BREAKFAST CEREALS PROCESSING.

Technology and processing lines.
For GEA, “engineering for a better world” is an approach aimed at developing technology and products that not only meet market needs, but which also create and set new trends that in turn transform into new needs and products.

GEA technology has always followed this evolutionary path by offering improved and innovative solutions in terms of finished product, production processes and the optimisation of space and production costs.

**Cutting-edge technology**

**Optimisation of the extrusion process**
Advances in extrusion technology enable us to deliver results comparable to flakes obtained using traditional methods, with the added advantages of:
- not having to purchase expensive, high-quality raw materials that are difficult to source;
- developing products with innovative recipes;
- ample flexibility, as the same machine can produce both flaked and direct expanded cereals;
- a more sustainable process, by reducing energy consumption compared with systems based solely on steam.

**Thermal pre-treatment**
Combining the advantages of steam pre-treatment (before the cooking phase) with preheating of the process syrup and the mechanical components maximises efficiency and intensifies the product’s particular sensory characteristics, while ensuring a balanced energy intake.

The resulting cereal product has:
- better colour and flavour;
- better texture and overall appearance;
- better barrier properties in liquids.

**High bran content**
Steam pre-treatment is particularly beneficial for products that have a high bran content. This is due to the prolonged exposure of the dough to heat in the presence of moisture, which causes the fibres to soften, cooks the residual starch and provides sufficient time for the malt syrup, sugar and salt to penetrate the bran.

**Versatility and great capabilities**
GEA xTru Twin extruders can be used to create lines that enable quick switchover between production of flaked cereals and shaped cereals, guaranteeing high hourly production capacities.
**BREAKFAST CEREALS APPLICATIONS**

Product solutions that meet any need in terms of raw materials, appearance and taste.

<table>
<thead>
<tr>
<th>Flaked cereals</th>
<th>Direct expanded</th>
<th>Co-extruded</th>
<th>Pellets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn flakes</td>
<td>Bais</td>
<td>Pillow</td>
<td>Multilayer's</td>
</tr>
<tr>
<td>Rice or wheat flakes</td>
<td>Shells</td>
<td></td>
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</tr>
<tr>
<td>Bran flakes</td>
<td>Rings / Multicolored rings</td>
<td>Pillow</td>
<td>Multilayer's</td>
</tr>
<tr>
<td>Composite flakes</td>
<td>Rice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bran sticks</td>
<td>Fancy shapes</td>
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**Syrup Coating**

To make the product more palatable and visually appealing, the coating phase can be carried out using syrup with a chocolate, sugar, honey or fruit flavoured base, or formulated according to the customer's specifications.
GEA has developed a product that combines breakfast cereal processing with the countless benefits of snack pellet technology.

The food industry scenario is constantly changing and the most innovative companies need to react and change with it through new and dynamic technologies. GEA’s R&D team works closely with its customers to create and develop new products and remain competitive in the market.

Elevating breakfast with expanding pellets
Introducing pellets to the breakfast industry is one of those innovative products. Pellets are produced dried and semi-processed for easy storage and shipping, then expanded and packaged in a second phase. Their unique ability to expand is due to the presence of gelatinised or partially gelatinised starch in their composition. When heated rapidly above boiling point the water trapped in the starch matrix evaporates, creating internal pressure that increases the volume of the cereal resulting in a light, crispy and pleasant texture. A result achieved with the BTO: a high-temperature belt oven using high airflow evenly distributed over the product, thus enabling optimal pellet expansion.

Chocolate multilayers are a completely new breakfast experience that combines the crunchiness of a snack with the sweetness and energy of breakfast: three layers for a pleasant mouthfeel, improved absorption of milk (or vegetable beverage), and an optimal nutritional profile thanks to the total absence of fat. A revolutionary product technologically rooted in GEA’s extensive know-how in snack pellets processing, which is the starting point for a new way of thinking about breakfast cereals production.
Extrusion technology
The growing demand for flexibility in the use of raw materials for flaked cereal production has made extrusion technology the preferred solution for breakfast cereal. The extruders in the GEA xTru Twin series have revolutionised the production of cereal flakes by simplifying production while increasing hourly production rates and economic yields.

Their main advantages are:
- continuous production process with no stoppages;
- elimination of issues related to disposal of cooking water waste;
- higher production capacity;
- increased versatility thanks to comprehensive control of extrusion parameters.

Flaking roller mill
This piece of equipment forms cereal flakes either from steam-gelatinised cereals or from cereals gelatinised in an extruder. The machine is both heavy-duty and technologically advanced, a perfect combination in line with GEA’s engineering principles. It is also safe to use and compliant with the most demanding standards. This all translates into efficiency, cost effectiveness and high quality of the final product:

Automation:
- a vibrating infeed system equalises the product stream and avoids stacked or clogged pieces;
- the machine automatically controls the distance between the rollers, to achieve a homogeneous thickness of the flakes;
- product presence probes automatically distance the roller in case of lack of product, to avoid damage.

Strength and resistance:
the machine guarantees the highest OEE and the longest maintenance intervals.

Food safety:
built with food-grade materials and designed to be easily washed and cleaned.
**CEREAL FLAKES PROCESSING LINE**

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**Ingredient preparation**
The solid raw materials (grist of cereal flours) are mixed together and amalgamated with a slurry typically consisting of sugar, malt extract, salt and water. The resulting mixture is continuously force-fed into the extruder in measured doses.

**Extrusion process**
The GEA xTru Twin can be easily set to cover the widest variety of conditions and process parameters. Our high-efficiency cooking process comprises a sequence of actions— involving melting tanks, a steaming vessel and a cooking barrel—that is completed to the desired level according to the preset temperature profile. Indirect and direct heat factors, such as steam injection and mechanical friction (the viscous dissipation of energy combined with heat generated in the barrel), are optimally balanced by the machine's automation systems.

**Flake forming**
The option of equipping the machine with round or flat dies, or even distanced cutting systems, provides an answer to all possible variables related to increasing production volumes and changing the dimensions of the desired flakes. The cooked dough is cut into cylindrical portions whose surface moisture is corrected in a shaking pre-dryer; this stage removes their stickiness and prevents glued or clogged pieces from falling into the flaking mills, with the risk of producing unnaturally large flakes. The flaking mill rollers are conditioned to maintain a constant temperature and avoid thickness variations.

The extruded product is then cut and conveyed into the shaker pre-dryer, to prevent the individual flaked pieces from sticking together and forming oversized flakes. The product is subsequently conveyed to the flaker, which is cooled to keep the rollers at a constant temperature and prevent the flakes having unwanted thickness variations.

**Toasting**
The toasting process is carried out in two steps to obtain the surface marking typical of traditional products, as well as a high-quality finish. Two BTO series toasters are installed in sequence, as the product is too moist on arrival from the flaker, which means that conveying it directly into a high-temperature toaster would produce a flake with excessively large bubbles. The first BTO toaster therefore dries the flake at medium temperature, thus expelling the water bubbles slowly and creating pleasant micro-bubbles on the surface of the finished product.
BELT TOASTING OVEN

The BTO is a high-temperature conveyor oven particularly suitable for the rapid drying, expansion and toasting of breakfast cereals. In particular, the in-line coupling of two BTOs enables the formation of quality blistering that improves the texture and chewability of the flaked cereals.

Technical and construction features

The BTO toasting oven features a circular-type air flow, achieved through the use of blowing pipes and perforated belts. This ensures good agitation of the flakes during toasting, which is fundamental to achieve uniform cooking and colouration.

The machine is equipped with the most modern safety devices, including temperature modulation and removal of process residues. The cleaning system eliminates the risk of fire.

The side panels are effectively insulated with a sandwich-type structure made of rock wool and stainless steel sheet.

A high-yield centrifugal fan circulates hot air and conveys it onto the product. It is insulated by glass fibre and includes intake and supply ducts.
A product made for extrusion

Direct expanded breakfast cereals enable a vast combination of shapes, colours, styles and sensations to be condensed into one spoonful of product. GEA has the knowhow and technology to equip customers with tools that will kickstart any product line and any success story.

GEA xTru Twin is the ideal production tool for this product category thanks to its high-quality mechanical dough processing and above all its extremely flexible screw configuration and process parameter control.

Flexibility and control also play a vital role in the interaction with the die, allowing producers to obtain a homogeneously expanded product shaped to suit any need.

While the production of more popular shapes such as rice, rings and stars is comparatively straightforward, the production of asymmetrical shapes is generally delicate and requires step-by-step modification of the proportions between the different parts on the mould to obtain the correct final shape. The GEA Dies & Moulds department takes care of this phase by accompanying the customer in developing and constructing inserts suitable for the type of product requested.

Another step that contributes to customising the finished product is the colour injection process, which is performed inside the extruder by an automatic liquid dosing system, thus reducing transition times from one colouring to the next.

The die plate is generally built from stainless or carbon steel with the cutting face hardened to withstand the action of the blade.
Ingredient preparation
The dosage of ingredients takes place directly inside the screw unit, using a gravimetric doser for flour and a modulating valve for liquids. The formulation is typically sweet and based on either cocoa powder or a complex recipe that allows for specific textures and nutritional benefits.

Extrusion process
Together with the flour, liquids (water or mixtures) are also pumped directly onto the extrusion screws, which, through mechanical friction and induced heat, cook the product and convey it towards the die. Here the die-cutting system shapes the cereal product by cutting it using a system of extremely sharp blades. The dies are also specially treated to withstand the mechanical stresses caused by the high friction speed of the blades.

Coating line
The coating line consists of rotating drums, inside which syrup is applied via spray nozzles, plus a continuous high-temperature DS dryer. The drum design enables the product to be turned over differently according to its direction of rotation.

Drying
Cereals shaped in the expansion and cutting phase still lack crunchiness and texture due to their high moisture content compared with the final product, so they need to be reduced by means of a drying process. The DS continuous dryer is the ideal tool for this drying phase:
- the simple parameter controls enable the product to precisely meet the required levels of moisture, texture, and appearance.
- conveyor drying guarantees a glossier product, by preventing rubbing of the product, and simplifies the washing process by reducing dust emission.
- it is a closed and isolated system, which allows for considerable energy saving.

Packaging
In the coextrusion process, a special coaxial insert allows for anhydrous creams to be injected into the direct expanded product. This creates classic pillow-shaped products with a soft, sweet interior and a crunchy exterior.

**The die: the heart of the process**
The main difference between processing shaped extruded cereals and coextruded cereals lies in the extrusion and forming step. Coextrusion technology requires a sophisticated extruder that enables filling to be injected into the extruded dough. Each injection is fed by a dedicated pump, to keep the amount of filling constant and equal for each product.

Furthermore, the configuration of the injection geometry can be adjusted by setting the thickness of the casing, which consequently alters the appearance and taste of the finished product. The result is a filled tube that can be cut to the desired length. Cutting is controlled remotely and performed by an engraving roller, which segments the tube into pillows and prepares them for subsequent separation. The cut product proceeds towards a shelling drum, which separates the filled pillows from each other prior to the drying phase. The drying profile is specifically customised for coextruded cereals, to avoid the hardening of fillings with a high lipid content.

Pillows are one of the most popular types of breakfast cereal. The extruded dough is sliced with a cutter into pillow shapes that are then separated in a rotating drum.

**CO-EXTRUDED: LOTS OF FILLINGS TO DISCOVER.**
GEA XTRU TWIN

The twin-screw cooking extruder with higher cooking capacity and enhanced process capabilities.

High cooking capability
The GEA xTru Twin extruder is equipped with two co-rotating screws that release sufficient mechanical energy to achieve the gelatinisation levels necessary for processing any raw material and product. In addition, the barrel is conditioned to deliver further energy to the extrusion of the dough. Thanks to the versatile process parameters controls, GEA xTru Twin extruders can process flaked, shaped and coextruded cereals.

High-capacity technology
The new high-capacity twin-screw extruders can increase productivity by up to 40%. GEA engineers have used their experience and know-how to increase the cross-sectional area, rotation speed and pitch of the screws in the new machines, while maintaining the extruder footprint and screw length. This also allows customers to upgrade their existing machines without buying a new machine or changing their plant layout.

<table>
<thead>
<tr>
<th>Product</th>
<th>Cereal flakes</th>
<th>Direct Expanded</th>
<th>Co-extruded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Line Capacities</td>
<td>200 kg/h</td>
<td>450 kg/h</td>
<td>200 kg/h</td>
</tr>
<tr>
<td></td>
<td>450 kg/h</td>
<td>1100 kg/h</td>
<td>450 kg/h</td>
</tr>
<tr>
<td></td>
<td>900 kg/h</td>
<td>2500 kg/h</td>
<td>900 kg/h</td>
</tr>
<tr>
<td></td>
<td>1250 kg/h</td>
<td>3000 kg/h</td>
<td>1600 kg/h</td>
</tr>
<tr>
<td></td>
<td>2500 kg/h</td>
<td>4000 kg/h</td>
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</tr>
</tbody>
</table>

The process lines must be dimensioned based on the production capacity of the extruder.

High-speed premixer for perfect flour hydration.
Two co-rotating screws composed of modular sections.
GEA XTRU
TWIN SERIES

Proven extrusion technology, higher capacity, higher efficiency, higher profitability.

The GEA xTru Twin series of extruders adapts perfectly to any requirement or need: barrel and screw configuration are made-to-order and designed based on process requirements. As a result, every need in terms of production capacity, product type and footprint is catered for with a xTru Twin extruder.

Two screws for multi-function extruders
The co-rotating, fully intermeshing screw assembly is composed of modular sections with the following functions: forward and backward transport, mixing, feeding of additives, injection of liquids, de-gassing, cooking and forming.

Increased quality, hygiene and safety
The key features of the GEA xTru Twin range include: a high-speed premixer for perfect flour hydration; a large, curved mixing vessel that ensures correct water absorption and maintains the required hygiene levels; a vertical forced feeding screw to dose the dough into the cooking screw; a powerful variable speed motor equipped with safety clutch; and a double cascade gearbox with high torque delivering a high level of reserve power and safety.

Control system
The typical control system of xTru Twin extruders features a supervising unit monitoring all functions of the extruder from dosage to the cutting unit, allowing for easy recipe management and displaying all process variables, such as raw material flows, extrusion torque, specific mechanical energy value, barrel temperatures and die pressure. The supervising system stores the values and allows data to be exported and managed with commonly available spreadsheet software.
Coating ready-to-eat breakfast cereals with variously flavoured or coloured syrups is a standard operation that is intended to make the product:
• more palatable by improving its taste;
• more attractive by improving its appearance;
• more suitable for consumption with liquids such as milk.

The coating system can comprise two rotating drum stations that work alternately to ensure continuous operation, with one station working while the other is being washed.

The uncoated product is fed through a gravimetric dosing system which, combined with a flow meter that manages the sprayed application of the syrup, manages the process in order to keep the coating percentage constant.

The whole syrup injection circuit is insulated to maintain the desired temperature and avoid dropping below a threshold that would lead the sugar in the liquid to crystallise and therefore clog the system. This expedient thus allows syrup with a high sugar concentration to be used.

Product exiting the drum enters directly into the high-temperature DS continuous dryer, where the flow is managed by a calibrated distribution system to achieve even and precise drying.

Finally, for flaked cereals, the time and temperature parameters of the DS dryer can be controlled to obtain frosted or shiny effects on the finished product.

Cleaning and washing
Given that the frequent use of sugar tends to leave behind solidified deposits, the coating system has been designed to be easily washable: the dryer is configured to allow washing of the metal belt by means of nozzles on each level the dryer bottom is designed to drain the water used for washing the coating drums have variable speed and inclination as well as a stop position, to facilitate the drainage of cleaning water.
Consulting, development of bespoke processes and products, a dedicated test centre and training courses at the service of our customers.

Teaming up with GEA means you benefit from the knowledge and experience we have accumulated over the years, and our Research and Development department is the ideal partner, sharing this know-how through the services of:

**Consulting**
- analysis of the customer’s raw materials and assessment of their compatibility with production processes;
- advice regarding process lines, with technological assistance aimed at optimising and improving existing processes or evaluating alternative solutions;
- specific and specialised training for the customer’s process line operators and maintenance personnel;
- definition and characterisation of the finished product with the aim of isolating the decisive characteristics for its manufacture;
- comparison between different finished products and tests on our pilot lines.

**Development of bespoke recipes and formats**
- development of raw material blends;
- testing and development of new formats;
- development and testing of innovative processes;
- collaboration with the customer on the development and manufacture of new products.

**R&D test centre**
Development of new food products can be a costly and labour-intensive investment for many customers. The addition of complex formulations, detailed process design and plant validation can make it a daunting process for some customers to undertake alone.

To help achieve greater confidence in the safe and repeatable production of your food products prior to market release, GEA has built dedicated test centres, designed to aid development and trialling on a small scale before releasing for larger scale production.

Created with the aim of sharing knowledge and expertise on food production technology, the Food Tech Master is a series of professional training courses that we have run since the early 2000s. Each professional course offers in-depth technological expertise on the production process of the main pasta, snack pellets and breakfast cereals technologies.

**Analysis laboratory for raw materials and finished products.**

A team of over 20 people including technologists, mechanics and laboratory experts.

Pilot lines equipped with all our extruders and with capacities ranging from 25 kg/h to 500 kg/h, configurable according to the different types of product cutting.

Our mechanics are dedicated to maintaining and improving the labs, machines.