The CLEXTRAL group is constantly evolving. Our frequent contact with clients worldwide provides the insight for our continuing innovations to meet each market’s changing requirements.

In each new issue of Clextrusion, we share details of our technical and process developments, together with our successes in engineering for complete lines.

In issue N°11 of Clextrusion, we also have the pleasure of presenting a new commercial aspect: **CLEXTRAL, a valuable resource in the market for second hand equipment.**

To ensure the satisfaction of CLEXTRAL customers who are interested in used extruders, peripheral units, or spare parts, we have dedicated our resources to developing this area since the beginning of 2004.

If you are looking for an opportunity to enhance your production tools, don’t hesitate to contact us!

Better yet, come to Firminy and look around the building that is dedicated to the presentation of second hand equipment.

Welcome to the second hand equipment showroom!

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**summary**

**NEWSFLASH**
Extrusion: market for second hand equipment.

**TECHNOLOGY**
Reactive extrusion: real potential for twin-screw technology

**DEVELOPMENT AND PROCESS**
Automated control of production lines.

**REALIZATIONS**
- The LYMAC Combipack: ... the winning combination
- From truck to truck... AFREM at your service.

**TESTIMONIAL**
RUSSO MANGIMI: “premium” products

**EVOLUTIONS**
Record in ALGIERS: a couscous of 6,5 T!

**IN BRIEF**

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WHAT IS REACTIVE EXTRUSION?

By providing continuous control of widely differing reactive environments in a single item of equipment, a twin-screw extruder enables us to give priority to macro- and/or micro-mixing, efficiently control a temperature profile and also form the product. Therefore, we define reactive extrusion as the time when the extruder is the site of chemical reactions used to make or modify products. Its applications cover:

- The mineral, organic, and macromolecular domains.
- Reactions suitable for High Temperature Short Time conditions
- Systems limited by physical kinetics (viscous or solid-liquid environments, etc.)
- Industrial situations confronted with the passage from discontinuous to continuous states to:
  - develop new materials
  - increase product quality (batch homogeneity), or process productivity
  - improve operator working conditions and reduce environmental impact (confinement of the reactive volume)
  - improve the economic and competitive aspects of the system.

EXAMPLES: CHEMICAL MODIFICATION OF POLYMERS

Considering that it takes about ten years to develop and produce a new polymer, reactive extrusion enables new materials with controlled properties of use to be developed more quickly using existing, widely known polymers. We can mention:

- Production of mixtures of polymers that were originally chemically incompatible
- Functionalization of polypropylene by grafting a monomer to improve its surface properties with a view to applications for paints
- Production of a thermoplastic elastomer by reticulation in situ
- Peroxide degradation of polypropylene
- Chemical recycling of polyesters into α-ω diols
EXAMPLES: ORGANIC CHEMISTRY
▶ Production of industrial soaps to draw metals using a continuous saponification process
▶ Oligo-condensation process for phenolic resins:

![Diagram of saponification and oligo-condensation process]

3 "process" sections in series:
the devolatilization and polycondensation sections are the most critical as to adaptation of the equipment and the operating conditions.

In these two examples, the conditions of extrusion have to be adjusted empirically by testing, at a temperature enabling a short residence time of about one minute. Furthermore, assessment of the heat transferred to the product meets with two difficulties: estimation of the transfer coefficient and estimation of the wetted surface, which is closely linked to the speed and the flow rate.

EXAMPLES: MINERAL CHEMISTRY
▶ Production of catalyser supports based on alumina.

In this case, the objective is to obtain a porous structure in a thick alumina-water mixture through a reaction of the nitric acid under the effect of intense but controlled mixing (importance of the shear rate / residence time combination), and then neutralization with ammonia. The conditions of transformation have a direct influence on the mechanical properties of the extrudates obtained. Besides improved productivity, the twin-screw process also reduces the percentage of nitric acid necessary by a factor of 3 as compared with the batch process, and hence greatly reduces the quantities of toxic waste compounds produced by secondary reactions (NOx).

THE SCIENTIFIC AND TECHNOLOGICAL BOTTLENECKS
These are of three types:
▶ A lack of knowledge as to the thermokinetic and thermo-rheological data, and the reactions and surroundings involved. This complicated in that the twin-screw operates here under conditions (concentration, time, temperature) that are considerably different from those usually found.
▶ Ensuring compatibility between the kinetics of the chemical processes and the residence times, and understanding the strong links between evolutions in the reactions and the phenomena of transfer and transport in twin-screw extruders (especially control of the secondary reactions).
▶ Taking into account evolutions in rheology associated with chemical transformations, based on the notions of macro- and micro-mixing, heat exchange and viscous dissipation.
**AUTOMATED CONTROL OF PRODUCTION LINES**

**Introduction**

How can we control the transformation process from raw materials to a finished product that is packaged, approved and standardized? How can we evaluate production, respond to operating situations, and monitor quality at each stage? One way is automation, an essential tool that provides powerful solutions to help us to answer these questions.

The CLEXTRAL Group provides automation systems that are adapted for every application. Whether for activities linked to AFREM, CLEXTRAL, LYMAC, or for other, separate applications, our automated systems provide control and consistency, reduce costs and ensure traceability.

**Automation**

**A suitable response to meet each need.**

We listen to our customers to understand what they want to achieve, spending time during the initial planning stages to provide the best response to our customers’ requirements. We work closely with customers to achieve cost optimization for each project. We develop the best control system solution for each application, whether a single programmable logic controller or an automation package that operates the entire factory.

**Some basic technology ...**

**Actuators** (valves, motors, cylinders, electrical heater elements, etc.) are piloted by electromechanical systems such as digital contacts (e.g. On/Off buttons), analogue signals (variable signals over a range of measurements from 0 to 100%), or regulators to control variable speed motors, for example.

**Sensors**, such as thermocouples, pressure sensors, level detectors, tachometers, flow meters, etc., deliver signals that are generally amplified and transformed using converters. For example, those converting analogue data (microvolts, milliamperes) into digital data; these data are then processed by calculation in an automatic controller; they are compared with the set values and then sent on to the actuators.

**The architecture**

Thus a single unit is made up of actuators, sensors, and safety equipment (fuses, circuit breakers), all installed in an electrical cabinet.

**The programmable logic controller** is made up of a Central Processing Unit (or “CPU” that includes a calculator); boards for communication between the various items of equipment on the one hand, and the central command and control system on the other hand; and digital Input/Output boards.

Rockwell/Allen-Bradley, Siemens and Schneider/Télémécanique are suppliers of programmable logic controllers known worldwide; they are partners of CLEXTRAL. Programmable logic controllers may be used to control several items of equipment, carry out automatic operating sequences, detect anomalies and inform the operator via alarms.
The operator terminal, also known as the MMI - Man-Machine Interface - is associated with the programmable logic controller. It includes a display unit and a parameter display program using tables, graphs and diagrams. It forms a true link, and provides a means of dialogue between the operator and the machine. It enables the display of real time operating data. It can also be used to associate quality criteria for the finished products (colour, texture, density, etc.) with certain machine parameters. The data is easily recorded to conserve historical records of the parameters, display trend lines, or memorize recipes. Depending on the options selected, it is possible to carry out machine maintenance and diagnosis operations remotely (see the article on “teleassistance” in Clextrusion N° 10).

Several programmable logic controllers may be connected together: they communicate via specific networks such as Profibus or Ethernet; this takes us on to centralized control. This is usually carried out in a separate, protected room that constitutes a real control centre for the production unit. One or more display units are used to enable the operator to control and display all the parameters for the line as a whole, from the raw materials to the finished products. There are several levels of access to supervision: display, control, maintenance, and administration.

The centralized control system gives the operator access to trend lines, historical records of all production parameters, and faults found (alarms). He can monitor the manufacturing process in real time, and review past operating conditions in days or months, depending on the system configuration. He can export files, draw up statistics, and make overall calculations. The control room will be equipped with a printer for reports and a data recording system.
Traceability and MES

Precise knowledge and monitoring of industrial processes, and control of food safety, involve traceability: many companies are called on sooner or later to install equipment and use working methods to comply with standards. Thus the European community has imposed directives in agro-food activities that come into effect in January 2005, as part of its regulation N° 178/2002.

Amongst other things, the **M.E.S** or “Manufacturing Execution System” option proposed by the CLEXTRAL Group integrates this possibility. The main objectives of this system are:

- traceability, e.g. from the finished products to the raw materials,
- optimization of manufacturing,
- control of manufacturing costs,
- swift adaptation to the various manufacturing constraints.

The system operates around a main core: a centralized database is supplied by several modules, such as acceptance management, manufacturing orders, production assessments, batch management, maintenance, etc.

Detailed information is provided for each module: for example, in “batch management”, each manufacturing batch is identified. We can find the set values for the machines that manufactured the products, any alarms that may have been triggered, the persons who operated the machines, the raw materials used for the batches with the results of the analyses (if the quality procedure provides for this), the use-by dates, the results of analysis of the finished products (samples): overall, it provides a genealogy of the batches manufactured.

A simple bar code reader can provide access to all this information.

The system provides historical operating data including the interventions completed, periods of operation, and maintenance performed. These functions are valuable tools for the department heads, because they enable an analysis of the manufacturing processes, allowing managers to optimize their use, and control costs.
A well-defined MES system will monitor quality, provide unit flexibility, and reduce manufacturing costs.

Finally, we reach the top of the pyramid, with the ERP or «Enterprise Resource Planning» system, which incorporates the MES tool in overall company management: it also takes into account the purchasing, financial, human resources and customer management functions.

Conclusion

With automated control, it is possible to establish a downstream genealogy - from the raw materials to the stored finished product - and an upstream genealogy: which raw materials were used to contribute to the measured quality of the end product?
CLEXTRAL provides the experience and means necessary to supply this tool and help our customers to set out their specifications. We can implement each of the phases as defined up to the MES stage, while taking into account the requirements of the customer’s existing or future ERP system.
CLEXTRAL’s services include consultation, diagnosis, and recommendations within the framework of automatic controller engineering, together with supplies, installation, tests, and training for new or existing lines.

We can thus enable our customers to make the most of the latest developments and contribute to their growth by reducing manufacturing costs, and also by securing and standardizing their units: enhancing the company’s product quality and brand image.
THE LYMAC COMBIPACK: THE WINNING COMBINATION!

Packaging is a fundamental phase that comes at the end of a manufacturing line. Each manufactured article must be specifically packaged and prepared for transport, storage and sales. LYMAC can provide completely automatic units for the phases ranging from the bulk finished products to the pallets ready for loading. The Combipack was designed to streamline these operations.

The LYMAC Combipack is composed of two complementary units: it combines a bagging machine and a vertical cartoner for “bag in box” packaging: a bag is shaped, filled and welded, then placed directly in a carton, in a fully automatic process.

This system offers maximum flexibility to package a wide range of dry products with varying particle sizes, from very fine powders to pasta, via rice or pellets for pet foods. Compact, reliable, and economical, the “Combi” also has other advantages:

- to change the bag size, simply change the former on the bagging machine,
- it is very easy to modify the carton sizes in all three dimensions, without any extra equipment,
- it accommodates a wide range of carton shapes: parallelepiped, conic, etc.,

- the two machines (bagging machine and cartoner) may be operated separately,
- the bagging machine offers the flexibility to utilize various dosing systems to suit the products packaged: screw type metering systems for powders, cup type systems for pellets, or associative scales for the fragile products such as extruded snacks or breakfast cereals.

The average filling rate is 45 boxes per minute, depending on the type of packaging materials (cartons and films), and type of products to be dosed. These characteristics make the new LYMAC machine highly competitive.

The many features of the Combipack ensure flexibility to meet market demands today and in the future. Today, installations of this versatile machine include packaging powdered milk (LABELLE group - Algeria) and packaging pet food pellets (CEC company - France).
Between receiving semolina at the factory and shipping the packets of pasta or couscous that go from delivery pallet to the store shelves, a complete selection of equipment is necessary. AFREM can supply you «from truck to truck»!

A truck delivers the semolina to the customer’s factory, where it is stored in raw material silos. Then comes the core process: the manufacturing line to produce pasta or couscous, designed by AFREM, which is composed of the following elements, depending on the end product: dosing the raw materials, followed by extrusion, rolling, VHT drying, cooking and cooling units, together with the line control systems (electrical power supplies, automatic controllers and M.E.S).

Once processing is completed, the bulk product is stored in finished product silos. Next, the product is packaged into individual 500g or 1 kg packets by a LYMAMAC machine, or bulk-packaged into packets up to 25 kg by a bulk machine. A cartoner packs the products into cartons, or a wrapping machine stretches wraps several packets together, and the finished products are placed on pallets for transport to the retailer by truck!

For several years, AFREM has supplied and installed all the peripheral equipment for its customers: upstream and downstream storage silos, refrigeration units, boilers, air compressors, vacuum pumps, etc. AFREM engineers can also advise customers who prefer to purchase the peripheral equipment themselves.

The AFREM team is an integrator, supplying the required equipment for all phases, from processing of raw materials to shipping the packaged product, providing a turnkey pasta or couscous factory, from start to finish.

Customer service is the highest priority of the AFREM team members, who work to manufacture the production line to meet the customer’s requirements and deadlines, also including:

- Engineer the overall plan of a new factory or lay out a new line in an existing building.
- Define the peripheral equipment, attaching special importance to certain crucial points such as:
  - Checking the heating capacity installed in the boiler room, a vital sector of the factory;
  - Correct calibration of the vacuum pump to enable manufacture of high-quality dough;
  - Fitting the compressor with a suitable air treatment system to ensure long service life for the equipment. This can mean dry air for the instrumentation, for example, and oiled air for the pneumatic cylinders;
  - The refrigeration units to cool the presses and the product. They enable recycling of the water for closed circuit operation, a solution that is appreciated in countries where water is scarce.

- Supervise installation of the various connections necessary,
- Supervise line assembly and start-up,
- Train the customer’s staff and provide process assistance, especially via the modem-based remote support service included in our InFrem automation system.
Located close to Naples, at the foot of the volcano Vesuvio, the family-owned company RUSSO Mangimi is one of the main Italian actors in the field of pet food. The young owners, MM Nicolas and Angelo RUSSO describe their company’s activities.

Angelo RUSSO, Sales and Marketing manager:

“Our company manufactures cat and dog food under the main trade mark FARMINA with various labels: CIBAU for dogs, MATISSE for cats, ..

We are among the leaders in the Italian pet food market and recognized as a manufacturer of high quality food for domestic animals.”

Clx: How do you see the evolution of these « premium » products?

A.R: This market is growing in Italy and we expect to double our production level in the next 3 years. Another goal is to increase our export rate which today is around 30%. We are currently working on many export projects.

We feel our growth is dependent on our quality and flexibility. We must create and develop new products as well as react to specific market demands.

Clx: It is rather impressive! but, how you are doing?

A.R: We manage our business very efficiently: all steps of the manufacturing process from the analysis of raw materials, through production, to packaging and distribution are strictly controlled and maintained.

We listen carefully to our customers and work to anticipate future requirements in the changing marketplace: such as the increase in urban living and the need to address the health of animals at every step of their life... etc. Our R&D department is very active in these areas. The acquisition of CLEXTRAL technology has helped us gain a significant market share.

Clx: Can you explain how?

Mr Nicolas Russo, factory manager:

We purchased two turn key production lines from CLEXTRAL. The first line, purchased in 1998, gave us the opportunity to become familiar with twin screw extrusion processing and the related drying and coating technologies. We have improved the nutritional value of our feeds: better gelatinisation of the starches and therefore a higher digestibility, use of a larger range of raw materials and ingredients to increase the levels and the value of our recipes such as protein sources, minerals, lipids and vitamins.

Our customers reacted very positively and our sales increased. Today we offer more than 20 different food formulas.
This technology allows us to switch rapidly from one manufacturing program to another because of the flexibility of the equipment: shutdown and start up procedures, cleaning, and maintenance are quick and simple operations. In 2001, we decided to invest in a second production line which included the most advanced developments and technologies including the Evolum extruders, the counter-flow drying system, and highly accurate coating technology. This line, which produces from 10 to 20 tons of finished products/hour has been the key to fulfilling our strategy. We have taken advantage of CLEXTRAL’s experience, adding to our own knowledge in the fields of recipes, line optimization, traceability and marketing.

**Clx : This cooperation with CLEXTRAL is beneficial for your company ?**

N.R : Yes it is!; as we stated, we have increased our market share. We maintain a close working relationship with CLEXTRAL and feel our success is due to this continuous exchange during the past several years. It is important to have a single source supplier who takes the responsibility for engineering, supply of the equipment, commissioning and after sales service. This is a win-win relationship. As a result of this cooperation, we anticipate new initiatives for a larger range of pet foods, better control of our costs and increased investment capacities.

**Clx : Nicolas and Angelo Russo, we thank you for your time and wish you continued success.**
Gilles MALLER joins CLEXTRAL SAS in July 2004

Gilles Maller holds an engineering diploma from Ecole Nationale Supérieure des Techniques Avancées, and he represented CLEXTRAL’s interests in 1993 and 1994 in FRAMATOME’s Moscow office, before joining the CLEXTRAL company in January 1995. After working for 3 years as a sales engineer responsible for Central and Eastern European countries, the Middle East and the United Kingdom, Gilles was appointed sales manager for North America with the CLEXTRAL Inc. subsidiary in Tampa, Florida. He was promoted to Sales Management for North and Latin America, with responsibility for the test centre and the services activities. He was awarded an MBA during his stay in the USA. Beginning in July 2004, Gilles will have dual responsibilities with CLEXTRAL SAS:

- Developing sales of turnkey lines worldwide,
- Accelerating the dynamics for creation of new products in partnership with our customers.

Laurent GARCIA joined CLEXTRAL Inc. on 1 May 2004.

Laurent Garcia, who holds an engineering diploma from the Ecole Nationale Supérieure Hydraulique in Toulouse, began his career as a sales engineer in a company specializing in equipment for centrifugal pumps, before joining CLEXTRAL SAS in 2000. Building on his technical and commercial experience of complex systems, he accepted a position as head of sales and marketing at a worldwide level in the DKM division: the wide variety of applications brought him into contact with the Agro-food, Energy and Petrochemicals markets. His taste for challenges has motivated Laurent Garcia to accept the position of sales manager for the CLEXTRAL group in North America. He will bring his skills to the team based in Tampa and enable our customers to benefit from the Group’s new knowledge in the field of complete lines and creation of new products, with the help of the two R&D platforms in Tampa and Firminy.

IN BRIEF

Record in ALGIERS : a couscous of 6,5 T !

The largest couscous ever prepared in the world was confirmed Thursday, June 3, 2004 in Algiers. It required 2,6 T of dry couscous, furnished by SIM (Industrial Semoulerie of the Mitidja) customer of AFREM Group CLEXTRAL, also the meat of 100 sheep and 1,5 T of vegetables.

This amazing dish, 6,5 T of couscous, served 22,000 guests. This gigantic preparation required a couscoussier 8 m high and 4,30 m in diameter, which was initially conceived by Thierry Viel, an AFREM engineer. A 3 T boiler was crafted by a boilerworks business to support the couscoussier. The preparation and service were provided by the students and professors of the hotel school of Tizi Ouzou.