



Clextrusion

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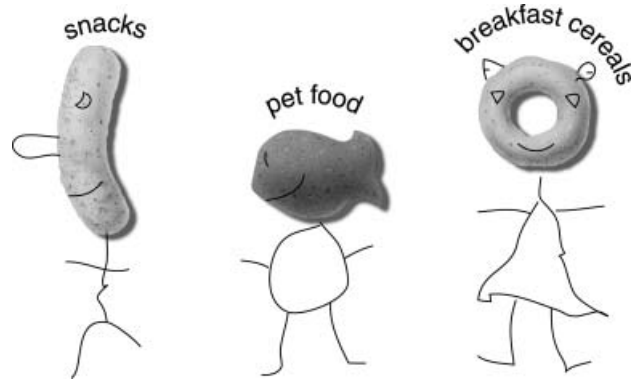
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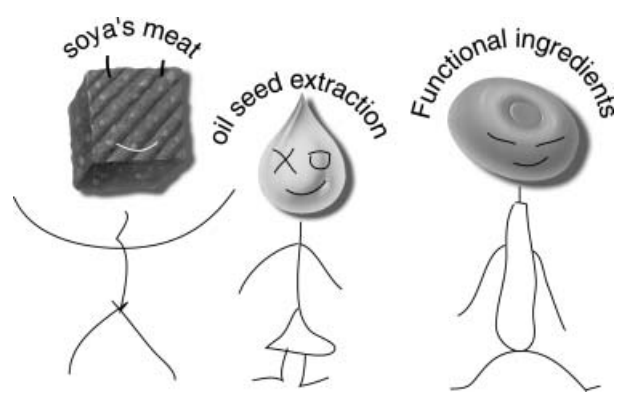
Throughout Clextral's history, the company's dedication to innovation and enthusiasm in rising to market challenges has driven our growth. Adapting to change, both in gradual market shifts and more immediate shifts within the functions of our corporate structure, has been a hallmark of our company's success. Our policy of innovation has several objectives :

- To ensure that we increasingly listen to our clients and monitor the market, with great attention at all levels.
- To promote partnership approaches, to enhance the relevance and effectiveness of innovative developments.
- To ensure continuous and dynamic development of the firm's skills, from mechanical engineering through to the mastery of complete systems (systems + process + training).

By devoting at least 5% of its turnover to R & D, Clextral aims to market competitive and reliable products and services, and to lay the foundation for the future by developing innovative products and processes.

Through Clextrusion we are able to keep you informed about concrete events and give examples that illustrate Clextral's innovation policy. This particular issue concentrates on research into mechanism of melting in a two-screw extruder carried out by Gilles Souveton as part of his post-graduate work.

J.M. Bouvier
Director of Extrusion Business



www.clextrusion.com

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Development & Process

Summary of

Modelling the melting of polypropylene in a twin-screw co-rotating extruder :

Introduction to the field

In a previous issue of Cextrusion, we described a study of the melting of polypropylene in a co-rotating two-screw extruder. This analysis, based on a number of experiments, demonstrated the four successive stages as the polymer changes from the solid (granules) to the liquid state. It also produced a substantial database (on pressures, material temperatures, dwell times, power consumption, and so on) that can be used for validating the modelling process we now propose to develop.

Modélisation

The model developed follows the melting process in a thread - mixer - reverse pitch sequence similar to the screw profiles used in industry

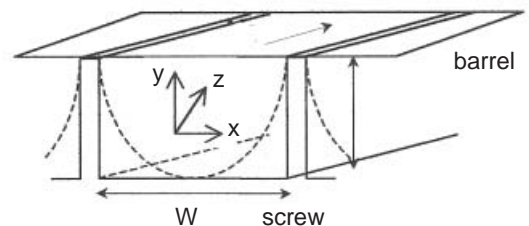


The model essentially considers a liquid/solid suspension, with no particular configuration of the solid in the screw interspaces. A one-dimensional approach is applied, compatible with that used for developing the LUDOVIC® program used for modelling the flow of molten polymer in this type of machine.

It is assumed that the screw interspace is rectangular, with the barrel rotating around the screws as in a

single-screw machine.

Shearing of the material in the interspace results in a dissipation of energy. This thermal activity, combined with the energy exchanged through the barrel by



conduction, tends to increase the temperature of the liquid and reduce the size of the granules. As a result, the temperature of the solid granules increases through conduction from the surrounding liquid.

If we consider an initial solid fraction Φ_0 of spheres of radius R_0 at temperature T_{s0} , in a liquid at temperature T_{l0} , setting the starting point of melting at z_0 and defining a time increment Δt , then the following are calculated in turn at each time t : density, flow rate through the interspace, mean rate of shear, equivalent viscosity, pressure gradient dp/dz , energy dissipated, reduction in radius, increase in the temperature of the liquid, and increase of the temperature of the solid.

The distinctive feature of the mixers is that there is no twist (or helix). They are mounted in series, each offset at a certain angle with respect to the others : each mixer then generates a circumferential pressure profile that reaches a maximum prior to each apex. The offsetting of the pressure profiles (related to the offsetting of the mixers) generates an axial pressure gradient along the screws which transports the material. By solving Stokes' equations one can calculate the circumferential pressure profiles and then, by iteration, their offset



the Research works completed by Gilles Souveton

such that the axial flow generated is equal to the real flow through the machine.

Melting is complete when the radius of the granules is equal to zero, or when the temperature of the solid reaches the melting point. If the pressure is non-zero at the exit from the reverse screw, the value of z_0 is changed and the calculation repeated.

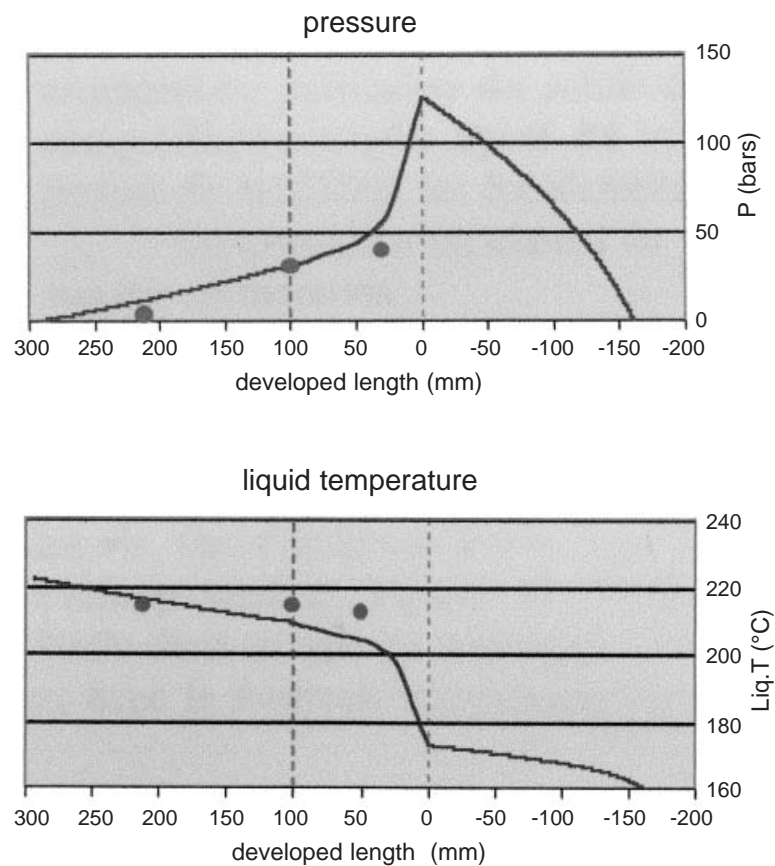
Résultats

The results obtained with the model are generally in agreement with those of the tests, particularly regarding dwell times, pressure values and the solid fraction. The widest difference between model and experiment concerns the calculated liquid temperatures (20 to 30°C maximum), but this is not critical in view of the initial assumptions and the difficulty of making measurements. The starting point of melting is also well modelled.

Outlook

This study will enable optimisation of screw profiles in the melt zone, notably for the range of EVOLUM extruders. It might also complement the LUDOVIC® software program and serve to improve its performance.

Gilles Souveton



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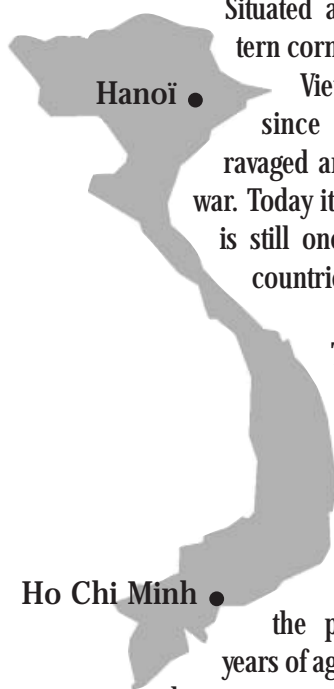
Realizations



Spring in

Anything will grow in Vietnam...

Vietnam was created under the sign of the dragon god, and the country is said to have the shape of an inverted dragon.



Situated at the extreme southeastern corner of the Asian continent,

Vietnam has been coveted since time immemorial, and ravaged and ruined by 50 years of war. Today it finally knows peace, but is still one of the world's poorest countries.

There are nearly 80 million Vietnamese, with an average population density of 225/km², and the country of the dragon is the most populous in Asia. Half of

the population is under 15 years of age, and eager for new products.

Although the country's natural resources are substantial, they are yet untapped. The country's economy is based essentially on agriculture : anything will grow in Vietnam... and 80% of the population earn their living from the land.

Rice from the Mekong and Red River deltas, where there are 2 to 3



harvests a year, is the basic foodstuff, and the country is the world's 3rd largest exporter of rice.

It is in the north of the country, in the capital Hanoi, at the head of the Tonkin Red River delta, that Clextral installed Vietnam's first production line for expanded snack foods in the spring of 2000.

Trang An Confectionery is a state company producing confectionery, sweets and waffles.

Contacts were initiated 3 years ago. Then the project kicked off again.

The invitation to tender issued by the Vietnamese government called for an extremely detailed and precise bid.

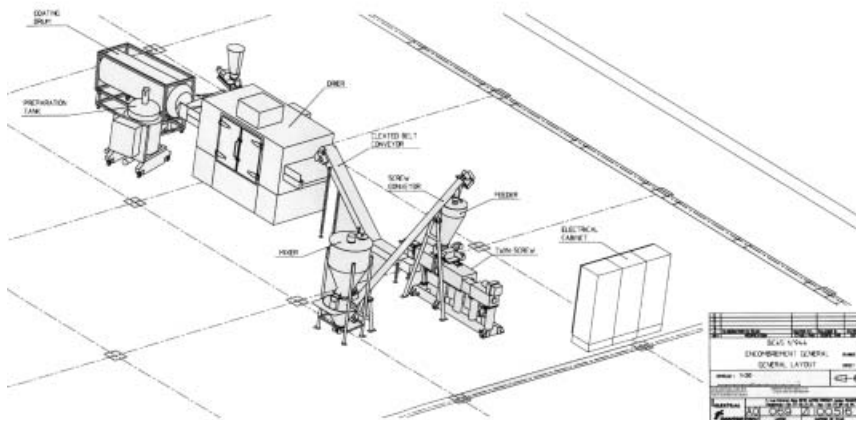
The trust placed in the Clextral team was rewarded by the signing of the contract without prior testing, a fairly unusual event.

Turnkey products

The production line supplied to Trang An consists of : a vertical mixer, a screw conveyor, a feeder, a BC45 NS twin-screw extruder, a granulator/cutter, a belt conveyor, a belt drier, and a drum coating system.

This installation allows considerable flexibility in using local raw materials - essentially rice and tapioca - for producing expanded and crunchy products. The typical recipes, based on maize flour, were adapted, reworked and tested and the production parameters were adjusted to create products that would satisfy the Vietnamese taste.

The company decided to make products with a variety of attractive shapes : balls, curls, stars, rings and animal shapes such as squirrels, dolphins, bear cubs and



the country of the dragon...

elephants. The Clextral system provides the flexibility to process these shapes with quick change dies, at a rate of 200 kg/h.

Tests were carried out on the site during installation which took place in 3 stages over a 3 week period between April and May 2000. Commissioning was completed during the final visit in May and involved the training of a group of 10 people, assisted by an interpreter.

The smooth progression of this project in an atmosphere of mutual trust, and the co-operation of the Trang An team in embracing this new technology, illustrates the benefits of this type of supplier-customer relationship and the rewards for continuing to cultivate this co-operation in the future.



T echnology

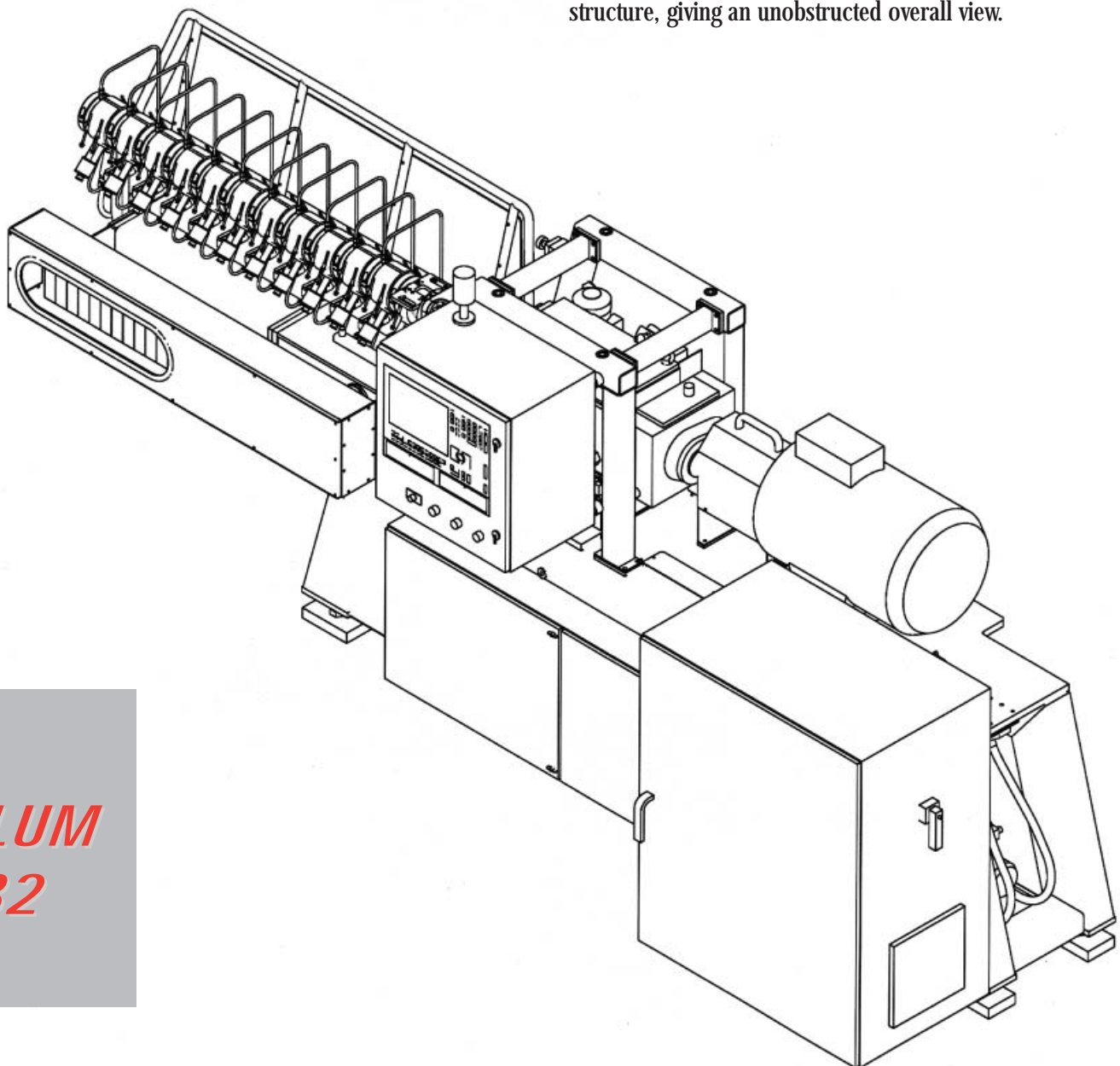


The EVOLUM

Benefiting from the same design and technological developments as the Evolum HT 53, Evolum HT 88 and Evolum IT145, our newest model - the Evolum HT32 extruder - is seen as the new laboratory tool for every application. Indeed, its innovative and compact design makes it ideal for laboratories and R & D centers.

The Evolum HT32 is an extremely simple machine : to start it up you just switch it on.

A notable feature of the Evolum 32 is its compact size : the entire electrical installation and its cabinet are cleverly positioned into the sides of the extruder structure. The operator's interface terminal is attached to the side of the structure, giving an unobstructed overall view.



**EVOLUM
HT 32**

range continues to grow...

Consistent with other models in this range, the support for the peripheral systems is built in, allowing, for example, the installation of a peripheral equipment

The absence of a separate electrical panel, the reduced overall size, and the design improvements concerning slide opening are substantial advantages. Evolum HT32 is available with various combinations of motor size and screw speed. The enhanced motor power is a major benefit of the EVOLUM High Torque range. Evolum HT32 is therefore ideal for R & D and for small size industrial productions.

This enhanced performance clearly offers very high efficiency

at an extremely competitive price.

By the end of 2000, 3 new machines will be installed in R & D centres, in the United States, Great Britain and Germany respectively for applications concerned both with agro-food products and plastics.

Now it's your turn to innovate !

At the same time the design teams are completing the development of an industrial sized machine, the Evolum HT 68 extruder.

CLEXTRAL EVOLUM HT32

Screw diameter : 32 (D)

Distance between centrelines : 26 mm

maximum torque per shaft : 200 N.m

maximum pressure : 275 bars

Length of a barrel module : 128 mm (4D)

minimum length of the barrel : 12 D

maximum length of the barrel : 48 D

Maximum motor power at maximum screw speed : 50 Kw

Service & Maintenance

Second-hand Clextral extruders : change for the better !

When Clextral Services technicians visit our customer's plants, they naturally listen to what the clients want : some are interested in increasing the production capacity of their system, while others are looking to benefit from the latest technological developments of our equipment, or even to buy a new extruder to replace their existing Clextral system.



BC 92 before check up



refurbished BC 92

When an extrusion system is removed from a customer's plant, it is not necessarily the end of its useful service. First, Clextral Services technicians complete a detailed appraisal of the Clextral system destined for the second-hand market. They determine its condition and value before returning it to our Firminy factory, where consideration is given to its possible applications and it receives an initial overhaul.

Our sales engineers, along with the CLEXTRAL technical team, work with interested manufacturers to determine the configuration that would best meet their needs.

Once the extruder has been configured to meet the customer's requirements and delivered to the new site, it is commissioned by our own technicians. It has been inspected, tested and reconditioned to Clextral standards, and is guaranteed to comply with the relevant standards in the same way as a new machine.

A previously owned extruder can be of great value to new businesses, to companies testing new products, or those looking to move towards twin-screw extrusion technology.

A twin-screw extruder - even a second-hand one - can be the instrument of innovation !

In brief...

In 2001 :

Clextral will be present at the following shows :

VICTAM in Utrecht, NETHERLANDS from 24 to 26 April, 2001

KUNSTSTOFF 2001 in Düsseldorf, GERMANY from October 25 to November 1, 2001

IFT in Nouvelle Orléans, USA in June 2001

ConfitExpo in Guadalajara, MEXICO from July 31 to August 3, 2001

Petfood Forum Chicago, USA from March 26 to 28, 2001

AACC table top

OUZBOUM : Opening of the site in Uzbekistan for the construction of a plant producing paper pulp for printing/writing paper as well as commercial pulp.

The initial phase being completed, all plant and equipment was shipped this summer. Work on site has now begun and is expected to take 8 months including plant construction and commissioning.

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