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TOMORROW'S PACKAGING IN THE PHARMACEUTICAL INDUSTRY*

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Introduction

Packaging is made up of one or more materials. It fulfils one or more functions and requires the use of one or more different kinds of machines.

We must examine each of these components before trying to sketch out what the future of packaging will look like.

We shall study:

- In the first part, packaging trends:
 - The current trends for different materials used in packaging and the medium- and long-term outlook;
 - Packaging's main functions today and how they will change over the next few years;
 - The changes that machines will undergo in order to gear up for the future.
- In the second part, we shall examine actual and future technology for pharmaceutical products in packaging fields.
- In the third part, we shall study the questions useful to determine ink for printing of plastic-based packaging materials.
- We shall conclude our analysis by describing what we think the four leading packaging trends will be over the next fifteen years.

I - GENERAL PACKAGING TRENDS

I.1 LIGHTER, SOFTER MATERIALS

The five basic materials used in packaging are wood, glass, cardboard, metal (especially tin and aluminium) and plastics, which were developed as late as the 1950s.

These materials make up most of the packaging industry's sales in Europe, France and the world. Their share of total sales varies depending on their degree of maturity.

For example, wood sales in packaging have been dropping steadily. Their share of total sales in France went down from 7.8% to 6.8% in the four years from 1985 to 1988.

Metal has lost an average of three points over 18 years and cardboard has fallen around five points in the same period.

On the other hand, the use of some materials is increasing percentage-wise. Glass has gained three points in 18 years. Plastic has undergone the most remarkable growth. Today, it accounts for more than 25% of all packaging materials in France, which is twice as much as fifteen-old years ago.

We can plot the positions of the various materials on a life curve, called an S-curve. This curve can be broken down into four phases : birth, adolescence, maturity and decline.

Thus, materials reaching the end of maturity, such as wood and tin, will rarely be behind innovations in the future. The few advances that use them will only serve to slow down their inevitable decline. Progress will be connected to the way these materials are processed rather than to the materials themselves. Manufacturing will be industrialized and standardized, as in the case of wood, or computerized and automated, as in the case of tin.

Materials in the mature phase such as paper, cardboard and glass, will undergo changes in production - CAD will reign supreme. They will also receive various physical and chemical treatments giving them properties that are still not thoroughly mastered : special paper for envelopes, self-extinguishing cardboard, lighter yet stronger glass, etc...

Materials in the growth phase, such as plastics, aluminium foil and complexes, will be the targets of major advances. The aim of these improvements will be to increase the materials' intrinsic properties and find new uses for them. Barriers will be higher, new coatings will be developed, fusion temperatures will go down, sealability will be better and the risks of cracking will decrease.

New materials, such as composites-a kind of alloy- are being developed. They will make it possible to enhance the properties of each component without any of the drawbacks. Europe, the United States and Japan are working on such projects, which should soon pass from laboratory research to the industrial production stage.

So we can see that the trend is towards replacing the old, simple and hard materials with newer, softer and more complex materials. Furthermore, mono-materials are increasingly being replaced by multi-materials.

1.2 FUNCTIONS ARE MOVING AWAY FROM INDUSTRY AND TOWARDS MAN

1.2.1. In the beginning, Power was in the hands of a few manufacturers

We needn't think back to the times of Roman amphorae or the noble trades of "Master Blacksmith" and "Master Glassworker" to remember that packaging's main role is a technical one. We only need to look back to the 1950s to be reminded that its basic function is to protect.

Packaging is a tool that safeguards quality, guarantees quantity and makes logistics easier.

If we plotted this idea on the Y-axis of an S-curve, the protection function would reach today approximately 90%.

There are still some packaging materials that do not work well, that leak or fall short of keeping the enclosed product fresh. But they are increasingly rare. Packaging's basic protective function has been steadily improved over the past forty years and today is reaching its most mature stage.

Packaging's "industrial" aspect was decided on by a small number of powerful materials manufacturers. The increase in consumer purchasing power has prodded them to develop new products which are so outstanding that they leave little room for spectacular breakthroughs in the future.

The consequences have been heightened protection, computer-assisted design along the length of the production line ; increasingly lighter packages ; longer product shelf life ; one-piece packaging ; improvements in shipping conditions ; improvements in productivity as part of the quest for total quality ; better monitoring of raw materials during the production process ; the development of ready-to-meal packaging for the consumer who will increasingly be able to put together, fill and seal the package himself ; computerization of quality control and decision-making assistance.

These slow but steady changes will be characteristic of increasingly international manufacturers and will use more and more multi-materials. Tomorrow, there will be fewer of them than now, but they will be increasingly concentrated.

1.2.2. Users have more clout

High-performance, increasingly numerous users did not start calling the shots until the 1970s. Driven by the intensity of mass consumption, they started thinking about using packaging as a way to sell the product itself. Packaging-as-marketing was born. More attractive, persuasive and "meaningful" packaging became necessary. This entails a new S-curve, including a sales Y-axis.

Various studies allow us to estimate that in 1990 we will reach a point of around 50%, leaving plenty of room for future advances. Among them will be improved flavour and aroma barriers, methods for keeping food fresher longer, smaller and more legible marking systems, groupage in shipping and handling units, higher-performance papers, modulatable delivery systems, increasingly strict quality control, improved resistance to storage conditions, shock-proofing of large-capacity packages, procedures such as MAP/CAP and empty irradiation, which greatly increases shelf life.

But the basic innovations will occur in decoration. They will include new printing techniques, 8-colour flexography, moulded labels, sleeve tubes, improved ability to print on specially-treated paper, silkscreen printing on glass, cardboard display shelves, shape, design and colour checked by spectrophotocolourmeters, etc...

Like the producers, these users for food, health and beauty industries, manufacturers and distributors will be increasingly concentrated. But there will still be enough of them to satisfy consumers, whose power will keep on growing.

1.2.3. A lot of decision-making consumers

They may not know it, but consumers have been in the driver's seat since the 1980s. Whether they are broken down into socio-professional, lifestyle, ethnic or cultural categories, or whether they are analyzed according to the way they look at life or their income, consumers today represent a veritable army of powerful decision-makers. It doesn't matter if they are well or badly organized, or if they know what they don't like better than what they would like. Their often poorly-expressed needs have brought about the appearance of a new packaging function : communication. This is linked to the fact that demand has gone from mass to individual consumption.

If the corresponding S-curve is plotted out, we can see that this function is still badly fulfilled : perhaps barely 20 %.

There is clearly still plenty of room for innovation. The 80% needed to reach the phase of maturity will come as a response to today's most significant consumption trends. Among these are the quest for individualism, personalization and hedonism ; the importance of health, hygiene and leisure ; the demise of traditional mealtimes ; the rise in the number of single-member households and the growing percentage of women in the work-force.

There will be a flood of new, promotional packaging products, including new, more easily-used materials which can withstand temperatures of between - 40 °C and +250 °C, tamperproof stoppers, detection systems, easy-to-open boxes and bottles, new shapes and a longer shelf life. These advances will be due to :

- Improved technology making it possible to destroy micro-organisms and absorb or even eliminate oxygen ; squeezable bottles and more transparent, shinier packaging.
- Clarifying agents ; systems that check the contents and the impregnability of the container ; unit-based packaging ; "service" packaging which is light, natural-looking, friendly, informative, personalized and adapted to the contents (for example, dangerous substances), the container (single-layer materials) and the consumer (children, senior citizen, etc...).

This "communication" function still has a long way to go. It leaps off the package to send a message to the consumer, and then bounces back and affects the package itself in the form of feedback.

1.2.4. A united but shifting group consciousness

Since about 1985, organized group movements of varying sizes, according to the country, have made it possible to perceive a new function. Packaging is becoming a means of cultural expressions, a teaching tool, a way to improve the quality of everyday life and a development aid for the Third World. In addition, in order to respect the environment less energy and as few raw materials as possible must be used to manufacture it. Of course, it must not pollute. This is the dawn of "humanistic" packaging.

This function is still in its earliest phase in France, as it is in the rest of the developed world. It represents only 5% of all packaging products manufactured today. However, increasing this figure is a top priority for the near future. New materials will be recyclable and longer-lasting. They will be printed with solvent-free inks. This packaging will help keep 800 million people from starving and will be a new means of cultural expression.

Everyday life and packaging will become closely linked. This latest function will be the one which will undergo the most stunning and drastic changes in the future. Packaging's environmental and quality-of-life aspects are becoming more and more apparent. But, on the whole, the functions involving education, culture and development of the Third World remain to be worked out.

To sum up, two basic trends are taking shape :

- Packaging's functions are becoming less and less technical and more and more ephemeral and orientated towards mankind ;
- Decision-makers are no longer a handful of powerful, highly-concentrated manufacturers, but a diverse and omnipresent mass.

To prove this, The Packaging Oscars organized by the "Institut Français de l'Emballage et du Conditionnement" (The French Packaging Institute) act as a trend indicator when it comes to the industry's degree of innovation. The number of candidates has risen from 80 to 262 in ten years. Furthermore, the results have shown a drop in the number of "technical" products, and an upturn in the amount of "marketing" products. The increase in the amount of "communication" products has been even more drastic, and the "quality of life" concept appeared for the first time in 1989.

I.3. FLEXIBLE AND VERSATILE MACHINES

Some 43 billion French Francs worth of packaging machines were manufactured in the world in 1988, which is around 3% of total materials sales. Nearly half (45%) of these machines were produced in Europe, with the German and Italian manufacturers in top positions. French production is much lower.

These machines can be broken down into four different categories, according to their functions :

- Packaging manufacturing machines,
- Processing machines which put the product into its container and stabilize it,
- Packaging machines which group together several containers in the same package,
- Packaging decoration machines.

The following table shows the breakdown of these four kind of machines :

- Manufacturing machines	10%
- Processing machines	50%
- Packaging machines	25%
- Decorating machines	15%

The growth rate could be called low for the number of processing machines, moderate for packaging machines, higher for manufacturing machines and high for decorating machines.

These trends bear out the conclusions already mentioned on the functions of packaging and processing.

It would be safe to estimate that future innovations will involve decorating and manufacturing machines more than processing and packaging machines.

It would be pointless, however, to divide these changes up according to functions ; some machines perform several different jobs at the same time.

But the most likely innovations will probably involve :

- Better performance, automation, modulation and regularity of continuous production, improvement of monitoring, reduced size and bulkiness, energy and raw materials conservation and userfriendliness for manufacturing machines,
- Operation control, machine vision, automation, easy-cleaning, access, maintenance and repair, and precision for processing machines,
- Flexibility, versatility, increased productivity and reliability, modularity, and decrease mechanics and hydraulics in favour of increased electronics and pneumatics for packaging machines,
- Improved quality, more sophisticated results, lower operating costs, improved working conditions for the operator, faster adaptation, and overall computerization for decorating machines.

Packaging manufacture and decoration will be increasingly carried out at the content's production site. This will lead to transformations of the trades involved. Yesterday's packer has become today's packaging manufacturer, and tomorrow he will be a printer.

He will have to gear his work towards manufacturing products that will vary in number, size, shape and appearance. In addition, he will have to bear in mind the fleeting character of demand, which means that he will need to adopt a flexible approach to this work.

This third chapter can be summed up by pointing out that fast, sweeping changes in demand will require packaging

machines to be more flexible than they have been until now.

II PACKAGING TRENDS FOR PHARMACEUTICAL PRODUCTS

Pharmaceutical products can be presented according to three forms: solid, liquid or viscous products.

For the first one, we find lozenge, tabloïd, granules, powders...

For the second one syrups, drops, collyrium, sprays...

For the third one creams, pomades, suppositories....

Choosing a packaging is essential for pharmaceutical industry, more than in other fields, according to an intransigent legislation.

Three main tendencies can be mentioned:

- Unitaris packages are used more and more because of security and hygiene, so we find many blisters and individual presentations :
- automated lines which give possibilities to increase production and quality,
- trans-dermic products with applications directly on the skin, which are multilayers materials, used to facilitate a controled diffusion of pharmaceutical components.

We don't have for pharmaceutical products, so many innovations as for food industry but, we can mention some examples seen during "Interpack" exhibition in Germany or "Salon de l'Emballage" in Paris last year :

- The trend towards so-called "isolator technology", which means reducing the sterilised area necessary for the packaging of pharmaceutical products to the packaging machinery itself.
- The move away from intermittent operations on individual machines to complete, automated lines where all steps, from filling to final packaging, are integrated without the need for intermediate product transport, is accelerating.

- Freeze-drying is becoming more common, with a consequent shift away from ampoules and towards injection vials. Freeze-drying is used, for example, to render pharmaceutically unstable preparations into a stable form, improve the solubility of poorly soluble substances or even in order to be able precisely to dose the smallest quantities of highly effective substances.
- Pharmaceutical products 100 % testing is also on the increase. In many cases sample testing is no longer adequate.
- Automatic changeover of machinery operating or packagings with frequent size alterations is becoming increasingly sophisticated and easy to perform.
- Operation data acquisition is slowly but surely becoming more common. It is capable of collecting the performance data of several machines and calculating their efficiency, downtime frequency etc...
- The pre-filled disposable syringe is becoming more and more popular in hospitals, especially when expensive medication is concerned, since it allows greater efficiency and reduces the risk of incorrect medicine being administered.
- Financial reasons have given rise to a trend towards re-sterilisable infusion bags.
- Thermoforming machinery for the processing of polypropylene are largely stimulated by problems with the plasticisation of PVC and the need for improved product protection.

III INK FOR PRINTING OF PLASTIC BASED PACKAGING MATERIALS

In food industry or for pharmaceutical products, when it is necessary to choose an ink for printing of plastic based packaging materials 9 questions must be studied :

- 1 - What will be the package life conditions ? Will the product be frozen sterilised ?
- 2 - What will be the type of plastic used : polyester, polyamid, propylène, multi-layers film ? What will be the adhesive characteristics ?
- 3 - Are documents for printing correctly realised ? Can they be simplified ?
- 4 - What is the type of printing ? flexo ? offset, tampography, serigraphy ?
- 5 - Are colors correctly selected ?
- 6 - Is it possible to verify the pictures and the colors ?
- 7 - Is the ink's density correct in function of the type of materials
- 8 - Is it necessary to prepare a test control ?
- 9 - What is the delay ?

According to these 9 questions, a document will be prepared and will permit to determine what kind of ink will be necessary for printing plastic with packaging materials.

IV TOMORROW'S PACKAGING IN THE PHARMACEUTICAL INDUSTRY

This overall view of packaging is a necessarily simple and restricted one. This synthesis of foreseeable changes in materials, machines, functions and individuals has brought out four main trends :

- 1 - Long-standing, simple, hard and highly-protective materials are being replaced by new, softer and more complex materials . efficiency will be more optimized than maximized ;
- 2 - This adaptability will also be found in machines shedding their unchangeable character and becoming more flexible and versatile ;
- 3 - Functions are changing and are turning an immobile, inflexible and simple instrument into a dynamic, humanist and complex medium ;
- 4- Power has passed from a few powerful, reassuring and authoritative businessmen to a broad spectrum of decision-makers who are individually weak and undecided, but collectively influential and orientated.

The "postmodern" world is currently discovering these trends not only in packaging, but also in physics, the sciences and everyday life. Simplicity is turning into complexity, rigidity into flexibility, certainty into doubt and uniqueness is turning into multiplicity.