

# KEY SUCCESS FACTORS FOR EFFICIENT GRINDING OF FISH & SHRIMP FEED

## Extending the Limits of Impact Grinding on Hammer Mills

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**T**ietjen is a highly specialised German manufacturer of grinding systems using hammer mills.

Tietjen solutions stand for highest fineness, efficiency, and the tightest grist spectrum.

Today Tietjen grinding systems offer the highest fineness, of course always depending on the recipe:

Fine grinding hammer mill FD: up to 98 percent < 500  $\mu\text{m}$

A grinding solution by Tietjen; fineness up to 99 percent < 400  $\mu\text{m}$

However, it is not the mill itself that offers the highest fines, low energy cost, and a high throughput: It is necessary to have a balanced system solution with feeder, aspiration, mill design, sieving solution, and automation in which provides the best performance and ratio between quality and capacity/efficiency.

In this article, Tietjen explains how grinding - as the first process step in making superior feed - has an impact on the quality of fish and shrimp feed and the production costs involved.

Tietjen shows:

- Why it is important to reach a high fineness and tight grist spectrum for fish and shrimp feed production.
- The key success parameters in terms of product quality as well as economic and ecological aspects.
- How a grinding system needs to be configured.

### Core parameters of fine grinding

Small fishes like hatchlings, early fries, or fingerlings and shrimp need very small feed due to their size. The fish must absorb and digest all content of the sinking, semi sinking or floating feed in a short time and with a short digestive track. The rest will be not absorbed or excreted unused, which leads to a reduced FCR (Feed Conversion Ratio). This reduced FCR means inefficient feeding, reduced economics for the farmer and a pollution of the water. An adapted grist structure means improved economics and improved environmental impact.

The quality of aqua feed increases with the fineness of the grinding process.

There are several arguments for a narrow and fine guaranteed grist spectrum all aiming at a smoother process after the grinding step, higher quality, and better utilization.

See here the main arguments for an improved process:



Reduced incidence of die plugging in extruder, due to uniformity and cleanness of the ground material

- Ease of cooking in the extruder and pelletizing efficiencies
- Better binding properties and reduced waste due to finer structure
- Improved liquid and steam addition due to small and uniform cell structure
- Less wear in the extruder barrel
- Ease of drying process
- Also, from the end-product and marketing perspective, an adapted grist spectrum brings a lot of advantages, among others:
- A superior pellet appearance and uniformity
- A noticeable reduction of water contamination, which is a reflection in reduced waste of feed

On the other hand, a high fineness often result in higher energy consumption and longer retention time in the mill which might cause a suboptimal grist spectrum (increased proportion of fines), heat exposure for sensitive nutritional elements in the recipe and an increased likelihood for blockings and dust explosions. From the economic side, a higher fineness normally goes with lower throughput of the line.

### Which solutions can be offered technically

When talking about grinding for fish and shrimp feed production it becomes clear that there is not just ONE solution. The grinding system depends on the application and recipes in use, required production capacity, product portfolio of the customer, local conditions, and raw material qualities etc. However, there are some established solutions which are used very commonly.

Tietjen compares these common approaches:

### Grinding with Two Hammer Mills versus Grinding with Pre-Crusher and Hammer Mill versus Pre-Crusher, Sieves and One Hammer Mill

The three grinding solutions compared here are typically used for grinding fish feed up to 98 percent < 500 μm for a pellet size of around ø1,5 mm.

Each pelleting process begins with the raw-material preparation. Some recipes contain hard products like pellets, peas, and legumes. These components often increase retention time of the recipe in the fine grinder and can cause screen damages in the hammer mill, which leads to down times and increased consumption of spare parts, mainly screens. Therefore, there was a belief that fish feed should be double ground (two hammer mills in line) for a long time. Hence, if two hammer mills are needed, both with main motors and a ventilator that can aspirate two grinding systems or even two ventilators for two systems with an even higher energy consumption.

### Tietjen Solution No 1: Straight Grinding with Pre-Crusher

Tietjen offers two different approaches. First, a very effective and simple approach: 'straight grinding'. It optionally includes the Tietjen crusher CR900 for the size reduction of challenging products like legumes and pellets. The crusher CR is a 'heavy duty machine', a mill designed for the tough jobs and challenging recipe parts. At the same time, its energy consumption is quite low with a 30 kW motor use and approx. 1-2 kwh per ton. With its small footprint, the crusher can be easily integrated into a consisting hammer mill setup. (see picture A). Another important effect using the crusher is as follows: it homogenises the product before it enters the grinding chamber and therewith protects not only the screens but also reduces the required energy input in the main grinding process substantially.

For extra-fine grinding, Tietjen chooses its large chamber hammer mill FD. This mill is optimised for fine grinding and reaches 98 percent < 500 μm fineness, recipe dependent. It has a flexible



Figure A: Efficient fine grinding solution: crusher CR plus feeder AGS AD plus hammer mill FD



Figure B: Hammer mill FD32 coming in 2024 will allow a capacity increase of up to 30%



Figure C: Set up of circle grinding



increased impact zone which can be enlarged by 25 percent by adding very flexible additional impact plates, depending on the recipe. There are further optimisations like a support case for the screens that allows very tight screens of < 1 mm and special sealings make sure that only fine grinded material leaves the mill, and that no off-spec grain gets into the extrusion process.

The FD 25 reaches a capacity of up to 15 t/h at a fineness of 98 < 500 µm. To become even more efficient and answer to growing capacities in extrusion, Tietjen announces that a FD32 will be available next year and that capacity of plus 30 percent compared to FD25 is expected (Figure B).

**Tietjen Solution No 2: Circle Grinding**

The second Tietjen approach contains the idea of ‘circle grinding’. This system solution makes sure that only those particles that need to be ground are sent through whereas fine materials can be directly sent through the bypass. Approach No 2 has many advantages:

- 99 percent fineness possible due to circle process with sifter.
- Energy savings are gained as less KW is needed for the grinding and the whole process.
- Process and quality control by the sifter in case of a potential screen breakage.
- Foreign body and over-size protection in front of the extruder.

**How is the setup of the circle grinding?**

The circle grinding works as the name implies in a circle process. Picture C shows a setup of a typical circle grinding application. At the beginning of the process, sifter technology separates - with a very small drive/energy input – material that is already

fine enough for the downstream process after grinding. Coarse material is conveyed to the hammer mill and ground there. Depending on the recipe, the hammer mill can be combined with the crusher CR before the sifter. After the grinding process, the ground material can be (control-)sifted again. Materials that do not meet the defined fineness and quality criteria return in the circle. The obvious advantage of this process is that very high finesses are reached and guaranteed. Tietjen customers reach up to 99% < 400 µm with this process.

Adding up all the nominal motor powers involved, a comparison unveils that fish feed producers can save a lot of energy with this improved set-up without making a compromise on quality. Of course, invest/CAPEX and footprint are higher than in straight grinding, but depending on product and design, the invest for the circle grinding can pay off in short time.

**Conclusion**

In times of increasing energy cost and scarce resources, the optimal utilisation of energy and an efficient production is a must and a key for success. Approaches like straight and circle grinding ensure both: high quality of the ground product and efficient use of energy.

Straight grinding uses a crusher CR for pre-crushing the hard materials like peas, pellets, and legumes before entering the hammer mill.

In circle grinding, the integration of a sifting unit guarantees 99 percent fineness and foreign body protection in front of the extruder. This process-saves energy and at the same time the quality of the ground product is even increased.

Both processes are common Tietjen solutions and used by pet and fish feed producers worldwide.



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