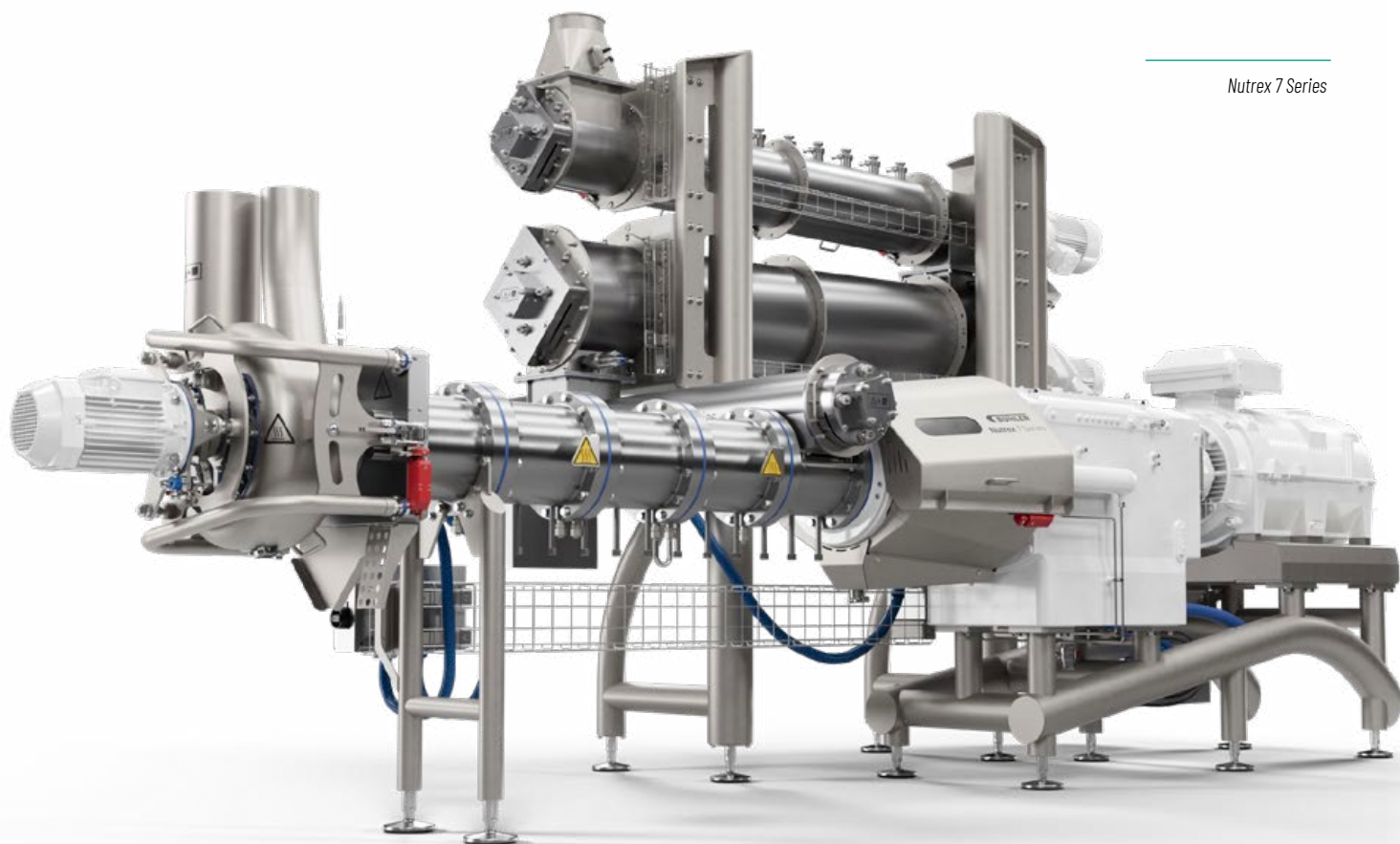


Nutrex 7 Series



INTERVIEW WITH BÜHLER: THE NUTREX 7 SYSTEM

BÜHLER



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How would you describe Bühler's development in the field of pet food extrusion, and which factors do you consider most representative of its current role in the sector?

■ Bühler has been building twin-screw extruders for more than 40 years and our development in pet food extrusion has been driven by a combination of process expertise, application knowledge and close cooperation with customers. We do not view the extruder as an isolated machine, but as part of an integrated process that includes raw-material handling, grinding, mixing, pre-conditioning, drying, coating and automation.

Our current role in the sector is best represented by three factors: global process and service capabilities, the ability to validate products and processes in our application and training centers, and our focus on measurable production outcomes. These include consistent product quality, reliable capacity, flexible recipe management, food safety, energy efficiency and reduced waste.

The Nutrex 7 Series reflects this development. It brings together Bühler's extrusion experience in a platform designed for the requirements of modern pet food plants: greater process control, operational stability, hygienic design and the flexibility to manufacture a broad range of products.

What signals from the market or from the operations of pet food plants did you identify as indicators that it was necessary to move towards a new generation of extrusion?

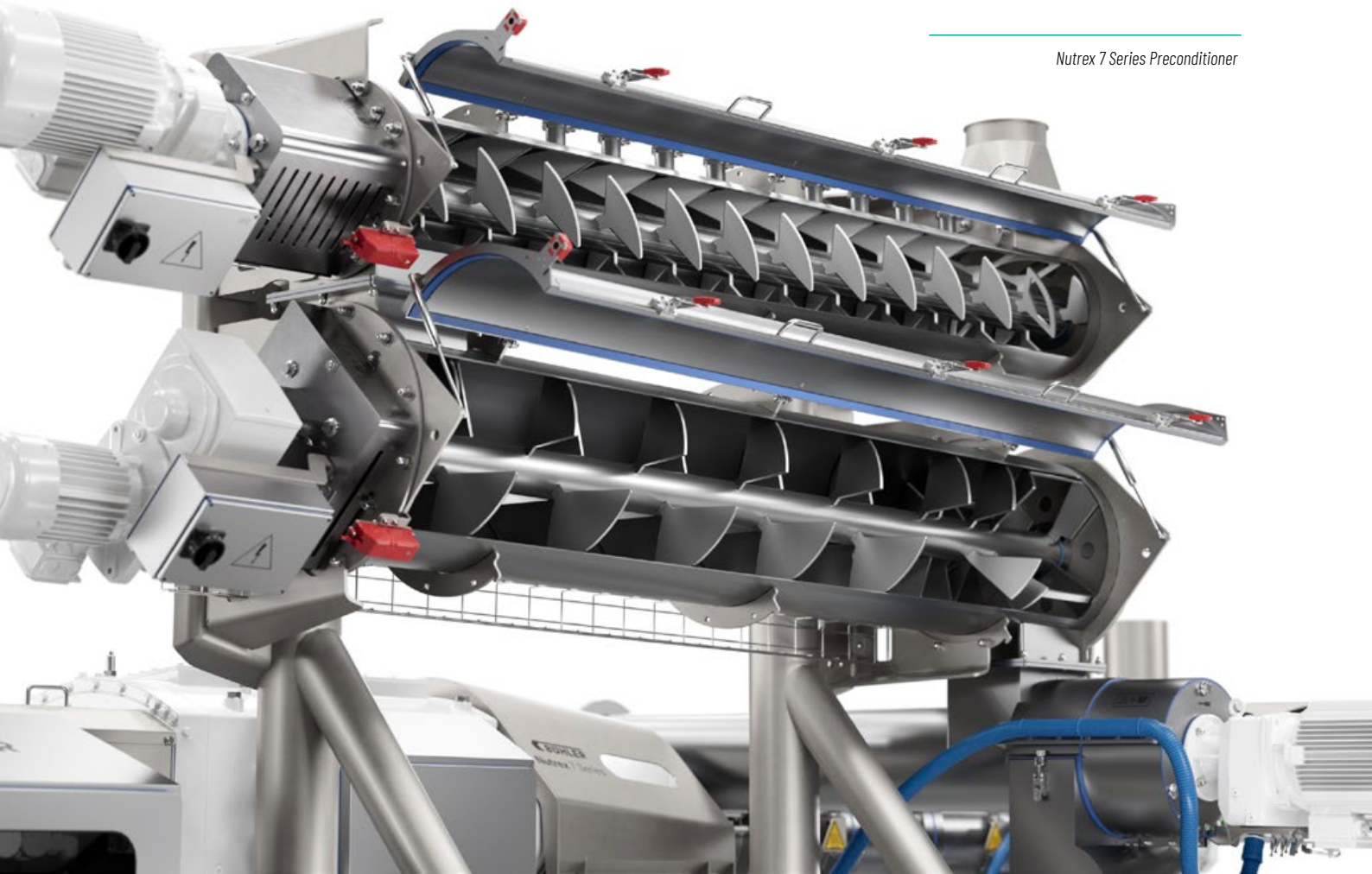
■ Four signals converged. The first came from the market itself: pet food keeps growing well above 5% per year, but the growth is fragmented. Humanisation and premiumisation have multiplied SKUs – high-meat and grain-free diets, veterinary and life-stage products, treats, filled and semi-moist formats – and campaigns have become shorter. Lines designed for standard kibble are now asked to do far more.

The second came from the plants: cleaning, changeovers and start-ups consume a significant share of available production time – hours that cannot be sold.

The third is people. Operations depended too heavily on a few experienced operators who compensated for variability manually, which makes results hard to reproduce between shifts and sites.

The fourth is cost and compliance: energy, raw materials, waste and food-safety documentation became business risks rather than housekeeping topics.

Together these told us that incremental improvement of an existing machine was not the answer. Nutrex 7 Series was developed as a platform covering machine, process, data and service.



Which aspects of pre-conditioning do you consider most critical to process quality, and how have you addressed these in Nutrex 7 Series?

Pre-conditioning decides how the extruder behaves. The critical factors are uniform hydration, mixing intensity, controlled water and steam addition, sufficient residence time and repeatable thermal treatment. In pet food, ingredients compete for water – protein binds moisture faster than starch in the early phase – so uneven wetting shows up later as patchy cooking, variable expansion and unstable dryer load.

Most designs on the market are effectively single-stage: intensive mixing and retention happen in the

same zone, which forces a trade-off – run fast for good mixing and you lose retention time, slow down for retention and you lose mixing quality. Nutrex 7 Series uses a two-stage concept that decouples them: short, intensive wetting and heat transfer first, with liquids injected in a defined sequence, then an adjustable diffusion stage so moisture reaches the particle core.

Full-surface wiping, heated wall surfaces that limit condensate and a defined split discharge give steadier feeding, fewer deposits and a markedly lower extruder load – torque reductions of up to around 50% have been observed, depending on the application.

What role do you believe specific mechanical energy (SME) control should play in modern extrusion, and what approach have you adopted to integrate it into Nutrex 7 Series?

SME describes how much mechanical energy the product actually receives per unit of throughput. It governs cooking intensity, starch conversion, protein denaturation, melt behaviour, expansion and texture – and therefore digestibility, stool quality and kibble bite. We believe it should be a setpoint.

In Nutrex 7 Series this is realised with an SME control module: two restriction elements inside the barrel that follow the barrel contour when fully open and, as

they close, build up filling degree, residence time and mechanical energy input. Their position is adjusted during production, and the module can be placed at different barrel positions to separate the cooking section from the forming section.

SME never acts alone – it interacts with moisture, temperature, steam, screw speed, throughput and die conditions – so the platform makes those variables transparent together. The practical result is on-line cooking control across puppy, adult, senior, dog and cat products without changing screws, and tight SME bands even when raw-material moisture or fat drifts.

the end of the extruder, an open barrel section with degassing spout and vertical back feeder, operated under positive pressure with steam injection, under neutral venting, or under vacuum. This raises expansion for light, voluminous kibbles or lowers it for dense weight-management and small-breed products – at the same cooking degree.

The technical challenge is consistency: density responds to melt temperature, pressure, moisture, SME, die geometry and the pressure drop at the die simultaneously, so the solution has to behave predictably across very different formulations.

That is a real robustness reserve with high-meat, high-fat, high-moisture and sticky recipes, where single-screw designs reach their operating limits earlier.

Automation carries the rest: clear values for the decisive parameters, defined recipe settings, meaningful alarms and guided start-up, shutdown and changeover routines. The aim is not to take the operator out of the process but to make good operating practice reproducible across shifts and sites. Finally, accessibility and maintainability – components that can be inspected, cleaned or exchanged quickly prevent small deviations from turning into unplanned downtime.

Nutrex 7 Series combines these mechanical, hygienic and digital design principles to reduce routine intervention and allow plant teams to focus more on optimization than on continuous correction.

How important do you consider the ability to manage product density independently, and what technical challenges does achieving this pose on a platform such as Nutrex 7 Series?

■ Bulk density is one of the hardest specifications in dry pet food. It determines bag weight and volume, kibble size and bite feel, portion control, logistics cost and – in coated products – how much oil the structure can hold. Traditionally it can only be corrected indirectly, through moisture and thermal conditions that also change the cook. Every density correction risks a nutritional or structural side effect.

Nutrex 7 Series therefore treats density as its own control parameter: a dedicated module at

Which elements of equipment design do you consider most influential in terms of day-to-day operational stability and in reducing the need for manual intervention by plant staff?

■ Stability begins before the extruder. Reliable feeding, uniform pre-conditioning, stable screw filling, accurate addition of liquids and steam and consistent die conditions remove most disturbances at source. In practice, a large share of what is reported to us as an extruder problem is a feeding or conditioning problem.

The twin-screw principle itself contributes: co-rotating, fully intermeshing screws are self-cleaning and provide mixing largely independent of die backpressure.

What criteria would you recommend to a manufacturer seeking to streamline formulation changes, and how can a platform such as Nutrex 7 Series facilitate this process?

■ Manufacturers should first evaluate formulations according to their functional process behavior, rather than only their ingredient composition. Important criteria include water absorption, starch source and degree of transformation, protein and fat content, fiber level, particle-size distribution, thermal sensitivity and the desired density and texture.

A structured scale-up procedure is also essential. Trials should define a robust operating window covering moisture, temperature, SME, throughput, screw speed, die conditions and drying requirements. The target should be a recipe that remains stable despite normal raw-material and environmental variation—not simply one successful production run.

Nutrex 7 Series facilitates this through controlled recipe management, transparent process data and reproducible machine settings. Its flexible process configuration supports a range of formulations, while automation helps shorten the path from an established product specification to stable production. Bühler's application expertise and testing capabilities can additionally help customers evaluate ingredients and reduce the risks associated with industrial scale-up.

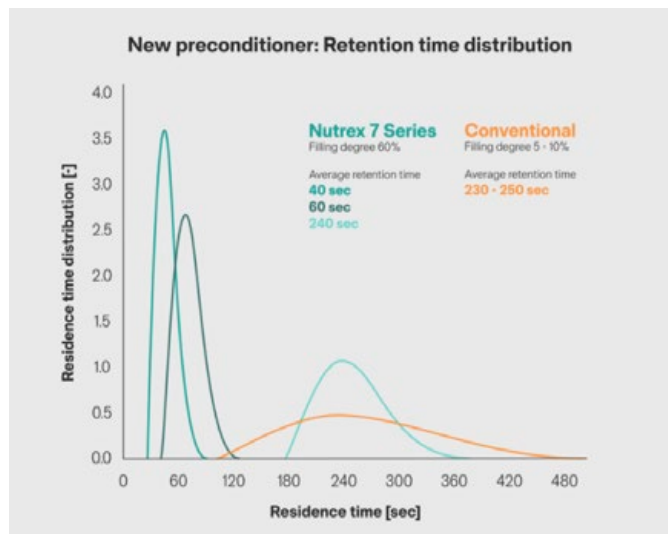
How do you assess the impact of extrusion on a plant's overall energy consumption, and what opportunities do you see for improving efficiency in this area?

Extrusion is a significant energy user – electrical energy for mechanical work, thermal energy through steam and hot water – but it must never be assessed in isolation. The condition of the product leaving the extruder directly determines the load on the dryer, and drying is typically the largest single energy consumer in a dry pet food plant.

Decisions taken at the extruder are therefore paid for, or recovered, downstream.

The opportunities lie in transferring energy to the product more effectively and in avoiding over-processing and reprocessing. Uniform pre-conditioning reduces unnecessary mechanical load; stable control of SME, moisture and throughput holds the process at the required cooking intensity instead of above it; optimised outlet moisture improves dryer utilisation within the quality and safety limits; and steam recovered from density control is returned to the preconditioner.

Nutrex 7 Series supports this system-level approach through improved process stability and visibility. The most meaningful performance indicator is not simply the motor load of the extruder, but energy consumption per tonne of saleable product across conditioning, extrusion and drying. Measured that way, better process control usually pays back faster than any single component upgrade.



Nutrex 7 Series Preconditioner Retention time distribution

What factors typically lead to wastage on extrusion lines, and what approaches do you consider most effective for reducing it sustainably?

Waste concentrates in a few well-known moments: start-up, shutdown and recipe changeover. On top of that come unstable feeding, variable raw materials, blocked dies, deviations in density or moisture, and product falling outside dimensional or visual specification. Where the process depends heavily on manual adjustment, the correction often comes too late – the material is already produced.

The only sustainable answer is to prevent instability rather than manage rejected product afterwards: consistent raw-material preparation, accurate dosing, controlled pre-conditioning, reliable recipe execution and early detection of process drift. Reprocessing is not a solution – it consumes energy twice and adds quality risk.

Nutrex 7 Series Control Unit



Nutrex 7 Series is designed for fast stabilisation and repeatable operating conditions, and its process data allows producers to identify causes instead of accepting losses as unavoidable.

Changeover is where waste and lost time are created at the same moment. The screw push-out device in Nutrex 7 Series addresses this directly: screws are pushed out in a defined, controlled sequence instead of being removed manually with lifting gear and considerable force.

The process section becomes fully accessible, residual product is removed rather than carried into the next batch, and wear is assessed visually instead of by assumption. Changeovers become shorter and more predictable – and running the optimum screw configuration per recipe becomes a realistic option rather than a compromise.

We recommend tracking waste per start-up, waste per changeover and first-pass yield alongside total waste per tonne. Those three figures usually show very quickly where the money is – and they are also the figures that move a sustainability report.

What principles of hygienic design do you consider essential in extrusion equipment, and how do they influence cleaning, safety and maintenance?

■ The essential principles are avoiding product accumulation, minimizing inaccessible areas, enabling effective drainage and providing safe access to all parts that require inspection or cleaning. Product-contact surfaces should be appropriate for the application, and joints, seals and transitions should be designed to limit residues and contamination risks.

Hygienic design is not only about sanitation, it decides uptime and maintenance. If operators can access critical areas easily and inspect them clearly, cleaning becomes more reliable and maintenance can be carried out more quickly.

In Nutrex 7 Series the preconditioner is fully wiped and heated wall surfaces limit condensate – which is exactly where deposits start. Cleaning that used to mean physically demanding manual dry scraping becomes a defined, repeatable procedure. That is better for the product, and better for the people doing the work.

The cleaning lance concept in the pre-conditioner follows the same logic. Critical areas are cleaned through defined access points in a guided routine rather than by opening the machine and scraping deposits out by hand.

Cleaning time becomes plannable instead of dependent on who is on shift, operator exposure is reduced and the result can be verified – which matters above all in demanding applications such as high fresh meat, where protein residues make fast and complete cleaning a food-safety requirement.

In Nutrex 7 Series, hygiene, accessibility and operator safety are considered together. A hygienic machine must also be safe to open, clean and maintain. Tool-free or simplified access, where technically appropriate, can help reduce changeover and inspection time.

The objective is to shorten cleaning procedures while making their results more consistent and helping customers meet their own hazard-analysis and food-safety requirements.

Which indicators would you recommend to a manufacturer for assessing the return on investment when implementing a new extrusion platform such as Nutrex 7 Series?

Return on investment should be assessed across the complete cost of ownership rather than only through nominal capacity. Relevant indicators include:

- ✓ tonnes of saleable product per operating hour;
- ✓ overall equipment effectiveness and line availability;
- ✓ energy consumption per tonne;

- ✓ start-up and changeover waste;
- ✓ first-pass yield and off-specification production;
- ✓ time required for recipe changes;
- ✓ cleaning and maintenance hours;
- ✓ wear-part consumption and unplanned downtime;
- ✓ labor requirements and manual interventions;
- ✓ production flexibility and the speed of new-product introduction.

Quality consistency also has a financial value. Reduced variation in density, moisture, dimensions and texture can lower overfilling, claims and rework while improving brand consistency.

For Nutrex 7 Series, the business case should therefore include improvements in capacity, resource efficiency, product yield, uptime and flexibility. In many cases, the strongest return comes from the combined impact of several incremental improvements rather than from one performance figure alone.

How do you anticipate pet food extrusion will evolve in the coming years, and what sort of solutions do you believe will be necessary to meet future market demands?

Extrusion will have to handle a broader and more difficult ingredient landscape: alternative and insect proteins, Fresh Meat Inclusion more diverse fibre sources, functional and upcycled

components, and raw materials with greater natural variability.

At the same time, humanisation and premiumisation keep pushing the portfolio beyond standard kibble – treats, filled and semi-moist formats, veterinary and life-stage diets – with tighter tolerances on nutrition, texture and appearance.

Technically, we expect a clear move towards more automation, sensor data and advanced process control. Lines will detect deviations earlier, recommend adjustments and hold defined quality targets with less manual intervention.

Traceability and the ability to compare performance across products, shifts and sites will become as important as peak capacity.

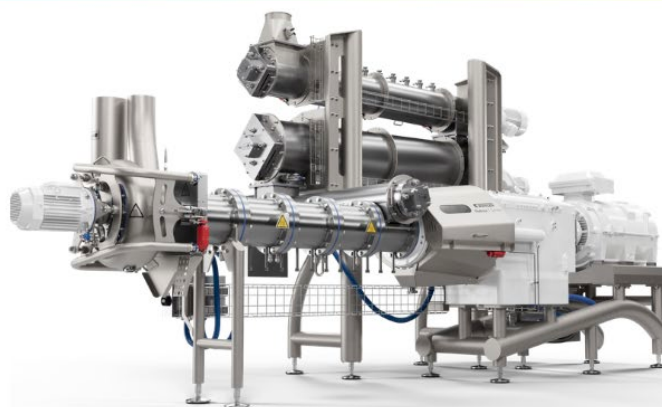
Sustainability will remain the hard boundary condition: less energy, water and waste per tonne of saleable product, without compromising food safety or flexibility. Platforms such as Nutrex 7 Series provide the foundation – robust twin-screw engineering, direct control of the decisive variables, hygienic design and digital connectivity. The long-term goal is an adaptive extrusion process that responds to changes in ingredients and recipes, rather than a process the recipes have to be adapted to.



Twin-screw extrusion system

Nutrex 7 Series

Nutrex 7 Series is our next-generation twin-screw extrusion platform for the food and feed industry. Designed according to EHEDG hygienic design guidelines, delivering highest food and feed safety standards - backed by over 40 years of proven technology.



EXTRUSION KILL STEP VALIDATION - WHITEPAPER:

The white paper is now available for download on the Nutrex 7 Series website. Interested customers can contact our experts directly through the dedicated contact forms.



Get our white paper on extrusion kill step validation

Extrusion can act as a kill step, but proving it works takes solid evidence. Find out how Buhler and LogRed help manufacturers validate and verify their extrusion processes, so they can meet food safety standards and get audit-ready without slowing production down.



DOWNLOAD THE WHITE PAPER

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