw extruders, we have traditionally segmented the extruder shaft into multiple zones using a very specific and complex screw configuration with lower levels of energy put in at the beginning of the process, a more aggressive “work zone” toward the center, followed again by lower energy until the product gets worked more tightly as it reaches the valve at the end. That method continues to function well in situations where the machine does not need to be reconfigured frequently—in other words, when there is little variation in the ingredients used or the product made on the machine.

But for other situations, we have the MBV. The MBV is a variable-opening orifice positioned in the middle of the extruder shaft (typically between heads 4 and 5 on an eight-head system) that allows for in-process tuning of mechanical shear (cook). This,



New, Advanced Specialty Pet Food/Treats configuration that allows for the production of both Specialty and Typical pet food/treats without re-configuration of the internal components.

along with a tailored die configuration, allows for the densification of the product in the final heads of the extruder (heads 5 to 8 on an eight-head system).

The MBV allows for a variety of inclusion rates and formulations—from high-protein to high-fat to standard products—without requiring the long six-hour plus downtimes required to change a screw element configuration. With the emergence of new functional ingredients monthly, this adaptability is vital in today’s market.

The MBV has proven its versatility at the 1 Solution Group pilot testing facility in Manhattan, Kan. The 1 Solution Group was launched by Extru-Tech in 2014 to offer a comprehensive array of services to the worldwide food and feed sectors, including research and development, process design, and production consultation. The facility has been using the same MBV screw stack-up for more than 18 months. In that time, 1 Solution Group has executed over 60 individual product trials with more than 30 different clients—all with the same screw configuration.

With the properly designed screw element stack-up tailored to a manufacturer’s specific needs, the MBV becomes a necessary tool for today’s competitive production environment.

MBV enables high meat inclusion

It is interesting to note that Extru-Tech originally designed the MBV in response to the aquaculture

market’s need to produce a dense, fully cooked, and high-fat product for the growing salmon industry. The qualities that make it useful for salmon feed production also make it suited to the ever-increasing high-meat pet food genre, which has become a permanent fixture in the pet food market.

On an almost monthly basis, clients ask us how high they can push the maximum percent of animal protein in the extrusion process. On dry-expanded kibble, we have used the MBV to achieve inclusion levels up to 150 percent fresh meat inclusion (see sidebar, “Understanding Inclusion Rates”). For specific pet food ingredients, we have achieved 186 percent.

Of course, these inclusion rates will not work in all scenarios. With these levels of fresh meat inclusion, you must consider both product conveyance and drying, as well. These should be discussed with your OEM provider.

MBV and MCMS work together like a treat

Using the MCMS system and MBV, 1 Solution Group recently proved the efficacy of using a single-screw extruder in the production of dental sticks, or chew sticks, within a single production step. Previously, the single screw process used to produce dental or chew sticks required two steps:

- extrusion
- densification/cooling, usually using Extru-Tech’s product densification unit (PDU) or former.

With the MBV and MCMS, we were able to produce a bi-colored dental stick that was 15 percent harder and 25 percent chewier in direct comparison with a commercial sample (compared via Young’s Modulus of elasticity).

Conclusion

Extru-Tech has established a strong standing in the industry by consistently implementing state-of-the-art engineering innovations. The MCMS and MBV systems are two examples of the ways we have helped single-screw extrusion progress with the needs of pet food manufacturers. With our dedication to pioneering research and our commitment to high-quality engineering and manufacturing processes, Extru-Tech continues to serve our customers around the world.

Understanding Inclusion Rates

The pet food industry has two main ways of talking about meat content in dry food: inclusion rate (also called percentage to dry feed rate) and formula ratio.

Inclusion rate compares the amount of one ingredient to the other ingredients in the recipe. If a pet food formula requires 500 pounds of fresh meat for every 1,000 pounds of other ingredients, the inclusion rate would be 500/1,000, or 50 percent.

Formula ratio compares the amount of one ingredient to the overall recipe. For example, if a pet food formula requires

500 pounds of fresh meat for every 1,500 pounds of total ingredients (500 pounds fresh meat plus 1,000 pounds of other ingredients), the formula ratio would be 500/1,500, or 33.3 percent.

The terms often get used interchangeably when discussing specialty meat-add pet food. They should not be. Because of the way they are calculated, inclusion rate is always a higher number than the formula ratio, even though the actual amount of meat in the product remains constant.

If the claim is made that “this equipment can manage 50 percent meat-add,” follow up and ask whether the claim is about the formula ratio or the inclusion rate.



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