

**An Analytical Survey on the Role of Packaging in
Industrial Design**

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ABSTRACT

In this thesis, packaging design is studied from the industrial designer's point of view. One of the main purpose of this thesis is to show importance that packaging has various aspects. And analytical research is used to indicate this aspects. Chapter 1, will include; analyzing the packaging from point of consumer society and graphic applications. Packaging will be shown as a communication tool and understanding for consumers and also their attitudes, beliefs, expectations and identity through their patterns.

In chapter 2, material and production techniques are considered as a unavoidable part of the total packaging. Four main group of materials are mentioned in this study namely, (1) paper and board, (2) flexible material, (3) plastic, (4) glass, (5) metal and they are supported with projects and images.

In chapter 3, environmental impact which is one of the role of packaging is analyzed. Environmental impact has to be considered to cope with reuse, reduce, recycle, disposal and waste in packaging process. Packaging designers should try to avoid or minimise the use of any materials that are damaging to health or to the environment during protection, use and disposal.

Finally, the thesis include a case study stress ball which is designed by taking into consideration of packaging design context.

Keywords: Packaging, consumption, graphic applications, material, production techniques, environment, recycling .

ÖZ

Bu tezde, ambalaj tasarımı endüstri tasarımcısının bakış açısına göre incelenmiştir. Bu tezin önemli amaçlarından biri ambalajın çeşitli yönleri sahip olduğunu göstermektir. Bu çeşitli yönleri göstermek için analitik araştırma kullanılmıştır. Bölüm 1 ; ambalajın tüketim toplumu ve grafik uygulamaları açısından analizini kapsamaktadır. Ambalaj tüketicinin iletişim aracı ve anlayışı olarak gösterilecektir. Ve ayrıca tüketicinin davranışları, inanışları, beklentileri ve kimlik kalıpları olarak tartışılacaktır.

Bölüm 2’de, malzeme ve üretim tekniklerinin ambalaj bütünlüğünün kaçınılmaz parçası olduğu gösterilecektir. Bu çalışmada ambalaj malzemesi dört ana grup içinde anlatılmış; (1) kağıt ve tahta, (2) flexibel malzeme, (3) plastik, (4) cam, (5) metal , ayrıca resimler ve projeler ile desteklenmiştir.

Bölüm 3’de, ambalajın önemli rollerinden biri olan çevre etkisi analiz edilmiştir. Ambalaj sürecinde tekrar kullanım, koruma, geri dönüşüm, elden çıkarma ve atıkların üstesinden gelinmesi için çevre etkisinin düşünülmesi gerekmektedir. Ambalaj tasarımcılarının koruma, kullanım ve elden çıkarma esnasında sağlığa ve çevreye zarar veren malzemelerin kullanımından kaçınılması yada az’a indirgenmesi gerekmektedir.

Son olarak, tez, örnek çalışma olan stres topunun ambalaj tasarımı bağlamında göz önünde tutularak tasarlanmasını kapsamaktadır.

Anahtar kelimeler : Ambalaj, tüketim, grafik uygulamaları, malzeme, üretim teknikleri, çevre, geri dönüşüm .

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INTRODUCTION



“ Good Things Come in Small Packages ”

Cliché

Packaging is one of the most important aspects of the creation of a product for nature and mankind. In order to understand the packaging, we can observe the nature phenomena which are relevant to packaging.

Some precursors to packaging have existed for longer than people have. These are biological forms that protect or propagate. By looking at biological forms, we can learn something about the nature of packaging. The egg may have of packaging come after the chicken, but it certainly came before the L' eggs pantyhose package.

Whenever we consider the nature of packaging the fruits and the nuts-and the birds and the bees-turn up eventually. There is no fruit without a peel or shell. From coconuts to pineapples, from peanuts to bananas, all have a particular kind of packaging. The most obvious place in nature that seem to be already packaged, such as nuts in their shells peas in their pods, fruits like oranges in their rinds. These biological adaptations perform some of the tasks of packaging, primarily protection.

Eggshells also have a protective function, but they are most often admired as an economical and beautiful form, well adapted to the physiology and behaviour of the species that lay them. The egg is a paradigm to “good design”.It’s probably too attractive, however to predators, such as ourselves.(see,case study)

And it is in nature that we find one of the best examples of modern concept of package design; the orange. It has a peel that is hard on the outside and padded on the inside, which protects it from external knocks and the damage that might be done to the fruit inside. An orange is more like a package because it invites participation and protects. Protection is a role of packaging, but it is not the only one. Packages are made to be opened. One other important thing about oranges they have visual identity. Like a good package, it communicates, and it happens to have an extremely eye-catching color (Aurelio,1990).

There is another aspect which is the guarantee of "virginity" because once the peel has been removed, it can never be replaced. It is like a seal for the guarantee of origin similar as human nature. Some packages are, of course clearly sexual. The literature of package design is suffused with eroticism.(see, Figure 2.11) Packages reveal and conceal. They beg to be unwrapped, and then a moment after consummation, they lose their magic as they turn to trash. Then very soon the cycle begins again (Thomas Hine,1995).

Industrial design is one of the field which is mostly affected by packaging. Packaging represents one of the most widely spread activities in industrial design and undoubtedly has played a determining role in industry and still is a leading component in the evolution of living standard, social relationship, life style and product protection, presentation and distribution.

This thesis is written from the point of view of a industrial designer and the intention of this study and method are to analyze the role of packaging in industrial design. As can be understood from the statement of this study indicates that the packaging chain is an area where availability and demand are continuously evolving: changes in consumption, communication, technologies, materials, distribution and, last but not least, increasing environmental constraints.

Instead of choosing categories by types of products such as foods, beverages, drugs or cosmetics, this study consist of total packaging area which is a level of understanding of the multidisciplinary oriented knowledge in the areas of materials, product sensitivity/fragility, production technology, ecology, marketing.

This thesis consist of three main objectives which are ; the nature of packaging design, material and production techniques of packaging process, and environmental implications of packaging.

The conclusion basically involves the case study, promotion product design which is created by using packaging objectives.

One of the main purpose of chapter 1 is to analyze the packaging from the point of consumer society to show qualities and conceptual aspects of packaging which has in culture as an echo of our individual being. In this volume, packaging will be discussed in the realm of consumption, advertising, communication, brand identity, recognizable icons and graphic applications which are unavoidable considerations in packaging design.

As a part of human behavior, packaging is a very powerful tool for communication and understanding. Individuals send signals and messages to others about their attitudes, beliefs, expectations and their identity through their patterns of preference for consumer goods. Psychologists get people to talk about the packages in order to get a sense of their innermost feelings about what they want.

This volume also involves graphic application which is an integral part of designing a pack to sell the products as well as to make it clear and informative for the purchasers. Its important task is to attract the customer's attention and clearly inform the customer what the product is and what benefits it offers by visual elements such as color, typography, shape, pack facing. Graphic has a key role in brand identity and icons that major components of packaging because of establishing a relationship between packaging and consumer. Graphics also play an important part in creativity character and image for the product, in conjunction with the pack materials.

Perhaps the most essential objective will be analyzed in chapter 2 which is "material and production techniques" in packaging process. In order to provide relative and realistic creativity the designer must therefore be contemporary in his knowledge of packaging materials, packaging methods, packaging structures.

There are four main groups of materials used in packaging systems, namely paper and board, flexible materials, plastics, glass, metals. These basic materials of packaging are processed or fabricated into flexible, semi-rigid and containers in traditional or conventional forms-wraps, bags, pouches, cartons, set-up boxes, cans, bottles, pins, drums, barrels, and bulk or mech containers.

Material selection has to be considered as part of the total manufacturing and design process, taking into account the entire life cycle of the product and pack and consideration of materials should begin at the earliest stage of the design process, with selection made in the context of how the product will be used, whether recycling is feasible and what performance characteristics are demanded. A variety of different solutions may be appropriate.

Materials, multimaterials and processes are tailored to fit specific, functional requirements by adding several availables, rather than by creating something totally new. Materials gives to package designers new uses of illustrative techniques, exciting graphic approaches dramatic new shapes and totally new functional advantages in designing for tomorrow's products.

The process of choosing materials for packaging purposes is very dependent upon characterising the product in terms, which can easily be transformed into parameters used to specify the packaging requirements.

A basic material character is the correlation between the material structure and the ability of the package to withstand different kinds of mechanical loads. Here time is a very important parameter. Other important characters are the material ability to withstand different stresses from chemicals and from the climate.

Recycling requirements are adding new dimensions to the packaging material area. Other dimensions are added by using radiation in the packaging process.

The packaging process covers converting (from packaging material to package) and packaging (filling and sealing). Converting is built up by sub-sequences like punching,

diecutting, printing and joining. Packaging may also be split into sub-sequences like ejection, filling and sealing.

Reducing the environment impact of packaging is considered in chapter 3 and designing packaging that is an understanding of the complete life of the pack, from the production of the material through to manufacture, distribution disposal. Producing and disposing of packaging material cause environment problems just like any other product pollution in the manufacturing process.

The combination of consumer concerns and legislative pressure ensures that environment impact becomes an essential criterion in the design of packaging material. In this point, the challenge for designers is to produce packaging that sells the product and protects it effectively but creates less environmental damage.

One of the main purpose of this thesis is to show the importance that packaging has various aspects such as consumption, advertising, communication, graphic applications, material, production technology and environmental concerns. As pointed above that this thesis is intended to analyzed the total packaging area and does not attempt to judge packaging as either good or bad. Rather, this thesis can be seen as an attempt at analyzing packaging chain.

CHAPTER 1

THE NATURE OF PACKAGING DESIGN

1.1 An Overview to Packaging Design

1.1.1 Definition of Packaging

The definitions of packaging and concepts related with packaging as published by European Union (see Directive 94/62 EC of 20/12/1994 published in the official Journal L 365 of 31/12/1994 pp 10-23).

Packaging:

Means all products made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer.

Primary packaging:

The packaging conceived so as to constitute a sales unit to the final user or consumer at the point of purchase.

Secondary packaging:

The packaging conceived so as to constitute at the point of purchase a grouping of a certain number of sales units whether the latter is sold to the final user or consumer or whether it serves only as a means to replenish the shelves at the point of sale; it can be removed from the product without affecting its characteristics.

Tertiary packaging:

The packaging conceived so as to facilitate handling and transport of a number of sales units or grouped packagings in order to prevent physical handling and transport damage. Transport packaging does not include road, rail, ship and air containers.

Reuse:

Means any operation by which packaging, which has been conceived and designed to accomplish within its life cycle a minimum number of trips or rotations, is refilled or used for the same purpose for which it was conceived, with or without the support of auxiliary products present on the market enabling the packaging to be refilled; such reused packaging will become packaging waste when no longer subject to reuse.

Recycling:

Means the reprocessing in a production process of the waste materials for the original purpose or for other purposes including organic recycling but excluding energy recovery.

Energy recovery:

Means the use of combustible packaging waste as a means to generate energy through direct incineration with or without other waste but with recovery of the heat.

Waste:

The definitions of "packaging waste" and "packaging disposal" were originally presented in the Council Directive 91/156 Ec of March 18th 1991 (published in official journal L78/32 of March 26th 1991) p:32-37. Under "waste" 16 categories are listed, among them it considers the following as especially related to packaging:

- production or consumption residues not otherwise specified
- materials contaminated or spoiled as a result of planned actions
- substances which no longer perform satisfactorily
- any materials, substances or products whose use has been banned by law
- products for which the holder has no further use

As an example of the packaging waste reduction scheme, it refers to the general policy of the European Parliament and Council Directive 94/62 EC of 2012/1994 on packaging waste the aim can be summarised as follows:

1. Prevention of packaging wastes (reduction in weight, reduction and/or elimination of products used, recognised as noxious, toxic and/or noxious),
2. Promotion of reuse and/or elimination of packaging and the recovery and recycling of materials.
3. The use of the best procedure, if 1 & 2 are not applicable: energy recovery from packaging materials is considered as one effective means of packaging waste recovery.

1.1.2 Basic Functions of Packaging

Packages have a reason to be and are thus conceived to fulfil a number of requirements. Among them it is considered as being important:

- to ensure the maintenance of quantity and quality of the packaged products as long as they form a unit within the subsequent packaging systems; packaging protects against losses in quantity and of the quality during handling, storage, transportation and distribution due to mechanical stresses, physical, chemical and microbiological agents.
- to ensure a proper convenience to the product user; in designing the packaging consumer convenience should be taken into account (e.g. easy opening, reclosable lids, dosing mechanisms) depending on the expected circumstances at consumption or use of the product.
- to ensure adequate labelling of the products; packagings shall thus by information, color and shape contribute to sales of the content, making the personal exchange of information and advertising unnecessary.
- to allow and/or to fulfil a management function; packaged products and/or the users should become identifiable by a code readable by electronic means in order to automate the management of the sale and distribution of goods.
- to contain signs, symbols or systems referring to the packaging materials used in order to optimise waste handling schemes and systems.

The optimisation and justification of a packaging choice;

When optimising packaging for goods (e.g. consumer goods, foodstuffs) a number of parameters should be considered: the material-related factors can be brought into a logical order because they depend upon compatibility with the product to be packed or with the transport stresses which they have to overcome. The order in designing a packaging as given below is general.

a. The market to be served:

There should be a compromise between the consumption rate of the product considered and its quality maintenance once the package becomes opened. So, the size of a package can be considerably different especially, when the product is intended to be delivered to hospitals, factories, restaurants, large families, and individuals.

b. The compatibility with the packaged product:

It is obvious that acids may not come into contact with metals, aluminum with bases, etc. Although lead is generally considered as one of the worst packaging materials, it is the best for packing radio-active products. Many product material combinations are thus excluded because of their incompatibility.

c. The transportation system:

It is not possible to design packaging which will protect products against all possible environmental stresses encountered during handling, storage and transportation. If we anticipate every drop or impact that could be encountered, considerable more packaging than needed generally would result. Optimisation in material use should thus be pursued on the basis of the fair knowledge of the transport stresses encountered during deliveries.

d. The socio-economic aspects:

Many materials and/or combinations can be found suitable for packaging a product. Each system considered will show advantages and disadvantages. The choice depends upon

priorities the consumer will put forward. As for example light weight, visibility, convenience of all sorts, etc.

The choice between several packaging systems for the same product should thus remain possible, because different socio-economic situations can be formulated into different priorities: e.g. camping, sports, travelling, induce packaging wishes, quite different from situations generally encountered.

e. Environmental related aspects:

Many people think that environmental related considerations should dictate the materials to be used and/or be excluded. With respect to the foregoing remarks and arguments, environmental aspects must be considered, but never with the option to exclude the use of particular materials. Each system, as argued, will maximise the fulfillment of requirements.

f. The safety of the packaging system:

Aspects with respect to interactions (e.g. due to migration phenomena) or with respect to possible injuries due to misuse of packaging materials (e.g. by children) may at least be considered to optimise packagings.

Because of the dynamic environment packaging systems are continuously due to optimisation, in fact a permanent search for the optimum between functionality and cost. This value analysis has to be conducted by relating the packaging concept, technically as well as from the economic point of view to the conditions required by the product, the packaging process, storage and distribution, market developments, consumer behaviour and trends and, of course, environmental concern.

A functional packaging constitutes of four main elements: shape, construction, material and graphic design (so graphic design is a functional part of the total packaging design). For each product a specific packaging concept can be designed. To do so we can draw up a product-specific list of demands, 'dictated' by the end-user and manufacturing process. But also dictated by distributors and legislators and not to forget ecological and economic constraints. Drawing up a list of demands for a specific product to be packed is not an easy

task; however, selecting the different options fitting in this list is even more difficult. For every packaging problem mostly more than one solution can be found or proposed. Finally, a value analysis of all reasonable options will give the right answer.

Up to now, we have seen definition of concepts which are related with packaging and essential functions of packaging and also it is obvious that selecting a packaging system, meeting all relevant conditions and restrictions is not easy. The ongoing alterations in consumer behaviour, distribution logistics, production technology, materials and environmental legislation will even make this process more complex.

1.1.3 Historical Overview of Packaging

Very early in time, food was consumed where it was found. Families and villages were self sufficient, making and catching what they used. When containers were needed, nature provided gourds, shells, and leaves to use. Later, containers were fashioned from natural materials, such as hollowed logs, woven grasses and animal organs.

Fabrics descended from furs used as primitive clothing. Fibers were matted into felts by plaiting or weaving. These fabrics were made into garments, used to wrap products or formed into bags. With the weaving process, grasses, and later reeds, were made into baskets to store food surpluses. Some foods could then be saved for future meals and less time was needed for seeking and gathering food.

As ores and compounds were discovered, metals and pottery were developed, leading to other packaging forms.

Paper and Paper Products:

Paper gets its name from papyrus, a reed whose fibers were used by Egyptians to make paper beginning around 2500 B.C. (Figure 1.1) Sheets of treated mulberry bark were used by the Chinese to wrap foods as early as the First or Second century B.C. During the next fifteen hundred years, the paper-making technique was refined and transported to the Middle East, then Europe and finally into the United Kingdom in 1310.



Figure 1.1: Egyptian scribe using paper made from papyrus

But these first papers were somewhat different from those used today. Early paper was made from flax fibers and later old linen rags. It wasn't until 1867 that paper originating from wood pulp was developed.

Francis Wolle invented the bag making machine in 1852 in the United States. Further advancements during the 1870s included glued paper sacks and the gusset design. After the turn of the century (1905), the machinery was invented to automatically produce in- line printed paper bags.

With the development of the glued paper sack, the more expensive cotton flour sacks could be replaced. But a sturdier multiwalled paper sack for larger quantities could not replace cloth until 1925 when a means of sewing the ends was finally invented.

The first commercial cardboard box was produced in England in 1817, more than two hundred years after the Chinese invented cardboard. Corrugated paper appeared in the 1850s about 1900, shipping cartons of faced corrugated paperboard began to replace self made wooden crates and boxes used for trade.

As with many innovations, the development of the carton was accidental. Robert Gair was a Brooklyn printer and paper-bag maker during the 1870s. While he was printing an order of seed bags, a metal rule normally used to crease bags shifted in position and cut the bag. Gair concluded that cutting and creasing paperboard in one operation would have advantages the first automatically made carton, now referred to as "semiflexible packaging," was created.

The development of flaked cereals advanced the use of paperboard cartons. The Kellogg brothers were first to use cereal cartons at their Battle Creek, Michigan, Sanatorium. When this "health food" of the past was later marketed to the masses, a waxed, heat sealed bag of Waxtite was wrapped around the outside of a plain box. The outer wrapper was printed with the brand name and advertising copy. Today, of course, the plastic liner protects cereals and other products within the printed carton.

modified :

Paper and paperboard packaging increased in popularity well into the 20th century. Then with the advent of plastics as a significant player in packaging (late 1970s and early 1980s), paper and its related products tended to fade in use. Lately that trend has halted as designers try to respond to environmental concerns.



Figure 1.1

1996, p.92

Figure 1.2 : Natural recycled lokta paper. It is used to make decorative,colorful gift packs for the body shop. (Mackenzie D., 1991, p:132)

1970s, packs

Glass

Although glass-making began in 7000 B.C. as an offshoot of pottery, it was first industrialized in Egypt in 1500 B.C. Made from base materials (limestone, soda, sand and silica), which were in plentiful supply, all ingredients were simply melted together and molded while hot. Since that early discovery, the mixing process and the ingredients have changed very little, but the molding techniques have progressed dramatically. At first, ropes of molten glass were coiled into shapes and fused together. By 1200 B.C., glass was pressed into molds to make cups and bowls. When the blowpipe was invented by the

Phoenicians in 300 B.C., it not only speeded production but allowed for round containers. Colors were available &om the beginning, but clear, transparent glass was not discovered until the start of the Christian Era. During the next 1000 years.

The split mold developed in the 17th and 18th centuries further provided for irregular shapes and raised decorations. The identification of the maker and the product name could then be molded into the glass container as it was manufactured. As techniques were further refined in the 18th and 19th centuries, prices of glass containers continued to decrease. One development that enhanced the process was the first automatic rotary bottle malang machine, patented in 1889.



Figure 1.3 : Creating Coca-Cola's identity between 1889 and 1924. (Küçükerman Ö., 1996, p:92)

While other packaging products, such as metals and plastics, were gaining popularity in the 1970s, packaging in glass tended to be reserved or high- value products. As a type of "rigid packaging," glass has many uses today.

Metals

Ancient boxes and cups, made from silue and gold, were much too valuable for common use. Other metals, stronger alloys, thinner gauges and coatings were eventually developed. The process of tin plating was discovered in Bohemia in 1200 A.D. and cans of iron, coated with tin, were known in Bavaria as early as the 14th century. However, the plating process was a closely guarded secret until the 1600s. In 1764, London tobacconists began selling

snuff in metal canisters, another type of today's "rigid packaging." But no one was willing to use metal for food since it was considered poisonous.

mal

The safe preservation of foods in metal containers was finally realized in France in the early 1800s. In 1809, General Napoleon Bonaparte offered 12,000 francs to anyone who could preserve food for his army. Nicholas Appert, a Parisian chef and confectioner, found that food sealed in tin containers and sterilized by boiling could be preserved for long periods. A year later (1810), Peter Durand of Britain received a patent for tinfoil after devising the sealed cylindrical can.

Aluminum particles were first extracted from bauxite ore in 1825 at the high price of \$545 per pound. When the development of better processes began in 1852, the prices steadily declined until the low price of 14 per pound in 1942. Although commercial foils entered the market in 1910, the first aluminum foil containers were designed in the early 1950s while the aluminum can appeared in 1959. After cans were invented and progressively improved, it was necessary to find a way to open them. Until 1866, a hammer and chisel was the only method. It was then that the keywind metal tear-strip was developed. Nine years later (1875), the can opener was invented. Further developments modernized the mechanism and added electricity, but the can opener has remained, for more than 100 years, the most efficient method of retrieving the contents. In the 1950s, the pop top/tear tab can lid appeared and now tear tapes that open and reseal are popular.

mal



Figure 1.4: Sharp edges of the can opener hole had caused several injuries to fingers, lips and even to the noses of consumers. (Domus Magazine Vol:790, 1997, p.71)

Collapsible, soft metal tubes used for artists paints in 1841. Toothpaste was introduced in the 1890s and started to appear in collapsible metal tubes. But food products really did not make use of this packaging form until the 1960s. Later, aluminum was changed to plastic for such food items as sandwich pastes, cake icings and pudding toppings.

Plastics

Plastic is the youngest in comparison with other packaging materials. Although discovered in the 19th century, most plastics were reserved for military and wartime use.

Styrene was first distilled from a balsam tree in 1831. But the early products were brittle and shattered easily. Germany refined the process in 1933 and by the 1950s foam was available worldwide. Insulation and cushioning materials as well as foam boxes, cups and meat trays for the food industry became popular.

Vinyl chloride, discovered in 1835, provided for the further development of rubber chemistry. For packaging, molded deodorant squeeze bottles were introduced in 1947 and in 1958, heat shrinkable films were developed from blending styrene with synthetic rubber. Today some water and vegetable oil containers are made from vinyl chloride.

Cellophanes and transparent films have been refined as outer wrappings that maintain their shape when folded. Originally clear, such films can now be made opaque, colored or embossed with patterns.

The Polyethylene Terephthalate (PETE) container only became available during the last two decades with its use for beverages entering the market in 1977. By 1980, foods and other hot-fill products such as jams could also be packaged in PETE.

Current packaging designs are beginning to incorporate recyclable and recycled plastics but the search for reuse functions continues. From containers provided by nature to the use of complex materials and processes, packaging has certainly changed. Various factors contributed to this growth the needs and concerns of people, competition in the marketplace, unusual events (such as wars), shifting lifestyles, as well as discoveries and inventions. Just as no single cause influenced past development, a variety of forces will be required to create the packages of the future. (Hook p., Heimlich Joe E., 1914)



Figure 1.5: Castrol GTX, Silver Star and British plastics federation award, 1989, (Sonsino S., 1990, p:17)

1.2 Power of Packaging

Packaging is an inseparable part of our everyday life. It serves many different needs: It protects and preserves; it expresses and impresses. Packaging can be viewed as important landmarks in homes and offices, representing much more than just their contents and sometimes outlasting them. Packaging can create personality for its sometimes characterless contents. Packaging is omni-present, in our kitchen and bathrooms, in department stores and supermarkets. Packaging records our evolution, reflects cultural concerns and lifestyles.

Packaging engages; informs and sells. Packaging made the super- market possible and changed the shopping experience of a whole planet. Packaging makes the availability of many products possible globally. But despite the fact that packaging is so boldly present and visible, it is also overlooked. Its existence is often ignored until it is no longer needed, and filling trash cans and landfills, seems to turn into useless waste.

This blind acceptance, instead of understanding the quantities of packaging before it reaches the stage of disposal is probably the major reason why packaging has gained a bad reputation in society, and why the packaging industry has to deal with such extensive criticism toward it's production.

Important environmental concerns such as the problems of waste, over-packaging, (see Chapter 3. 3.2) and material separation are being addressed by the packaging industry, in governments and environmental organizations. Environmental improvements are visible in packaging, manufacturing, and material use. Many materials that are currently used for example are marked with recycling-codes, making it easier for their separation and recycling.(Figure 1.6) Other less environmentally sustainable materials have been replaced, and manufacturing processes are being up-dated to new standards Polystyrene producers, for example, were ordered by the fast food industry to eliminate the use of ozone destroying chlorofluorocarbons. These concerns and changes in the packaging industry have resulted in extensive lines of available products that claim to be "environmentally-friendly," both in terms of the packaging and the products. Many communities offer recycling programs for the collection, separation and recycling of glass, aluminum, plastic and paper. Today, "Recycling" has turned into a huge industry offering new profitable business opportunities and employment. Someday, perhaps we might reach the point where all materials used in the manufacturing processes will be recycled and recyclable. (see Chapter 3 3.4)

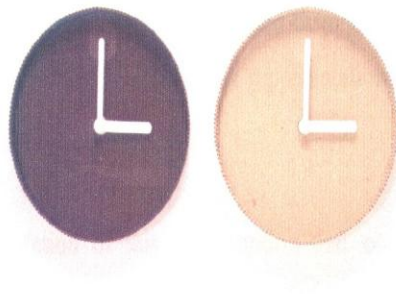


Figure 1.6: “ O Clock” made from corrugated card which can be recycled, designed by Eiji Hiyama. (Mackenzie D., 1991, p:74)

The environmental issues early on not simply to dispose them but rather to acknowledge that while this first level of discourse is the most common, it is by no mean the only one. There are other issues, apart from environmental concerns that need to be addressed in order to fully understand the deep complexities and very nature of packaging.

Packaging, the visible discourse of consumer concerns, has the power to work on an emotional level that exceeds the issue of "pure usage" considerations. Many products stand as symbols, a visible sign of something the meaning of which is not immediately apparent to the senses. It triggers the emotion that leads to the comparison of the representation (the package) and what it stands for. If true, the package becomes a very important object that defines an emotional need for the user and has an existence that is independent from the actual product inside the package. At that moment the package takes on a value in itself. (Scherrer P., 1996)

1.2.1 Packaging and Consumer Society

It is surprising that packaging has such a negative reputation in society. A majority of individuals feel ambivalent about its role in their life. Packaging cannot be considered simply as wrapping material that turns into waste and fills up our landfills. Rather, it is an unavoidable necessity in a society in which people have been encouraged to see themselves as consumers of lifestyles, government, health, etc. When dealing with packaging in the society, we are dealing with the concept of consumption and not only with the product itself. Consumption is about consuming images in advertising, packaging, movies, etc. Packaging contains all the associations established through consumed images at the point of purchase. These images are verbal or visual representations suggestive of something, of an idea, or concept. (Figure 1.7)

Packaging as

Packaging is a representation of this consumption that comes into play when options exceed the bare necessities for survival. Consumption becomes its own message, shifting the empty space of necessity to a much more intimate proximal called desire. The more this space moves away from necessity, the more personalized and the more intimate that space becomes.

Consumption is an act of individuals trying to fulfill their desires and to invent themselves in relationship to others or in relationship to objects surrounding them. Packaging is not just defined by containers it is closely connected to, and part of, marketing, branding, and advertising efforts. Packaging displays the "last stage of advertising" at the point of purchase and is the closest form of the promotion of a message next to the product. It is, at the same time, part of the object and promise it. Quite often the words advertising and

packaging could be interchanged. TV commercials, radio spots, billboards and print media are usually recognized as the most common forms of advertising. They can create a widespread awareness of a product different from packaging these forms of advertising are recognized in the public eye much easier, because they interrupt TV-movies and radio shows, break up articles in magazines and newspapers. Packaging communicates on a more intimate level with the consumer. It not only advertises, but if convincing enough, closes the sale.



Figure 1.7: Visual representations of Mc Donald's golden arches marked a distinctive package on the 1960s. (Hine T., 1995, p:138)

Despite the fact that modern consumer society makes so many goods available compared to earlier economies, it still shares a fundamental characteristic: Material objects produced for consumption not only satisfy immediate needs, but also serve as symbols and communicators for interpersonal distinction on in social groups.

Our society is called a consumer society. If one steps back and looks at history, one might be amazed at how much this life, that seems so natural to us, has changed just in the last hundred years. Before, the advertising of goods retained the quality of announcements. Before mass production, satisfying one's needs happened for the most part locally through familiar handicraft tools and skills. With few exceptions, people knew how the items they consumed were produced and who produced them. People in older economies might never

have had the chance to participate in the satisfaction of certain desires even if they had existed. This problem was based on lack of availability and affordability.

The early stages of the market-industrial society represented a radical change. For the first time people were surrounded by goods that were no longer familiar, even though most of the goods initially replaced the goods that had been produced and used at home and in local shops. Gradually this changed and people were confronted more and more with items for which they had little or no understanding. The purposes and benefits of these new products could not be understood by a shopper's unaided senses and intellect alone. Advertising was one way to explain products and emphasize their benefits.

The developed stage of the market-industrial society is the consumer society, where an enormous variety of goods confronts the individual and where the characteristics of those goods change constantly. The rise of real income, disposable income and leisure time meant that advertising and marketing could focus more and more on other messages rather than simply fulfilling the need to understand the basic functions of a product. Mass production turned many products into their own salesperson, carrying all the information a consumer got previously from sales personnel in the market. In many cases, packaging provided, the advantage of having all the information visible, silently, eliminating sometimes embarrassing questions, such as affordability and delicate personal issues.

Packaging that is encountered in the market place is often supported through advertising which incorporates not just information about necessities, but broader messages that present "lifestyle" images, which reflect cultural trends and values. Advertising, often called a "by-product of industrialization", helps maintain a demand for products and their production. Advertising can create interest and desire for a product that was never thought about before and through repetition it reinforces that want. It also offers the solution to fill that desire: This desire is created by presenting a consumer with lifestyle imagery and makes the consumers aware that they can become part of this lifestyle too. This is a complex web of social status and meaning that advertising draws its imagery from. In older economies this web was created in a more familiar setting, in a world where people knew the goods surrounding them based on their production. Part of the vital information that people needed about the products was "who produced it; where it came from and what its role was in social relations." This changed with the start of mass production. Packaging and

advertising have taken the role of recreating these social relations, disconnected from the actual labor process. (Scherrer P., 1996)

1.2.1.1 Consumer Characteristics

Studies have shown the increasing dominance of three types of consumer.(Sonsino S., 1990, p:10) An increasing majority is subsistence buyers, whose purchasing patterns and attitudes reflect their relative poverty. Their numbers include a large number of the old and the unemployed. Their purchases are almost exclusively the necessities of life, such as food, clothing and housing. The major consideration for these people is cheapness, rather than quality. Packaging has an important part to play in portraying low price. Graphics, banners and promotional piggyback packs bearing money-off messages can almost effortlessly sell goods.

The second consumer group comprises discriminators, who rank quality above all else, even in times of recession. To discriminators, the organization selling the goods is as important as the products themselves. Packaging has no direct control over this, but it can influence the retailer who sells the goods.

Other important factors to discriminators include the social responsibility of the retailer. A growing number of consumers will not buy goods from South Africa, for instance. And a large number of buyers are prepared to pay more for a product if it is ecologically sound.

In this category, also, the glass bottle and jar markets have been helped enormously by the introduction of recycling projects such as bottle bank schemes. Consumers simply place their used cans into the mouth of the machine. Now plastic bottles can also be recycled.

It is not just discriminators, however, who worry about the ecological aspect of packaging. General public concern is growing: fears about safety and the environment are putting pressure on product manufacturers to limit their output or to design products using recyclable or biodegradable materials only.

The final group of consumers, known as hedonists, tends to ignore economic recession altogether. The group includes people from widely differing areas of society, who spend

large sums of credit and largely ignore marketing trends, buying simply what they want at the time. Because it would be far too difficult to predict how these buyers might respond to packaging or advertising.

1.2.2 Packaging as a Communication Tool

Deciding what message the product should project is an essential part of the marketing process and the most important task for the packaging designer. In order to make this decision, it is important to ask the question, why should the consumer buy this product? These decisions are most usually made after detailed discussions with the product's manufacturer and the marketing department.

Unfortunately, there is no hard and fast set of rules that designers can take and apply from one product to another, but they must have some inherent ability in deciding what colors work well together and what impressions lines and shape can create within the mind of the casual passer-by in a supermarket.

The visual elements of packaging design (see, Chapter 1 1.3.1) color, shape and typography can enhance or distort the consumer's perception of packaged products. It is useful for designers to be aware of this research into customer behaviour. The psychologists use to analyze whether patients respond more to colors or to shapes and forms. It shows a series of abstract shapes and colors in which the shapes move from right to left and the colors from left to right. "Which way is the design moving", it is possible to tell whether form or color dominates in someone's minds. The test has wide implications for packaging designers. Young children, for instance, respond overwhelmingly to color, while adults respond to form and shape. Men apparently respond more to form, though, than women. There are well documented differences between different cultures and groups of society, too, which can make designing an international package difficult.

Because, of its extensive presence, consumer goods and the visibility of their packaging have become vehicles used for social communications in industrial societies and offer a place for discourse. They enable individuals within a group to communicate a complex set of otherwise abstract social attributes (such as status), thus giving individuals a chance to define their position within that social structure.

Consumption defines style and lifestyle; which is evident in the dominance of packaging and logos more, than the products themselves, in the ways in which people are featured in products. It is evident where consumption is bigger and more potent than the things consumed Consumption has become its own message and 'wanting' is more important than 'needing.' In our consumer world, package design and its supportive advertising does not only have to be about the, product, or the consumer, but about the relationship between product and consumer.

1.2.2.1 Brand Identity

Packaging is a major component of brand identity, the unique personality that is projected and designed into a product. Branding tries to establish a relationship between product and consumer, trying to make a consumer say "Yes, that's me." Well known brands took years to establish a strong identity. Graphic elements and colors turned into symbols visually representing companies, products and ideas. Logos, Logo-types, bottle shapes and slogans became icons, carrying meaning and messages in society so prominent and recognizable in their importance that they became the most valuable asset of brands. The Coca-Cola brand identity, outscored only by the Marlboro brand identity, would be worth 39.1 billion dollars.



Figure 1.8: First, Marlboro marketed as a women's brand, had a sex-change operation in the 1950s, of which the distinctive red and white, hard sided, flip-top box was an important aspect. (Hine T., 1995, p:138)

This shows that name, brand identity and the history of a product have an immense economic worth, beyond the physical product and production facilities themselves, and if you would buy every bottling plant, every bottle and gallon of syrup Coca-Cola owns, it would be worth much less if you couldn't buy the brand identity as well. Packaging like the Coca-Cola bottle that stand as "brand representatives" on store shelves, appearing in commercials and billboards, "staring" in movies and households all over the world, interacting, comforting and satisfying consumers day in and out, deserve a great deal of credit for establishing such a strong brand identity.

Another example of a successfully established brand identity is Nike, a manufacturer of sports shoes and sports merchandise. It uses attitude and a spokes person, Michael Jordan, who represents for many kids the "shaman of the shoe." This has helped to turn the Nike brand into a religious-like icon. For "Michael Jordan-fans" the goal is to become a member of the "brand-family". It is virtually a sin to get a different product than Michael's choice. Placing the Nike mark on all advertising collateral helps to turn that mark into the visual representation of that mythology. Every shoe and every shirt showing that mark becomes a sign of that mythology. Nike created such a strong recognition of its identity that it no longer needs the formal language of the word "Nike," and Communicates its identity through the logo mark alone.

1.2.2.2 Recognizable Icons

Packages have developed into such important icons in society that they have become the strongest tools in supporting advertising for a product. A prime example is the Coca-Cola bottle, which developed out of the desire of Coca-Cola to create a bottle that could even be recognized in an icebox by the touch of hands. It was designed in 1915, by Alexander Samuelson, a Swedish glass blower. Coke TV-commercials throughout history usually feature the Coca-Cola bottle as the most prominent element. Regardless of whether the commercial is based around a couple in a romantic setting, a farm worker taking a break from hard work, a little kid talking to his sports idol or teenagers dancing and having a good time, the focus always comes back to the bottle which is highly recognizable, distinctive and different from other soft drink bottles even when seen from far away.

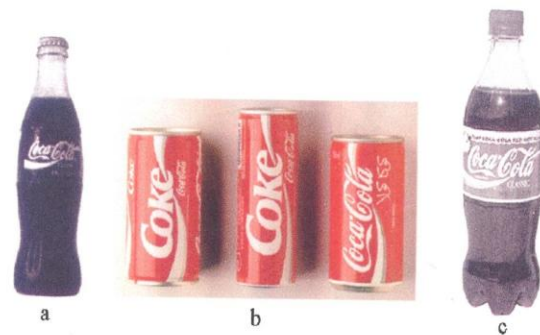


Figure 1.9 : (a) The most famous and recognized of them ‘‘Coca-cola’s’’ contour bottle. (b) Coca-cola’s tinplate and aluminum cans various shapes and volumes behind the brand identity. (c) A crude version of the contour in PET plastic.

When the aluminum can technological innovation in itself, was introduced to the market in 1958 and soon after established itself as a popular soft drink container, Coca-Cola still focused the contour bottle as the most identifying element in its commercials even though the bottle almost disappeared from the market. Currently, in addition to the classic *glass* bottle, which is hard to find, a PET (polyethylene terephthalate) version of the bottle is available. Its shape; not as elegant or defined as the classic bottle is still a strong enough representation of the established shape to contain its original iconographic power. It is not surprising to see a company like Coca-Cola still taking advantage of an established icon to gain even more recognition. Coca-Cola is picturing a representation of its contour bottle even on other containers such as the can, thus, making consumers aware that they are still choosing "the icon" of soft drinks and not "just another cola."

In Germany Coca-Cola is working on a newly shaped can that is supposed to remind us of the shape of the famous contour bottle. In Switzerland the current Coca-Cola advertising campaign is based on the shape of the contour bottle, that is interpreted through typographic slogans or in photographic manipulations. This "representation" of the packaging turns into a message itself, containing all the associations viewers can make through their relationship that has been established through the sum of advertising and personal experience, in the bottle.



Figure 1.10: The contour, hobble-skirted Coca-Cola bottle was created in 1915 and has become the world's most recognized package. Tab-open tops, introduced during the mid-1960s, finally led Coke to move to cans, which didn't succeed in changing the product's imagery. (Hine T., 1995, p:138)

1.2.3 Review

Packaging fills an important space in society. We are surrounded by packaging everyday and in addition to its utilitarian function, we rely on its symbolism to orient ourselves in our social environment to communicate and identify with social groups and values.

It is a package designer's challenge, to compose a formal backdrop created of codes, a canvas onto which consumers are able to project their own individual associations. If consumers do not understand the symbolic implications of an object, they will ignore it.

By offering a variety of options to the consumer, brands and products have established themselves as symbols for living standards, quality of life and our personal beliefs. These symbols are strong enough to be recognized and understood, and to be used by a large part of society. These symbols build their power from and on existing mythologies that are commonly understood. They also become by-products of new mythologies that are created by new packaging and its supporting advertising. But even with the universal and pervasive effects that advertising has on the perception of packaging, it also has its limits of influence on people. Consumers develop their own, highly personal relationships with symbolic objects, including packaging. It is especially these personalized associations and meanings that an individual learns to read into the packaging. This gives packaging a highly

individualized importance and value, which cannot be measured with the generic standards of a generalized society. They are read through a complex web of associations which are unique to every individual and understood only by specific individuals on their own terms.

It is important to look at packaging because of its objectification, as separate from advertising, because it is the object of its own promotion. It is an object, which communicates through materials such as glass, plastic, foil, paper, etc. The element of touch and feel can't be offered through visual imagery only, that is to say through a visual facsimile of the real object. The sensuality that goes with picking up a perfume bottle or a book, and the possibility of ownership connected with this contact, should not be underestimated. Just as objects that represented religious icons were believed to contain healing powers, which extended far beyond that of the pictorial icons, the same can be stated about the packaging of consumer goods. And just as pilgrims might travel all over the world to see and touch an important religious relic, a consumer's journey is not finished by simply identifying with an advertisement's promise, but only with the purchase of that promise.

The package gives individuals a chance to bring an object and the message attached to it, into their living environment and call it their own possession. In doing so, consumers have the opportunity to make the package an important and personal part of their lives. Because of this interaction between packaging and the individual, packaging seems to take on a life of its own which gives it a much different quality beyond that of simply a material object with utilitarian qualities. It becomes part of the consumer's identity and the consumer becomes part of the product's mythology. Because packaging is such an integral part of everyday life it seems invisible to most individuals on the one hand and yet highly responsible for their identity on the most intimate of levels.

1.3 Graphic Applications in Packaging Process

Graphic design is an integral part of designing a package to sell the product, as well as to make it clear and informative for the purchasers. Its first, and arguably most important task is to attract the customer's attention. After that, it must clearly inform the customer what the product is and what benefits it offers. In general, aesthetic and marketing reasons for

package illustrations should not be separated. Should the package show the product on a package, or should it show the result of using the product?

Graphic design has a key role in establishing product and brand identity. The most famous example of how colour, shape and typography can be used to do this is perhaps the Coca Cola bottle (and now the can) which is immediately recognizable the world over. Graphics can be used to project similarity, as well as uniqueness manufacturers attempting to cash in on the success of a product can adopt a similar graphics style to show the consumer "here's another product for that market, but its advantages are X."

Graphics also play an important part in creating character and image for the product, in conjunction with the packaging materials. However, after the packaging has achieved all this, it must then fade into the background a little. Packages should also be acceptable in the home, or in the office, in the garden or the garage. At the point of use, products do not usually need to stand out with as much vigour as they do in the retail environment. This is one of the great dilemmas of graphics design how to balance the need for the product to be an effective sales tool and an acceptable commodity. It is one, all too often, that designers fail to achieve. (Sonsino S., 1990)

Figure 1.1

In summary, the basic functions of graphic design in packaging are:

Yanti Goli

- to identify product in the market,
- to inform the consumer about the product it contains and the benefits of using that product,
- to add character and value to the product ,
- to increase the sales worthiness of the product ,
- to appeal to the consumer long after the purchase is made.

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1.3.1 The Visual Elements of Packaging Design

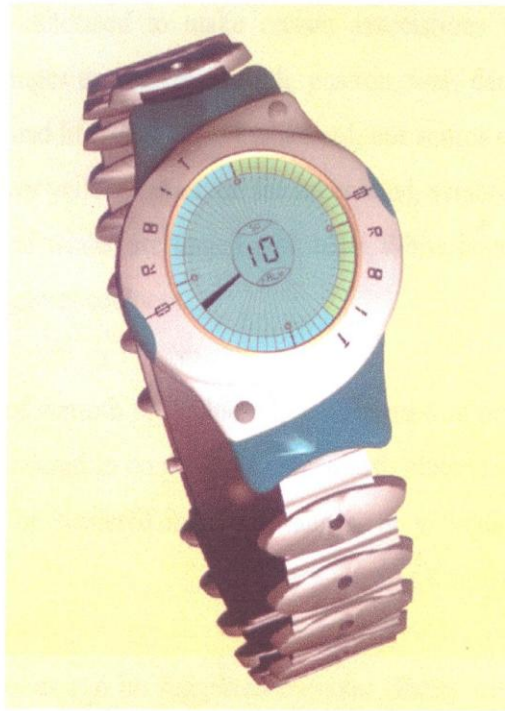


Figure 1.11 : The visual elements of packaging design such as color, shape, size, typography, pack facing is considered in “Orbit” digital arm watch, designed by Yankı Göktepe in 1998.

1.3.1.1 Color

Color as an aspect of design is becoming an increasingly visible part of our lives. Whether the medium is packages, printed matter, photography, movies, or television, color images have a greater impact than black and white. Color represents objects, scenes, and people with almost complete fidelity. In design, color can suggest abstract qualities, such as moods, temperament, warmth, coolness, and danger.

Color gets our attention. And when we first look at something, it's color that, can create a pleasant, a shocking, or some other first impression. Color also has the psychological advantage of fixing visual impressions in memory and stimulating interest. Finally, color

can add prestige to a package or advertisement. All three general reactions to color attention, interest, and prestige constitute part of its sales value.

We are taught from childhood to make certain associations with certain colors. For example, reds and oranges symbolize warmth, passion, war, danger, and a host of ideas connected with action and life. Blood and fire are red; our source of life, the sun, appears as a circle of red, orange, or yellow. Blues, on the other hand, symbolize ice, snow, and water. Almost all the colors of winter are tinged with blue. White is so closely associated with snow that it usually suggests coolness.

The basic suggestion of warmth or coolness is widely used in design. A picture of an ice bucket looks cooler rendered in cool whites or greenish blues than in oranges or reds. An electric heater would be rendered in reds, oranges, or yellows to suggest warmth and comfort.

Other abstract impressions can be suggested by color. Purity can be conveyed by white, light blues, pale greens, and other tints associated in our minds with things that are pure, such as water, snow, and blue sky. Sky blue frequently suggests serenity and peace. Hot pinks, reds, and yellows may suggest joy, gaiety, or the festive character of parties, celebrations, and parades. Mystery seems to lurk in soft, dusky hues. Deep reds, purples, and gold suggest riches and quality. (Roth L., 1990, p:24)

Of course, people's experiences differ, and we cannot be sure that a given color will suggest the same quality to all beholders. We know, however, that the distinction between warm and cool colors is relatively constant.

Designers can use the fact that people react to color. In most people, reaction to color is a pleasurable experience; it seems that a love of color is an inborn human trait. Colors that are both brilliant and brightly illuminated give us so much to see that we actually become keyed up, excited by the challenge to our faculties. Our response to color is similar to our response to music. Brilliant reds and oranges suggest loud, lively music. Soft hues remind us of slow, peaceful passages.

1.3.1.2 Shape

Shape has always been an important visual element in graphic arts and it is easy to see how it has evolved as an important part of the packaging designer's work. It can be used in various ways. First, there is the shape of the label on the pack. There is the shape the items shown on the label take up in relation to one another. And finally there is the shape of the package itself. For example, square and rectangular packages can be used to good advantage as they offer the greatest face space for the product's message.

In addition, cuboid products stack closely together and waste less shelf space than circular or oval packages. There is some evidence to suggest that retailers prefer these packs, particularly in the fast-moving consumer goods markets, and consideration of shape is extremely important for this reason alone.

If the shapes embodied within the package do not interrelate comfortably, then the potential purchaser sees a mess of type and colour, and may pass the product.

1.3.1.3 Size

Another of the visual elements a designer can use is size. Cereal packets, for instance, are usually large, although buyers often complain that they are too large. However, research has shown that the large size of the cereal packet is almost as much a part of the package as its colouring. It gives the consumer the feeling "of bounty, of expansive energy-giving food" (Pilditch, 1973). Small cereal packages, conversely, would make cereals seem heavy or solid. Another example of the importance of size is occasioned by those tiny gift packages of perfume, which give the recipient a feeling of something precious or expensive.

In considering shape, the designer should also take into account the possibility that the package may not always be seen in optimum conditions, i.e. on an eye-level shelf under the correct lighting conditions. Packaging is designed to be seen at adult eye level, but in an average supermarket, only around 12-15 per cent of the items receive the benefit of good lighting and prime shelf position.

Rectangular bags lying flat compost in a garden centre or cement in a builders merchant also project a rectangular shape to the buyer, but from an angle. And the designer must understand the complexities of gusseting and the current state of the art in printing, too, before specifying impractical graphic designs and sizes. The most effective sack designs seem to be the simplest, with few of the intricate touches that can sometimes be seen at eye level on the supermarket shelf. For builders materials such as sand and cement, strong typefaces often capitalized, usually sans serif - help reinforce the strong image.

1.3.1.4 Typography

First experiences with the basic tool of communication, type, can be confusing. There are so many styles to choose from and so many faces in each group. There are even new faces just waiting to be designed. There is no doubt that the world of type can be complicated, but as with many aspects of design the correct approach opens up endless possibilities. For instance, many designers come through college having worked with only a few faces and then stick to them for the rest of their working careers. More creative work seems to come from people who introduce seemingly incongruous faces that nevertheless suit the job exactly.

The strength of type as a marketing tool can be seen in packages that use different styles of lettering to imbue character or mood in display headings. Gift packages of confectionery, on the whole, adopt flowing text with long thin stems to suggest a mood of sophistication and delicacy. Cartons for a computer's floppy disks tend to use solid strong faces serif or sans serif to represent reliability.

In addition to display headings, the text for ingredients or additional information must also be chosen for readability, and here the standard rules regarding typography will stand the designer in good stead. Text that is centred or ranged Hush right is sometimes more difficult to read than material ranged left unjustified, for instance, line length should also be considered carefully, in conjunction with text size, depth of text and any inter line spacing or leading. If the lines are too long, the text becomes difficult to read as the on to the next line large slabs of italic text are also difficult to read and are so best avoided for technical information on product use, especially on packaging for pharmaceuticals and poisons.

1.3.1.5 The Packaging Facing

The main opportunity to be exploited by the designer is the packaging facing that portion of the package which faces the consumer from the shelf. In many cases this will include a label and, despite the increasing number of legal requirements labels must meet, it is still has great potential for graphic design. In some instances labels can be used as wrappers, physically binding two or more items together.

2.1.1

Where the package can be printed directly, the label is often dispensed with. In these cases, the package outer takes on the label's function. Sometimes an outer is not necessary at all. Some designers believe that the use of labels will decrease as printing technologies improve. If full-colour photographs can be reproduced with no loss of quality on any material - from aluminum and polyethylene to zinc, for example why use a label? However, there are equally clear signs that the convenience and cost-effectiveness of labelling will keep it competitive for some time. Also, the qualities and responsiveness of paper and board as printing media will ensure that the label will be with us for many years to come. (Sonsino S., 1990)

increase the

In packaging design a good corporate symbol of brand identity serves well as a means of identification. It also serves to strengthen the bond between components of a range of goods, and enhances the chance that a buyer pleased with one product may try another from the range.

CHAPTER 2

MATERIAL AND PRODUCTION TECHNIQUES OF PACKAGING DESIGN

2.1 Paper

Today, there are three major processes for making pulp from wood. They are the *sulfate*, *sulfite*, and *caustic soda* processes. These are all cooking processes in which the pulp is washed, bleached, and cleansed of all foreign materials and then fed into a machine that will form the mass of fibers into a sheet. At that point the pulp can be colored with dyes.

When a smooth surface is needed for printing or writing, glue or starch is added. When a slick surface is desired, the paper sheet is covered with special clay or fine plastic coating material. Paper can also be coated by being impregnated with waxes and plastics. Finally, to increase the smoothness and gloss of its surface, paper is passed through a set of iron rolls at the end of the paper machine. This process is called calendaring.

2.1.1 Paper, Board and Structural Design

The paperboard used in cartons is specified according to the size of the carton or, more often, the weight of the item that goes into it. A glass bottle for 3.5 fluid ounces of a fragrance, for example, would take a folding carton of approximately 18 to 24 points. The paperboard's thickness is expressed in what is called caliper points.

2.1.1.1 Paper and Board Used in Packaging

Paper

Different types and grades of papers are available for different uses. The following are some basic papers used in packaging;

Unbleached kraft, or coarse brown paper, is the most economical and strongest packaging paper. It is used for wrapping paper, paper bags, brown grocery bags, sacks and general packing purpose. Unbleached kraft can be laminated, coated, and impregnated with various protective materials such as plastics and waxes naturally brown kraft paper can be bleached to a variety of beiges and even to white. A similar paper sometimes called shipping sack paper, is used to construct multiwall bags and sacks, having from two to seven layers. A plastic or foil layer can be substituted for paper in special cases, for instance, where an additional barrier to moisture is required. This multiply construction makes bags particularly such as dog food and animal feeds, charcoal briquettes, cement and other building materials. They are also used for fertilizers and agricultural chemicals, but as always the product determines the package. The designer needs to consider carefully the product characteristics before choosing paper as the packaging medium, for example, it may not be appropriate for very moist or sharp edged items. Corn syrup solids, for example, need a moisture-resistant bag while insecticides and other poisons need to restrict the passage of air as they need to be odour resistant. Cement, in comparison, and other dense or sharp-edged products such as gravels and some forms of charcoal, need strong sacking material.

Glassine and greaseproof papers, can be plain, printed, lacquered, waxed, corrugated, or laminated onto other packaging materials. Outstanding qualities of these papers are their ability to act as a barrier against water, vapor, and odors, and, especially, their resistance to grease. Glassine and greaseproof papers include pouches, bags, lined cartons, and envelopes. About 85 percent of them are used in food packaging.

Parchment papers, are made by dipping sheets into a concentrated solution of sulfuric acid. The result is a tough, dense, translucent film that is sterile, free of fibers, strong when wet, and highly greaseproof. Parchment is an excellent liner or wrap for oily or wet items like butter, fish, and vegetables.

Tissue, is used primarily as an inner wrap. It may have a hard or a soft surface, can be waxed or impregnated with plastic resins for strength, and is available in both translucent and opaque colors. Tissue is widely used by florists and in the hosiery and food industries.

Sulfites, clay, and chromecoats, are used in printing, labeling, and decorative packaging. They are of two types, one with a flat or dull finish (coated and uncoated) and one with a glossy finish. Smooth high-gloss paper comes in brilliant white and colors especially beautiful are the flint papers used for covering boxes and gift wrapping. The glossy-finish super calendered whites (sulfites, clay, and chromecoats) emboss well and are excellent for high-quality printing.

Foils, are produced by laminating metal foil to paper or by gravure-printing paper with metallic powders mixed with lacquers. They are available in a wide range of colors and finishes and can be beautifully embossed. Foils are used for speciality box coverings and overwraps.

Specialty papers are textured with flock, glitter, foam, and other materials. Iridescent and pearlescent papers are used in box coverings and platforms (inserts) for gift and luxury items.

Board

Boards account for more than 60 percent of the materials used in packaging, including folding boxes and set-up boxes (see later discussion). With the exception of the low-cost, plain chipboard, most boxboards are lined or laminated to another paper liner or liners. The inner board is usually 100 percent recycled fiber derived from low-grade papers. The outer or top liner varies according to need and quality. The basic boards used in packaging follow.

Plain chipboard, the lowest-cost board, can be adapted for special linings. It is not suitable for printing. Colors range from gray to tan.

White wat-lined chipboard, has a white liner that can be adapted for color printing. It is used for high grade set-up boxes with a white liner.

Bending chip, the lowest-cost boxboard, is used in inexpensive folding cartons. It is usually light gray or tan but can be printed on in any color.

White-lined 70 newsback, is a smooth board that is much whiter than most of the inexpensive grades of board. The back is usually gray. It is excellent for folding cartons, posters, displays, and die cut items.

Bleached manila-lined bending chip, is the same as bending chip except that the top white liner is of better quality.

Clay-coated boxboard, is a smooth, white board with an excellent printing surface. It is used for cartons and displays and whenever high-grade multicolor printing is needed.

Solid manila board, is available with a white liner and a manila back. It is used for all types of cartons that require durability and strength.

Extra-strength plain kraft-type boards, are available with or without the white liner. They are used for hardware, automobile parts, housewares, toys, and other items that require extra-strength packaging.

Uncoated solid bleached sulfate, is strong, white board that is plastic coated or waxed and hence water resistant. It is excellent under freezer conditions and is widely used in frozen food cartons.

Clay-coated solid bleached sulfate, offers excellent scoring and folding characteristics, is highly uniform, and provides a good surface for printing. Its appearance (dull to high gloss) depends on the coating process used. It is most suitable for quality goods such as cosmetics, gifts, and pharmaceuticals.

Clay-coated natural kraft, is a strong, moisture-resistant board with a whiteprinting surface. It is used in heavy-duty packaging, bottles, beverage carriers, and similar items.

Ovenable paperboard (for microwave ovens), is a paperboard with a heat-resistant coating that will withstand conventional oven temperatures and allow microwave energy to pass through it. Coated solid bleached sulfate is the most frequently used ovenable paperboard.

(Roth L., 1990, p:45)

2.1.1.2 Characteristic of Paper and Board

Although paper and board come in flat sheets or rolls, different things can be done with them to create packages and other three-dimensional objects.

Grain

In all papers and boards the fibers are aligned in one direction, called the grain. The paper or board will fold or score easily along the grain. If they are torn with the grain, their edges will be smooth; if they are torn against the grain, their edges will be ragged.

Scoring

Paper can be easily folded. To facilitate folding, a *score*, or crease, is made in the paper or board. The tool used for scoring is a blunt-face (round edge) scoring rule (dic). Scoring rules come in different widths for different thicknesses of paper. When constructing a carton by hand, *never score the paper with a sharp blade*. A cut will crush the fibers and weaken the paper. Use a blunt edge, such as a paper clip, coin, or ballpoint pen, against a steel rule. Always bend against the score to produce an embossed, raised edge.

Embossing

Paper and board also lend themselves to *embossing*, the process by which a design or image is made to appear in relief on the paper or board. Embossing can be superimposed on printing or done on blank paper for a sculptured, three-dimensional effect. The latter is known as *blind embossing*.

Embossing is achieved by pressing a sheet of paper between a brass female die and a male bed or counter, both of which are mounted in register on a press. Since embossing is a costly process, it is generally used for prestigious packages, cosmetics, gifts, stationery, and promotional materials.

Die-Cutting

Every paperboard product or paper, whether three-dimensional or flat, has a shape or form that is produced by die-cutting. The process of *die-cutting* involves creating shapes of many kinds, using cutting and stamping die, from papers, board, and plastics. There are three methods of die-cutting. *Hollow die-cutting* is done with a hollow die, which looks like a cookie cutter. This method is used almost exclusively for labels and envelopes.

Steel-rule die-cutting is used when close register is required. Steel rules are bent to the desired shape and inserted or wedged into a $\frac{3}{4}$ " piece of plywood. The multiple dies are locked up in a chase on a platen of the die-cutting press. Several sheets can be cut at one time. A flatbed cylinder press can also be used for diecutting.

The third die-cutting method uses lasers, which were invented by C.H. Townes and Arthur Schawlow in 1958. *Laser* is an abbreviation for light amplification by Stimulated emission of radiation. The laser beam, which can be concentrated on small point and used for manufacturing processes such as drilling, cutting, and welding, has changed many processes in manufacturing, communications, and medicine. All types of materials, including paper, metal, plastics, and wood, can be die cut with lasers. Since the laser beam is extremely sharp and precise, the cutting is very accurate. Therefore, the resulting edges do not have to be finished in any other way, such as filing or buffing, as filing other methods.

Adhesives

Paper and board packaging materials need to be joined or fastened together. Adhesives are used for those purposes. An entire industry is based on the production of glues, cements, gums, and hotmelt adhesive materials. Designers need to be familiar with the adhesives used with different types of packaging materials, such as resin emulsion adhesives for coated boards and hotmelt adhesives for plastics and plastic films. They also have to be aware of government regulations, such as the federal regulations for the use of adhesives in food packaging.

2.1.2 Folding Cartons

In 1879 a Brooklyn printer, Robert Gair, was inspecting a printed seed package that had been inadvertently cut by an improperly positioned printing plate. It occurred to him that it might be possible to make a die press that could score and cut paperboard in one impression. Such a press would be suitable for cutting out carton blanks. Gair's idea was the birth of folding carton. Folding cartons are precision-made, low-cost packages supplied *in knock-down form*, also known as *blanks*. (Roth L.,)

When assembled, they become three-dimensional, rigid packages. They can be packed by high-speed automatic, semiautomatic, or hand-operated equipment. Knock-down containers lend themselves to various types of marketing and retailing systems, such as those for food, gifts, pharmaceuticals, cosmetics, toys, hardware, and housewares.

2.1.2.1 Types of Folding Cartons

Structural designers can choose from about 500 styles and variations of carton constructions, with more being added every year by skilled paper engineers. The styles and construction are determined by the product to be packaged and the type of filling operations that will be used. Filling operations are done on fully automatic filling equipment. There are several types of such equipment; the one used depends upon whether the item is bulky, liquid, powder, or granular.

Tray-Style Carton

One basic style of folding carton is the tray. In one type of traystyle carton, solid bottoms are hinged to side and end walls. The sides and ends are connected by a flap, hook, locking tab, or lock. These cartons have a variety of cover and flap parts extending from the walls and sides of the tray. In another type of tray carton, two pieces, one slightly smaller than

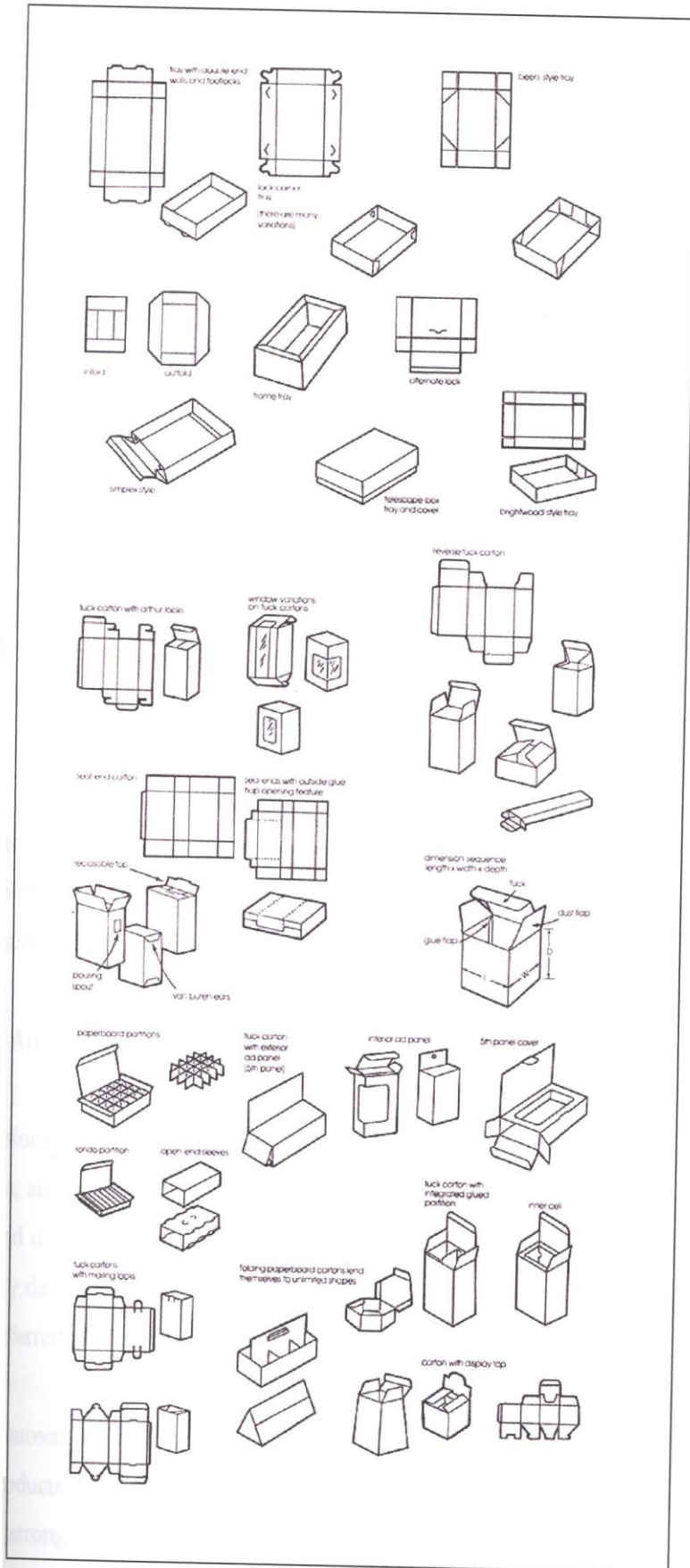


Table 2.1: Basic folding carton patterns (Laszlo R., 1990 p.54)

the other, form the base and cover of a two-piece telescoping box. Typical tray packages are cigarette cartons, bakery trays, ice cream cartons, pizza cartons, and garment carriers.

Tube-Style Carton

Another basic type of folding carton is the tube. The body of a tubestyle carton is a sheet of board that is folded over and glued against its edges to form a rectangular sleeve. It has openings on the top and bottom that are closed with flaps, reverse or straight tucks, and locks. Tube-style cartons give the product fully enclosed protection. They are therefore used to pack bottled products, cosmetics, and pharmaceuticals. Often windows are added, which enable purchasers to see the product. Many unusual tube styles are available, including contoured, triangular, octagonal, or even rounded.

Shrink-Wrapping

Another method of packaging toys, housewares, and contoured products is to shrink-wrap them. *Shrink-wrapping*, which involves sealing a layer of plastic around an object with the application of heat, is a good way to display as well as protect products.

2.1.2.2 Adaptations of Folding Cartons

Adaptations of the folding carton include the bag-in-the-box, boil-in-bag pouches, soups in pouches, and paper frozen-food cartons that can be heated in a conventional or microwave oven and used as a serving dish. Beverages such as milk and fruit juices are packaged in specially designed folding cartons that are lined with film and foil. This type of package is often referred to as *aseptic packaging*.

Many innovative modifications of folding cartons are found in the institutional market for food products. One of these is a liquid-tight, leak-proof package that automatically folds to form a strong tray. It can be frozen, stored, reheated in a conventional oven, used as a serving dish, and easily disposed of. Similar packages are used in vending machines that dispense both cold and hot foods.

The technology of the folding carton is an exciting subject of study for both designers and sociologists. One of the central problems of human history is how to feed the world population. Packaging can provide part of the answer. Containers can be designed to preserve and ship staple and perishable foods anywhere in the world, and even to outer space.

2.1.3 Set-Up Paper Boxes

Set-up *paper* boxes, which are rigid, permanent, three-dimensional containers, have been in use ever since the invention of paperboard. Especially attractive paper boxes were made in France at the end of the nineteenth century. They were designed to contain ladies' hats, fragrances, and fashion accessories.

At first, cardboard was used to make set-up boxes, which were covered with colorful papers or fabrics and used by merchants to sell luxury products. Set-up boxes are now available in many attractive styles and finishes. They are mainly used for prestigious products, cosmetics, fashion accessories, jewelry, and cameras.

Construction of Paper Boxes

The basic materials used to construct setup, or rigid, paper boxes are paperboard and covering materials. In addition, plastics can be combined with them to make useful packages, including transparent plastic domes, windows, and thermoformed trays. (Roth L., 1990, p:60)

Many types of papers and fabrics are used for box coverings. These range from inexpensive wraps to embossed foils and lacquer spray-coated sheets. In addition, special designs can be developed and custom-printed. Accessory materials such as seals, tags, ribbons, and ties are used to enhance rigid boxes.

2.1.4 Corrugated Containers

An American inventor, Albert L. Johns, patented Huted paper for use in protective containers for bottles in storage and shipment. In 1874 another American, Oliver Long,

invented a process for sandwiching the flutes between two sheets of paperboard. This innovation marked the beginning of a new industry-corrugated containers. (Mosberg S., 1989, p:30)

Like most packaging materials, *corrugated board* (often called *fiberboard*) has a long and colorful history. You pack your belongings in them whenever you move. Your TV set, stereo, VCR, and other appliances were shipped in impressively designed corrugated boxes. It may surprise you to learn that this popular packaging medium, the workhorse of the industry, was originally part of an article of clothing.

2.1.4.1 Construction of Corrugated Containers

Corrugated containers are constructed from a fluted sheet glued to one or more liners. The structural characteristics of the corrugated medium are governed by four variables:

- The strength of the liners
- The strength of the corrugated mediums
- The height and number of flutes per foot
- The type of walls (single, double, triple, etc.)



Figure 2.1 : The latest technology combining the excellent looks of offset print the strength of corrugated material. (Gül Matbaacılık)

Four flute structures are available for corrugated containers:

- A-flute, in which wide spacing of flutes results in greater capacity to absorb shock.
- B-flute, which has a greater number of flutes per foot, providing maximum crush resistance.
- C-flute, which combines the properties of A and B flutes.
- E-flute, which is a very thin corrugated board and is perhaps most popular type for large, sturdy displays and packages.

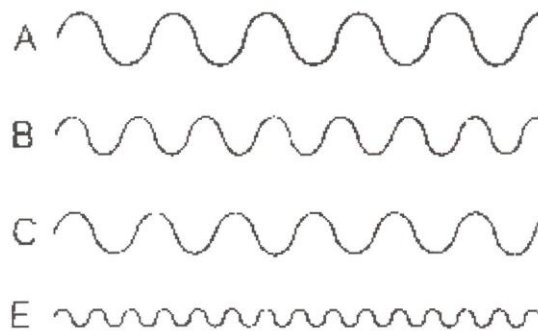


Figure 2.2: Diagram of corrugated fluting (Stewart M., 1989 p.29)

Another important element of corrugated boxes is interior protection. A wide range of corrugated partitions, liners, pads, and other devices, including plastics (molded polystyrene foam) are used to provide inner reinforcement, cushioning, bracing, and shock absorption. The most commonly used closure techniques are stitching, stapling, gluing, and taping. Although stock sizes of corrugated boxes are available, custom-made cartons are usually required for special jobs such as large quantities of products (10,000 to millions). Industrial or *master cartons*, which are shipping cartons with smaller cartons in them, are used for food, detergents, hardware, housewares, and so on.

Governments and industry standards and regulations are designed to protect users of cartons. There are laws pertaining to shipment method, such as rail, air freight, truck, and regular parcel post. All corrugated materials and cartons must be certified by the manufacturer. Weight, paper content, and puncture and bursting test certificates must be displayed on all corrugated boxes.

The tests for the materials involve subjecting them to the same conditions to which a product is subjected in the course of normal handling; these include drops, jolts, shocks, and vibrations. These tests are designed to select the right box for a product, as well as the right master carton in which to ship the boxed product, without costly packaging, overpackaging, or underpackaging.

A significant trend in corrugated technology is impregnating and coating the corrugated board with waxes and plastics. The moisture-resistant coating permits reuse of cartons to ship products such as fruits, vegetables, and other products that were previously shipped in expensive wooden crates and barrels.

Printing on Corrugated Materials

The most important advance in printing on corrugated materials is *flexographic printing*, which uses quick-drying inks and high-speed presses. Another significant trend is toward greater use of colors on clay-coated white liner board. The use of preprinted liners and full-color lithographed, laminated labels turns a common cardboard box into an elaborately print package.

2.1.5 Displays

The expansion of the self-service stores and the change in consumer buying habits have both contributed to the development of point-of purchase (POP) displays. The POP display and its variations have become an effective sales aid for retailers.

2.1.5.1 Types of POP Displays

There are several types of POP displays, each serving a specific merchandising function. The major categories are ;

- Display merchandisers and shippers
- Permanent display
- Window and showcase displays
- Posters
- Commercial vehicle

Display Merchandisers

Retail establishments are busy places. A large percentage of the selling therefore takes place through self-service, whereby consumers choose merchandise themselves rather than having it brought to them by a salesperson. This makes impulse buying possible.

The types of displays used for impulse buying are *display merchandisers*, sometimes called *promotional displays* because they are designed to be used only for the duration of a particular sales promotion. These displays are strategically placed within the store, often near the checkout counter where the customer has time to look over the promotion while waiting in line. Structurally, the display merchandisers are designed for easy assembly.

A variation of the display merchandiser is the *counter display*, often called a *shipper*. Generally a small display, it is popular with stores that sell cosmetics, health and beauty aids, and other small items. An interesting variation of the counter display is the *gravity-fed display*, which dispenses batteries, films, shoe polish, cosmetics, polish, and similar objects.



Figure 2.3 : A Promotional counter displays (Özge Plastik Packaging Company Inc.)

Another variation of the display merchandiser is the *floor stand*, a large structural display used mostly in supermarkets and liquor stores. It is often animated with a small battery-driven motor. A *dump bin* is a mass display unit into which merchandise can be "dumped" directly from the shipping carton, thereby encouraging consumers to help themselves. Dump bins are frequently used in supermarkets to display sale-priced items. Other types of promotional displays are used both inside of stores and outdoors, such as at gas stations. They include mobiles, flags, banners, spinners, and devices that move with or without electric power. Another POP device used to stimulate sales is the "send away" *premium display*. This more elaborate type of stand is made to entice dealers into prominently displaying a product. In addition, there are a number of promotional display graphic devices, such as shelf extenders, danglers, and die-cut signs, designed to catch the attention of the consumer.

Permanent Displays

Sometimes temporary promotional displays are not suitable for the store or product. *Permanent displays* are made of durable materials such as wood, plastics, and wire and tend to be elaborate and expensive. They are closely associated with cosmetics. Their functions include selling, demonstrating, and helping consumers sample products (e.g., fragrance testers and shade charts).

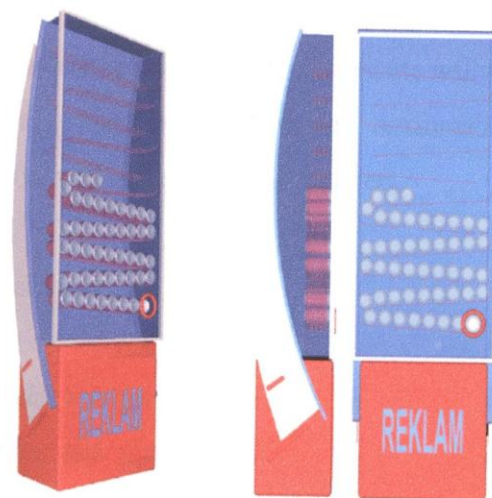


Figure 2.4 : This product is designed to be promotional display for can beverages. It consists of two main parts which are base (refrigerator) and body (wire register). Glass and sheet iron are used as a material. (First Honourable mention award is given to Yankı Göktepe and Erol Kaya by ÜÇGE - Store Equipments in 2000)

The most valuable type of POP display is probably the *window display*, since they attract customers from the outside. Window displays range from a simple poster to the intricate displays seen in the windows of travel agencies and liquor stores. Since window displays are created by the store's display department, technically they are not a POP display.

Posters

The *poster* is the oldest graphic promotional device. Some of the most prominent artists of this century, including Toulouse-Lautrec and Picasso, created posters for theaters, ballet companies, art galleries, and political movements. The art of poster design is highly expressive, making posters powerful social and political weapons as well as works of art.

Signage

The POP graphic displays that identify companies and products and convey messages about them is called signage. This type of POP is frequently used by fastfood outlets and gas stations, where a total environment is created with signs. Automobile dealerships, appliance showrooms, international fairs, and the Olympic Games are other examples of places in which signage can be used effectively.

Soft-drink, beer, and camera manufacturers distribute wall plaques, clocks, and indoor and outdoor signs-often using neon to bars and restaurants. These POP "signs" are an advertising device as well as a service to consumers.

Commercial Vehicles

The *commercial vehicle* is another valuable selling device. They include circus wagons, ice cream carts, trucks, and airplanes, all bearing the name and logo of the company. Commercial vehicles can be thought of as moving billboards.

2.2 Flexible Packaging

The introduction of cellophane and the development of plastic films, foils, and specialty papers, as well as methods of coating and laminating, led to the development of new types and uses of flexible packaging. Today the larger user of flexible packaging (80 percent) is the food industry. Some of its packages those designed for freezing, cooking, mixing, preserving, and dispensing foods and ingredients are having a dramatic impact on the food industry, especially in the are of convenience (fast) foods.

2.2.1 Types of Flexible Packaging

There are three basic types of flexible packaging: wraps and overwraps, preformed bags and envelopes, and form-fillseal pouches. A fourth, recent, type is aseptic packaging.

Wraps and Overwraps

Both *wraps* and *overwraps* are sheets of flexible material that are usually fed from a roll stock. Wraps are formed around a product such as a candy bar or a loaf of bread; overwraps are formed around a basic package such as a carton. Variations on the wrap are bands and sleeves. Closures for wraps include adhesives, heatseals, and peelable closures . Various kinds of specialized high-speed wrapping machines have been developed, often with a high degree of automation.

Preformed Bags and Pouches

A *preformed* bag is basically a tubular construction fabricated from paper, plastic, foil, fabric, or a combination of these materials. There are four standard styles of paper bags: flat, square, self-opening or automatic, and satchel.

Invented around 1850, the flat bag is the oldest form of paper bag. Made by simply folding paper into a tube, it is used for hosiery and textiles. The *square bag*, in contrast, has pleats or gussets and is designed to hold bulky materials. Originally made of paper, it is now available in high-density polyethylene for industrial products.



Figure 2.5 : BOPP, PE, A1, paper, metallised, pearlised, co-extruded and laminated films on rolls for automatic packaging. (Zirplast Plastic Company Inc.)

The self-opening style, or automatic bag, has side gussets and a built-in flat bottom. The popular grocery and shopping bags are in this group. The *sachel-bottom* bag has no gusset in the sides and has a flat base. It is used for bulky materials, mostly foods such as coffee and flour.

In addition to these four styles of bags, there are numerous *multiwall* bags, which are used for bulky products, that come in large or small sizes. Large multiwall bags are used for products such as cement, plaster, polymers, and fertilizers. Small multiwall bags are used for coffee, rice, and other bulk food stuffs. Multiwall bags consist of several layers; the number of layers and material used for them depends upon the contents of the bag. For example, a multiwall bag for cement would have a paper outside and plastic liner; for food it would have specially treated and laminated materials. A variety of closures is available for bags, including sealers, twist ties, plastic clips, coffee tabs, and drawstrings.

Form-Fill-Seal Pouches

The first totally automated package form was the *form-fill-seal pouch*. This package comes in the form of a roll and is filled and sealed on high-speed equipment. Available in a variety of styles and shapes, the pouch has been responsible for the development of many new products. Examples include boil-in-the-pouch frozen foods; instant soups, coffee, and gravies; alcohol and fragrance dabs; instant shoe shines; and packs for pharmaceuticals.

A recent form of flexible packaging, originally developed in Europe, is the *tetrahedral* (pyramid-shaped) pouch. It is used for- fresh milk, since in these containers milk has a shelf-life of six to eight weeks. Pouches for liquids are not new, of course; wineskins were used in biblical times. Wine, motor oil, and soft drinks are also being marketed in flexible packages. (Roth L., 1990, p:133)

Space-age packaging, originally designed for the Apollo flights, used plastic-laminated pouches. The development of the retort package and aseptic packages were originally created as a result of the needs of astronauts. Today, these types of packages are used for popular consumer products such as dairy items and fruit juices. Sterilized snap-open pouches are used for medical kits, surgical gowns and gloves, and other disposable hospital supplies.



Figure 2.6: “Coctail” object-holder curtain designed by Olivier Peyricot, (Byars M., 1998, p:27)



Figure 2.7: Left, the doubled-over top edges is high frequency heat sealed. Right, close view of object PVC-*polyvinylchloride*. (Byars M., 1998, p:26)

Another type of pouch is the *microen-capsulation* pocket. It contains the product and also serves as the applicator. Liquid floor polishes and cleaners come in disposable urethane applicator pouches with vinyl-coated paper "hats," which serve as sponge applicators. Shoe polish is marketed in microen-capsulation pockets. The polish is trapped between the two layers of a polyethylene-paper pouch and released upon application.

The *bag-in-box* is a practical packaging form that is appearing increasingly frequently on supermarket shelves. It is used for products such as snacks, cereals, and cookies. Different types of paperboards and laminates can be used to create the outer box. The inner bag is made of plastic film, aluminum, or special paper laminates.

The *retortable pouch, or retort package*, has been developed to permit sterilization of a product in its package. The pouch with its product can be stored at room temperature and has a shelf life of as long as seven years. The pouch is polyester-foil-polypropylene laminate with specially developed thermal adhesives.

A variation of the retortable pouch is the *institutional-size pouch*. Because of the costs of packaging material and transportation, this lightweight, low-cost package is replacing the large metal cans that have long been a fixture of the food service industry.

2.2.2 Aseptic Packaging

Aseptic packaging is an exciting new technology in the packaging field. An *aseptic package* is a sterilized container or pouch suitable for food products, beverages, and

pharmaceuticals. Aseptic packages have a long shelf life and do not require refrigeration either during transport or in the store.

Aseptic packaging refers to the conditions under which the product is packed, i.e., the independent sterilization of product and sealing processes. The product a soup or yoghurt, for example is usually sterilized by one of a number of high-temperature, short-time methods. In milks and dairy packaging this is usually the ultra heat treatment process, but juices fare better at lower temperatures. The pack itself is sterilized separately, sometimes by exposing it to steam or the bleach, hydrogen peroxide. (Sonsino S.,1990, p:110)

2

Two major aseptic packaging systems are currently available. The first system, *paperboard-based* aseptic packaging, includes the popular brick-style box made from a polyethylene-paper-foil-polyethylene laminate. It is used for juices, wine, tomato sauce, and other liquid foods and beverages. Another type of paperboardbased aseptic package is made from preprinted roll-stock material formed into a tubular shape. The material is a polyethylene-board-polyethylene-aluminum laminate. The lid material (i.e., can ends) is a PVC-aluminum-polyethylene laminate.

Conve

The second system of aseptic packaging is plastic-based. This type either uses laminated multiple plastics or is coextruded into a single sheet that can be thermoformed into a container. Coextruded plastics for aseptic packaging include ethylene vinyl alcohol (EVOH) and polyvinylidene chloride. These polymers are sandwiched between layers of adhesive, or "tie layers." The multilayered sheet is a minimum of five layers thick; it is often seven. This package form is used for fruit juices, apple sauce, tomato sauce, and a variety of puddings.

2.2.3 Procedure of Flexible Packaging

presented

The food industry is a major user of flexible packaging, and whether packaging a loaf of bread, cheese flavored popcorn, single portions of non-dairy creamer, or frozen gourmet style chicken and herbs flexible packaging has helped make it possible. The variety of products to be packaged requires that a host of objectives be met. The objectives may or may not include : (Moesberg S.,1989, p:97)

- Moisture barrier protection
- Oxygen barrier protection
- Fragrance and taste protection
- Puncture resistance
- Clarity
- Sealability
- Re-closeability

2.2.4 Graphic Consideration

Applying graphics to flexible packaging is generally accomplished by flexography or rotogravure printing. Gravure is far more costly and time consuming than flexography, but the results, particularly on large volume runs, are far superior. The gravure process relies on expensive and complex printing cylinders that are etched and may take weeks to prepare. Changes are difficult and costly and may require considerable down time. Although these negative aspects are cause for concern, the gravure industry is working to improve the proofing, minimize the large volume run requisites, and computerize the revision process. Conversely, the reproduction quality of gravure is vastly superior and will yield consistently faithful graphics in spite of color subtleties and tonal variations.

2.2.5 Shopping Bags

Shopping bags are the most effective of advertising a store and in some cases a product or service. They are actually moving billboard. As an advertising medium, shopping bags are used by stores organizations, banks, labor unions to name just a few.

To design a successful shopping bag, it is necessary to start with a basic idea or concept presented in thumbnail form. Variety of ideas, ranging from simple typography to unusual, sometimes humorous concepts. When the final concept has been worked out, the design may be transferred to the bag through various media, such as photography collage, photocopy, illustration, or even a photostat reproduction in color or black and white. Almost any technique can be used in creating a stunning shopping bag.

do not soften when heated and are not flammable. Commercial polymers within each group, or family, and their characteristics follow.

Thermoplastic Polymers

Polypropylene was developed in 1954 by Giulio Natta, a professor at the Polytechnic Institute of Milan. It is produced from propylene gas, another by-product of petroleum. Polypropylene is a strong, hard, white material that is resistant to cracking. Polyethylene is probably the most familiar of all plastics. It is available both as a film and as a flexible plastic and is used for many purposes, including containers, toys, plastics bags, tubings, and coatings. It is used for luggage, cosmetics, containers, and automobile and aviation components. Because it can be sterilized it is also used in hospital equipment. Polypropylene is most suitable for blown bottles, housewares, electronic parts, and fibers for carpeting. Polyethylene is produced from ethylene gas, a by-product of petroleum. It can be injection molded, blow molded, extruded, vacuum formed, casted, and calendered; it can be either high or low density.

Polystyrene is inexpensive and therefore is used for disposable items such as cups, containers, trays, and utensils. Typical molded, polystyrene products include appliance parts and housings, furniture, optical components, toys, and hobby kits. In fact, polystyrene sheets are the favorite material of designers and modelmakers because they are easily cemented. Another popular form of polystyrene is the expanded foam. It is used in packaging fragile objects, in insulated products, and as insulation material for the building and construction industries. It can be applied in sheets in liquid form.

Styrene acrylonitrile (SAN) is produced by copolymerizing acrylonitrile and styrene to form the SAN polymer. Styrene acrylonitrile is used for food packaging, glasslike containers and bottles, lenses, electronic components, and piano keys.

Acrylonitrile-butadiene-styrene (ABS) is a terpolymer (a triple polymer) that combines flexibility with toughness. Products typically made of ABS are boat hulls, automobile trims, telephones, power tool housings, football helmets, radio and television cases, extruded pipes, and pipe fittings. Acrylonitrile-butadiene-styrene is suited to most molding and calendering processes.



Figure 2.9: “ECO” Waste bin designed by Raul Barbieri. Materials: Opaque ABS (acrylonitrile-butadiene-styrene). The main feature of this product is the rim ring that covers the top edges of a standard plastic-film waste-bag liner and holds it firm. (Byars M., 1998, p:144)



Figure 2.10: Producing tecnic: A waste bin has been formed under high heat and 500 tons of pressure. The same worm channels are used for both ABS or polypropylene injections. The oleodynamic press is regulated by a micro-processor. (Byars M., 1998, p:146)

Polyvinyl chloride (PVC) is the most important polymer in the vinyl group. Polyvinyl chloride is produced from acetylene and hydrogen chloride. It has excellent resistance to water and chemicals and is self extinguishing. Among its applications are wire coatings and glasslike blown bottles. Calendered PVC sheets are used as simulated leather (i.e., vinyl), shoes, handbags, rainwear, automobile interiors, shower curtains, coats, and upholstery

materials. Polyvinyl chloride pipes and tubings are widely used in the building industries. Products made of PVC are processed by means of extrusion; blow, injection, and rotational molding; and calendering.

Polyvinylidene chloride is prepared from ethylene chloride and is available in both rigid and flexible forms. It is widely used in upholstery, pipes and tubing, and outdoor furniture. As a film, it is an excellent material for food wrapping and is familiar to consumers as Saran Wrap. It can be molded, extruded, and calendered.

Polyvinyl chloride plastisol, a liquid form of PVC, is basically a coating material. When heated, the resin swells and forms a solid coating material. Polyvinyl chloride plastisol is used in molding soft, flexible products and as a coating for metal parts.

Polycarbonate resins are among the toughest of all plastics. They can be used in place of many metal parts and are found in electrical panels, insulators, street lighting globes, football and safety helmets, machine parts, shoe heels, electric appliances, and power tool housings.

Cellulose acetate is produced by extrusion, injection molding, or compression molding. In sheet form it is used in vacuum forming. Other applications include toys, combs, lampshades, and housewares. The extruded film is used in X-ray, photographic, and tape-recording equipment. Cellulose acetate can also be made into fibers for weaving into a fabric known as acetate rayon.

Fibers

Cellulose propionate is usually processed by means of extrusion or injection molding. This economical material is used in items such as toothbrush handles, pen and pencil barrels, and tool handles.

Acetate

Cellulose acetate butyrate (CAB) is the "outdoor" plastic; low temperatures do not diminish its strength. Extrusion and injection molding techniques are used to form CAB into sheets, tubing, outdoor signs, mailboxes, and building materials.

Acetal resin

Ethyl cellulose has several outstanding properties, including high impact strength at subzero temperatures, rigidity, and suitability for molding. It is used in bowling pins, safety

helmets, gears, and outdoor objects. Cellulose nitrate is rarely used today because it is flammable. It is found primarily in explosives and pigments.

Cellophane is a pure form of cellulose. It is produced by treating cellulose from cotton or wood pulp so that it dissolves. The solution is spread onto flat sheets, which pass through a bath in which the pure cellulose is reformed or regenerated. The film then passes through a plasticizing solution, making it less brittle, and is coated with lacquer, which makes it moisture proof. Cellophane is used mostly for wrapping food products and in die-cut window boxes (to face direct holes).

Nylon is the trade name for a group of polyamide resins introduced by the du Pont Company in 1938. A du Pont chemist, Wallace H. Carothers, had been experimenting with condensation polymerization, and his work led to the development of polyamides. Nylon was originally used as a fiber for fabrics and did not come into widespread use as a molding material until the 1950's. Nylon can be injection molded, blow molded, and extruded. Its major advantage is strength. It is used in gears, bearings, ship propellers, hinges, fishing lines, and textiles.

Acrylic (methyl methacrylate) polymers are produced from petroleum-based ethylene and propylene. The outstanding properties of acrylic resins are exceptional clarity and the ability to transmit light. Acrylic rods and fibers are widely used in diagnostic medicine to conduct light from a single source (fiber optics). Acrylic plastics appear under numerous trade names, including Lucite, Plexiglas, Acrylan, Orlon, and Dynel. The last three are fibers suitable for all kinds of clothing. Water-soluble acrylic paints are used by artists and decorators.

Polyphenylene oxide (PPO) offers outstanding electrical properties over a wide temperature range. Many uses have been found for PPO in electronics. Small electrical appliances, heaters, switches, battery cases, printed circuits, and electrical housings are made from PPO. It can be sterilized and is used in making medical and surgical instruments.

Acetal resins are prepared from formaldehyde. They are highly resistant to most chemicals and can be easily processed using all molding and extrusion methods. They are used by the

automobile industry in carburetors and fuel pumps and are suitable for hardware items and aerosol bottles.

Polysulfone resins are produced for high-temperature applications. Owing to the high heat resistance of this plastic, it can replace many thermosetting materials. Polysulfone can be adapted to many molding processes. Product applications include circuit breakers, microwave oven parts, automobile distributor caps, and medical equipment that can be sterilized.

Polyurethane can be prepared as either a rigid or as a flexible, pliable material. Most polyurethane is produced in the form of foamed plastic. Rigid polyurethane resins called elastomers can be stretched to more than twice their original size. They are used in tires for heavy equipment and for automobile bumpers.

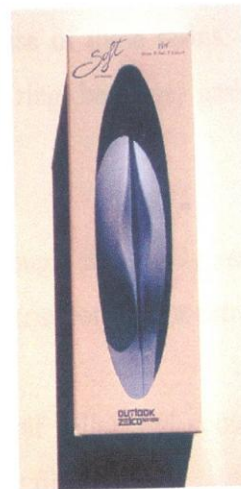
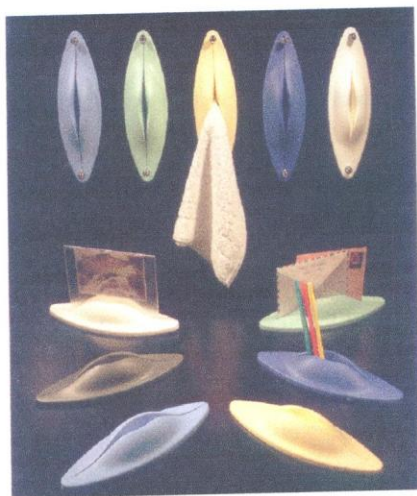


Figure 2.11: “Soft” object holder designed by Syn-Marina. Left, object mirrors the human female sex organ is undeniable. Right, the package of product. (Byars M., 1998, p:50-52)

Polyurethane foams are available as liquid sprays that can be used for coating and packaging fragile objects. They also come in the form of stock slabs, which are used for furniture cushioning, insulation materials, sponges, life jackets, filling in aircraft wings, and insulation for fuel tanks on the space shuttle.



Figure 2.12: Soft expanded polyurethane resin is formed in injection molds. (Byars M.,1998, p:52)

Polytetrafluoroethylene (Teflon) and tetrafluoroethylene resins (TFE) are the most inert of all plastics. They are extremely resistant to solvents and corrosive chemicals, but because of their high melting point they are hard to work with. They can be molded as a powder, then fused. Many consumer and industrial products make use of these resins. Products include nonstick cookware, irons, and frying pans; piston rings; bearings; gaskets; and chemical-resistant tools.

Ionomer resins are produced from ethylene gas. They are tough and highly resistant to chemicals. Ionomers can be injection molded, blow molded thermoformed, or extruded.

They are used in molding bottles, sports equipment (e.g., golf balls), and containers for food packaging. Papers and fabrics can be coated with ionomer film.

Polyimide resins can be formulated in thermoplastic as well as thermosetting methods. Polyimide is one of the most heat-resistant plastics. It is widely used in the electronics and aerospace industries to insulate wires and motor windings in aircraft and missiles.

Polyallomer resins are produced from ethylene and propylene. Since they are light in weight and flexible, they are used in hinges for luggage, cosmetic containers, flex-top packages, closures, and applicators. Polyallomers are processed by extrusion, injection molding, or thermoforming. (Roth L.,1990, p:102)

Thermosetting Polymers

Thermosetting polymers differ from thermoplastic polymers in many ways. As noted previously, thermosetting polymers are cross-linked networks of long chain molecules; hence, they are rigid and infusible. Once they have been molded into a shape, they cannot be reheated and reshaped. Compression molding is the chief method used to make thermosetting plastics. Phenol formaldehyde resins, commonly known as phenolics, are rigid, heat-resistant materials. These inexpensive plastics are produced by means of compression and transfer molding. They are used in a liquid form for laminating plywood, fabrics, and board. Phenolics are also used in brake linings, distributor caps, automobile body parts, and housewares.

Polyester resins are available in liquids, solids, pastes, and fibers. When they are combined with glass fibers, the result is fiberglass, which is used in boat hulls, aircraft and automobile bodies, gears, luggage, and tools. The resins are compression molded. Soft-drink bottles made from polyester-oriented polyethylene terephthalate (PET) are blow molded after being reshaped by injection molding. Polyesters in liquid or paste forms are mixed with catalysts at the time of use. Catalysts in this case are hardeners of adhesives, filters, and other plastic solvents, glues, and powders; an example is epoxy glue. There are also thermoplastic polyesters that can be injection molded and extruded.



Figure 2.13: “ Cable Turtle ” cord manager designed by Flex Development B.C. (Byars M.,1998, p:47)

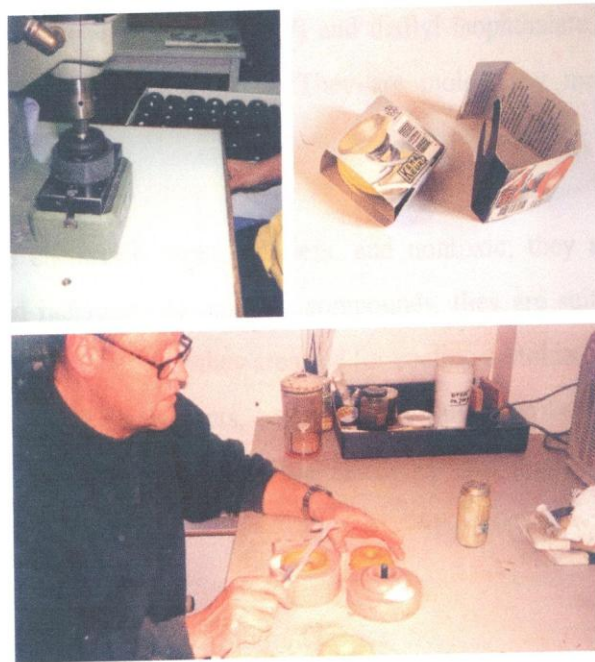


Figure 2.14: An injection machine is infusing a mold with SBR a polyester-based thermoplastic elastomer. (Byars M.,1998, p:48)

Amino resins include melamine formaldehyde and urea formaldehyde. These clear thermosetting resins are fireproof and resistant to detergents and oils. Molded products made from urea include buttons, closures, TV and radio cabinets, and switch plates. The best-known melamine product is china-like dinnerware. Both urea and melamine are used as adhesives in wooden products.

Alkyd resins are produced as molding compounds and liquids. About 90 percent of alkyds are used in liquid form as coatings. Alkyd resins in liquid solutions are used in odorless paints, enamels, and lacquers. As molding compounds alkyds are compression molded to form electronic components.

Epoxy resins are used in coatings to resist corrosion of pipes, tanks, containers, wall finishes, steel, and masonry. Epoxy adhesives are very strong and can be adapted to metals, glass, ceramics, and some plastics. Molding compounds of epoxy are used with catalysts for compression and transfer molding of electronic components and boat and aircraft bodies.

Allyl resins include diallyl phthalate (DAP) and diallyl isophthalate. These materials are used in rocket and missile components. They are molded by means of transfer and compression processes.

Silicone resins are chemically inert, odorless, and nontoxic; they are resistant to most chemicals, oils, and radiation. As molding compounds, they are suitable for transfer and compression moldings. As liquids, they are used for coatings. Molded, flexible silicones are used in airplane parts and components, artificial heart valves, gaskets, and small electronic parts. Silicone compounds are used in the aerospace and appliance industries to seal electronic parts.

2.3.2 Production Methods Used to Shape Plastics

As clear from the discussion so far, several different processes are used to convert polymers from their pellet, powder, or liquid form into plastic products. The choice of material to use is not the only decision to be made in plastic designing. Equally important is the production method. How you produce the package will affect the cost, aesthetics, and durability of the container as much as the resin. This part will describe several of the most commonly used production methods as they pertain to packaging.

2.3.2.1 Molding Processes

Injection molding is a widely used process to form thermoplastics. First, a hopper is loaded with resin; then heat is applied until the plastic becomes soft enough to flow. The liquid plastic is forced through a nozzle into a mold. After the plastic has cooled, the mold separates and ejects the product. Production by injection molding is very fast, taking only 10-30 seconds per item.

Specialized equipment is used to mold thermosetting plastics. Injection molds usually consist of two halves, one stationary and the other movable. There are also multiple-piece molds for complex parts. Since molds are expensive, this process is most appropriate for large production runs.

Blow molding is used to make hollow shapes. In this process a thin-wall plastic tube called a parison is placed in the mold, which closes on the softened polymer and pinches off the bottom. A jet of air blows into the other end and expands the plastic to fill the cavity. The mold is then opened and the product ejected.

In compression molding, thermosetting resin is placed into the heated mold. Pressure is applied and the molten resin fills the mold cavity. The mold can have one or more cavities.

Transfer molding involves the same principle as compression molding except that the resin is not placed in the mold cavity. Instead, it is placed in a separate cavity known as a transfer pot. There it is heated under the pressure of a plunger, which forces the softened resin into the mold cavities. This molding process is most suitable for small, intricate parts.

Thermoforming or vacuum forming is the primary technique used for shaping plastic sheets. The sheet is held in a frame and heated until it is soft and pliable. The mold is placed under the heated sheet, and a vacuum is applied through small holes in or around the mold. When the plastic cools, it hardens and retains the shape of the mold.

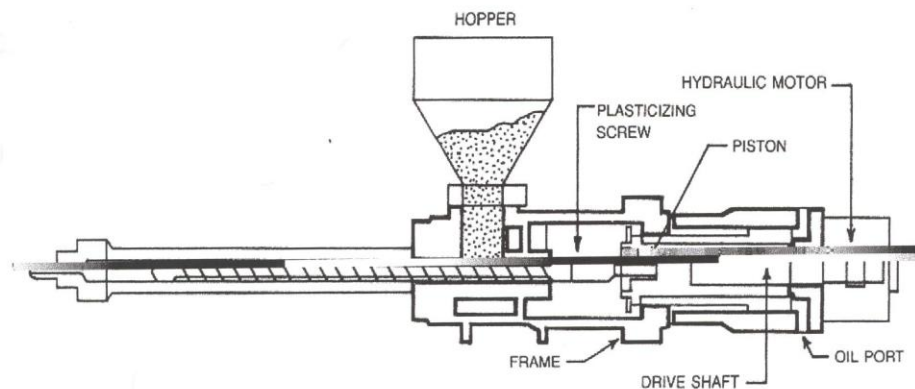


Figure 2.15: Blow molding sequence, diagram by Elizabeth Downey . (Thelma R. Newman, 1972, p:44)

Thermoformed packages are in wide-spread use and take many forms. Among them are the following:

Blister pack: This is the most widely used of all eard paeks and is intended to provide visibility.

Prefabricated blister pack: A preformed blister is attached to a die-cut, hinged window card. The product is displayed inside the bubble and is visible on both sides of the card.

Skin pack: The product is laminated to a card with a thin, tough film.

Stretch film pack: A film is bonded to a die-cut double window card so that the product is encased in a see-through display package.

Thermoforming offers some exciting options. In the hands of a creative and informed designer, it can be a highly effective self service packaging form for a wide variety of products.

Another type of molding process is plastisol molding. Plastisols are mainly coating resins consisting of PVC resins and plasticizers. They are used to coat or dip nonplastic objects. Among the products produced by dip-molding are toys, spark plug covers, wire racks, tool handles, and housewares. Cold-dip plastisols are available for coating without heat and require only air drying.

2.3.2.2 Extrusion

In extrusion, thermoplastic resin is fed into a heated tube. The soft plastic is then forced through a die by a rotating screw or plunger to form a continuous shape. Extrusion is used to manufacture rods, pipes, sheets, film, and coatings for cables and wires. This process is used only with thermoplastic resins.

In coextrusion, two or more films are simultaneously extruded to produce a multilayered film. Coextruded films are used in packaging for frozen foods, cereals, and meat.

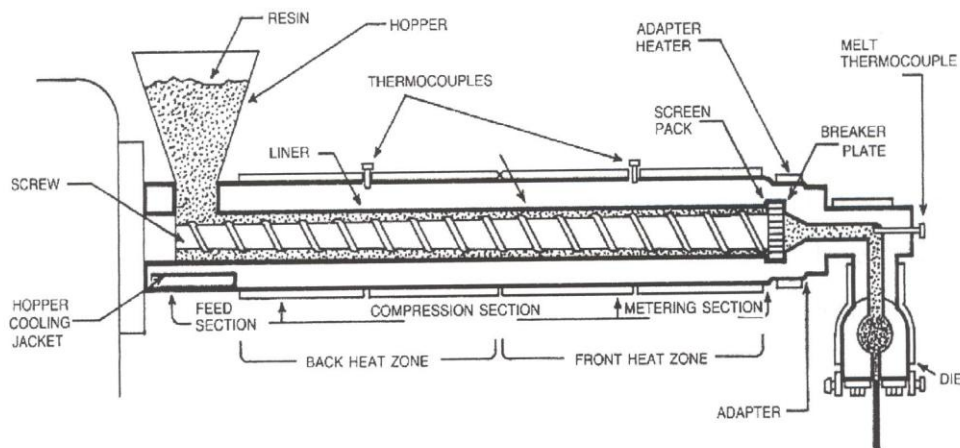


Figure 2.16: Extrusion. Cross section of an extruder, diagram by Elizabeth Downey. (Thelma R. Newman, 1972, p:44)

2.3.2.3 Calendering

In calendering, softened thermoplastic material is pressed between two or more rolls (cylinders) to form a continuous sheet. Calenders are also used to coat papers and fabrics.

2.3.2.4 Laminating

Laminating is a process in which two or more layers of material are bonded together to form a single sheet. Plywood and paperboard are examples of products that are made by this process. Most lamination is done with a heated hydraulic press.

2.3.2.5 Casting

Casting with plastics is similar to casting with other materials, such as plaster, cement, and latex. The liquid plastic is poured into the mold. The plastic is a liquid resin to which a catalyst (hardener) has been added. The mold may be a simple plaster mold or a complicated precision mold with many parts. Resins used in casting include acrylics, polyester, silicones, epoxies, nylons, phenolics, and urethanes. (Roth L., 1990, p:115)

2.3.3 Designing With Plastics

Many packaging designers today are finding that the first question in choosing a packaging material is whether or not to use plastics. Now, more plastics are used in packaging than any other material. Containers made from plastics are extremely light and can be moulded into intricate shapes in many different colours. More recently, designers have devised a number of different finishes to counter the challenge from the glass manufacturers that plastics packs can never have a high quality image.

Another major advantage of plastics packs is that they can be squeezed, enabling product to be forced out of a pack. Perhaps the most exciting example in recent years has been the plastics ketchup bottle. The plastics container has become a familiar and essential part of household requirements, for toothpastes, cleaning materials, toiletries, foods, so on due to the innovation of the designers who work with plastics. (Sonsino S., 1990, p:116)

The rapid development of plastics had a dramatic effect on packaging and design. Never before had product and package designers been offered so many opportunities to exercise their creativity. Today many consumer and industrial products are made of plastics; they can be produced at a lower cost than products made from natural materials. In a free-enterprise, consumer-oriented society, increasing quantities of goods must be produced each year to satisfy the demand for an ever-higher standard of living. At the same time, consumers continually seek change and novelty, a tendency that is exploited to the fullest by marketers. New styling, new features, even new colors will make last year's model obsolete.

This "planned obsolescence" is often criticized, but it has numerous benefits. It increases the availability of most consumer products. It stimulates competition in the marketplace, often improving the quality of products and creating job opportunities for millions of people. Many of these benefits are related to the availability of plastics for use in product and packaging design.

A well-planned design program with plastics requires the teamwork of many experts, including product, packaging, and graphics designers; engineers; computer technologists; and model makers. The product designer, often called the industrial designer, needs a

background in basic engineering. To use plastics effectively, he or she must know which materials are appropriate for particular functions. In addition, the industrial designer must be able to design a product that performs well, is attractive to the consumer, and is economical for the manufacturer. Creativity, precision, and skill in drafting, rendering, and model making are required.

2.3.3.1 Finishing and Decorating

A variety of processes are used to finish and decorate plastic products and packages. In general, the finishes include paint, print, coat, and texture. The specific processes follow.

Vacuum metalizing consists of coating plastic with a thin layer of metal to give it a metallic appearance. This method is used to create metallic surfaces for toys and automobile components.

Electroplating is another method for creating metal like plastic products and components. Plumbing supplies, and automobile grilles and taillights are made from chrome-plated plastics.

Hot stamping is a popular way of decorating plastics or cardboard for packages and products. The process consists of transferring the design from a thin foil or film onto the product. The application of heat and pressure to the back of the foil adheres the design to the product or package. Several colors can be hot stamped in a single operation. Plastic bottles and cosmetic containers are hot stamped in metallic or nonmetallic colors.

Silkscreen printing is another method for decorating plastic products and packages. Plastics can also be engraved on a special engraving machine to produce signs and nameplates. Some plastic products, especially dinnerware (melamine), are decorated using the in-mold process. A printed full-color overlay film is placed in the mold and fused to the molded piece during the molding process. This method is used in compression molding with thermosetting resins and can also be used in injection molding.

Surface texturing and embossing the container can create special effects and result in a truly proprietary design. By incorporating color into the plastic, a stronger trade dress can be

achieved as well. Texturing and color can also help improve the appearance of potentially unsightly products and should be given consideration in the early stage of design. To communicate the marketing message, the designer may use labels, embossing, hot stamping, silk screening or heat transfer processes. These must be considered at the beginning of the design program since the method chosen will affect or be affected by the plastic resin and molding technique used.

As a reminder of the complexities the designer and marketer must consider when developing a plastic container, the following important questions should be asked :
(Moesberg S.,1989, p:67)

- Will the product be a liquid or a solid ?
- Will the package require a protective barrier ?
- What kind of shelf life is required ?
- What kind of filling, capping, handling, shipping, and storage will it undergo ?
- What kind of graphics and decoration is need ?
- Does the configuration require a handle, hinge or pour spout ?
- What component parts are needed ?Will they be integral or separate ?
- Are there shape and color requirements ?

2.3.4 Important Usage of Plastics in Packaging

The packaging industry uses over 30 percent of all the plastics produced. And this percentage will increase in future years. Because of ecological pressures, the plastics industry has responded to environmental concerns by developing new methods for the disposal, recycling, and reuse of plastics. Manufacturers have also invested in the development of biodegradable plastics.

2.3.4.1 Beauty and Bodycare

Increasing the perceived value of products such as toiletries and cosmetics is almost an art form in itself. A knowledge of the materials and processes that can be used to raise this value is essential to both the design and marketing. Italian designers are renowned the

world over for their design sense so it is no surprise that the Italian people are spending more than ever on beauty and bodycare products.

2.3.4.2 Medical Packaging

Acrylic polymers have also been used to good effect in medical packaging. Dacron for instance is used regularly in the manufacture of blood filters for use in transfusion. The housing for the filters need to strong enough to withstand knocks and a certain amount of rough treatment and again the chemical resistance is an important factor. The clarity of the plastic is significant, too, for surgeons and doctors can often make important deduction from the colour of different blood samples, or other liquids, as they pass through the filters. Materials that are tainted with impurities, however slight, must therefore be avoided by the designer. (Sonsino S.,1990, p:122)

Medicine and dentistry have also benefited greatly from the availability of special plastic materials. Also, plastic valves, tubes, tubings, fiber optics, and pouches are frequently used in medicine and surgery. Prosthetic devices (replacements of limbs) are made of lightweight, flexible plastics. Disposable plastic instruments and accessories in sterile packaging are also in widespread use.

In recent years considerable progress has been made in the replacement of body parts and vital organs (implants). In orthopedic surgery, implants of synthetic bones and joints have become almost routine procedures. In ophthalmology, implants have saved the eyesight of many people. Recent progress in orthotopic cardiac replacement has led to the construction of the artificial heart. The ventricles are constructed of polyurethane, and the connections to major blood vessels are made of Dacron. In dentistry, plastics play an important role in the restoration of teeth. They are also being used for adhesives and fillers. Plastics are also important in pharmaceutical packaging. Disposable kits, medications, and other surgical-medical aids and products are supplied in sterile plastic packages.

2.3.4.3 Packaging For Beverages

Besides alcoholic beverages, mineral waters are also being designed in PET. In the past they have traditionally appeared in glass or PVC bottles, but PET's clarity and sparkle,

Resin Name	Advantages	Disadvantages	Production Methods	General Uses
Polyethylene (High Density)	Low cost, Stiff Tasteless, Odorless	Poor Quality Poor Surface Finish	Blow Molding Injection Molding Extrusion	Bottles
Polypropylene	Lightweight Low Cost, Clarity Sterilizable	Low Impact Resistance Shrinks	Casting, Thermoforming Blow Molding Injection Molding Extrusion	Screw Caps Boilable Bags
Polystyrene	Clear, Lowest Cost Excellent Surface Finish, Odorless	Brittle Crazing, Clouds Attracts Dust, Poor Moisture Barrier	Injection Molding Blow Molding Thermoforming	Food
Polyurethane	Resists Abrasion Odorless	Discolors	Molding Foaming	Cushioning
PVC Polyvinyl-Chloride	Low Cost, Clear Good Barrier Properties	Low Melt Point Poor Impact Resistance	Blow Molding Extrusion Casting Thermoforming	Bottles
PET Polyethylene- Glycol Terephthalate	Clarity, Tear resistance, High Barrier Qualities Recycleable	High Cost	Blow Molding Extrusion	Bottles Films Containers
ABS Acrylonitrile Butadiene Styrene	Resists Impact and Surface, Strong Lightweight	Not Transparent	Thermoforming Extrusion Blow Molding Injection Molding	Thermoformed Packages
Acetal	High-Impact Strength, Good Barrier Properties	High Cost Translucent	Blow Molding	Aerosol Bottles

Acrylic	Low-Softening Point, Resist Light Clear	Scratches Easily Attracts Dust High Cost	Extrusion Casting Thermoforming	Covers(lids) Dispenser Pumps
Nylon	Testeless, Odorless Non-Toxic, Strong Hi-Impact	Shrinks Swells Absorbs Moisture	Blow Molding Thermoforming Casting	Aerosol Valves (over 100 uses are known)
Phenolic Dihydroxydip Henimethane	Low-Cost, High Resistant, Hard Rigid	Available Only in Dark Colors	Compression Molding Transfer Molding Injection Molding	Bottles Caps
Polycarbonate	Tough, Odorless Non-Staining	High Cost	Thermoforming Injection Molding Extrusion Blow Molding	
Polyethylene	Soft, Low-Cost Lightweight	Bags Wrappers Squeeze Bottles	Injection Molding Blow Molding	Bags, Wrappers, Squeeze Bottles

Table 2.2: Production method, usage and advantages of plastics. (Mosberg S., 1989, p:52)

combined with the fact that it is almost unbreakable in the mineral water market to look closely at the material. Mineral water has proved a difficult product to pack in plastics as it has little taste of its own. This means it can be affected by trace impurities of acetaldehyde in PET, which confer a slight lemon taste. However, PET manufacturers have devised a separate polymer such as water, which generates undetectably low levels of the impurity.

2.4 Glass

Glas is a compound substance made up a silica (sand) soda ash and limestone, which nature has generously provided Earth in the form of obsidian. Obsidian is formed by extreme heat generated by lightening or volcanic activity. The sand in glass is almost pure silica while the soda ash and limestone are more nearly carbonates.

Glass is superbly strong and even the weakest container can carry a dead weight of over 100kg, although it has a low impact resistance, and shatters easily if dropped. An important factor in the biggest market for packaging food is the ability of glass to protect contents from contamination. Another increasingly important facet of glass's use as a food packaging medium is that it can resist high temperatures and be placed straight in the microwave oven. With the accelerating trend towards designers should begin to consider using glass as an alternative to canning.

Designing for Glass

Though constantly being challenged by the plastics industry, there is a look and feel of glass that can and does lend a sense of quality and permanence to a product. Choosing the right materials has gained significance where image connotation plays a major role in product presentation. The special properties of glass as a package make it an excellent choice for many products. The most obvious advantage of glass as a container is its clarity. This clarity is a distinct advantage when it is desirable to see the contents. The added "sparkle" of glass can enhance the visual appeal of a product immensely and it is the astute marketer who takes this into consideration when considering a medium for their brand.

The most unique characteristic of glass, however, is not so obvious. The resistance glass offers against interaction with its contents is a primary reason for its selection. Fragrances are kept intact, taste is unchanged and the likelihood of contamination or deterioration of the contents due to contact with glass is less than remote. The added advantage of glass being molded affords bottle designers the opportunity to build in greater strength, shock resistance and proprietary decoration and shape. On the negative side, the more obvious drawbacks of using glass are its fragility and weight. Filling line speed is seriously affected by using glass, though you would not know it upon visiting a filling plant.

The shape of the bottle can seriously affect the filling operation. Oval bottles might turn on the conveyor and start to shingle and overlap if the sides are too great. If the top of a bottle is wider than the base, they may tip over when pushed together on the conveyor. Where the bottles touch one to another, the contact point can be raised or extended beyond the bottle surface. This will help prevent shock and potential breakage. Such protective devices should be considered as incorporated into the design. Other decorative effects, such as

Jars are simply wide-mouthed bottles. The large opening accommodates utensils and fingers. Certain types and shapes of jars are suited to particular kinds of products, primarily cosmetics and food. Jars usually have a low center of gravity, making them easy to store and transport.

A tumbler is similar to a jar. It is shaped like a drinking glass and used in packaging foods such as jams, jellies, spreads, and sauces.

A jug is a large bottle with a short neck and a carrying handle. Jugs are used for water and wine.

Carboys are heavy-duty industrial shipping containers used mainly for chemicals. Their capacities range from three to thirteen gallons, and they are transported in wooden or plastic crates.

Vials are small, flat-bottomed glass containers. They are tubular in shape and may have any of a variety of neck finishes. Vials are widely used for antibiotics and other pharmaceuticals. Plastic closures and tamper-proof devices are often used on these strong containers. Ampoules made from glass tubing are used for serums and injectable drugs. After the product has been poured into the ampoule, the open end is melted and sealed shut. The ampoule must be broken at a designated breakline before the contents can be used.

2.4.3 Decorating Glass Containers

Decorated glass containers are both functional and attractive. An often used form of decoration is the label, which can be die cut in various shapes and adhered to the bottle. Types of labels include front, back, full wrap, and neck bands. Pressure-sensitive labels and decals are also used on glass containers, especially those for cosmetics. Pressure sensitive labels, which can be peeled off, are used for removable price labels. Decals are transfers that create the impression of printing or screening on glass.

Another frequently used method for decorating glass is silkscreening on the glass in metallic and ceramic colors. Other special effects, such as frosting (creating a cool, delicate effect with acids), hot stamping (a mechanical transfer method done with metallic or

nonmetallic colors to create a delicate look for containers; used mostly on plastic bottles), and transparent colors, are also possible. Thermoset powders are another innovation in glass decorating. The powders can be cured at relatively low temperatures to provide an overall finish in an almost unlimited range of colors.

The ways in which to decorate closures are equally numerous. These include printing, screening, embossing, hot stamping, or vacuum metalizing.



Figure 2.17: Left, Vecchia Romagna bottle designed by Michael Peters. Right, Bell's whisky designed by Michael Peters Group. (Sonsino S., 1990, p:54/131)

2.4.4 Packaging Cosmetics

The properties of glass, as well as its elegance and beauty, make it ideal for packaging cosmetics. Cosmetics, like drugs or pharmaceuticals, require chemically inert containers to ensure a long shelf life. Glass has that property.

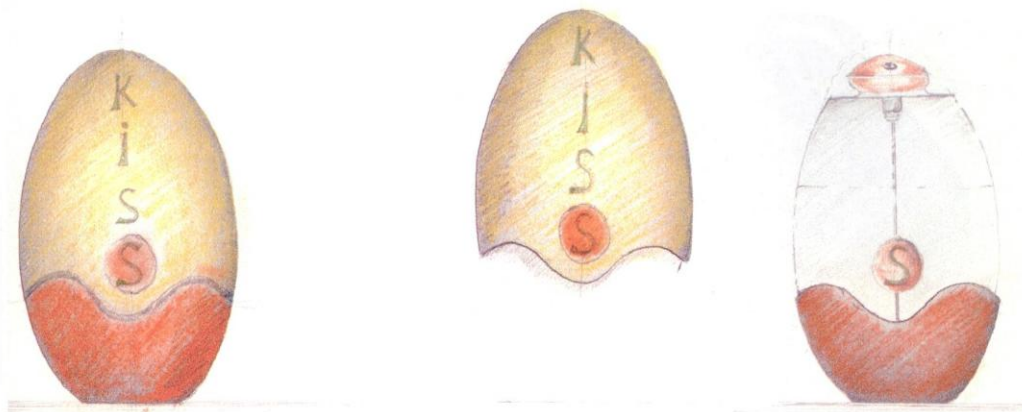


Figure 2.18: 'kiss' preliminary sketch of perfume bottle, designed by Yankı Göktepe

The cosmetics industry produces products in a broad price range, and the bottles in which the products are packaged closely reflect that range. A fine fragrance or lotion is an exclusive, luxurious substance, and the superbly crafted bottle, jar, or aerosol that contains it serves as a visual symbol of the product.

2.4.5 Designing a Fragrance Bottle

There are fashions in bottle designs, as there are in clothing. The fashion ranges from refined simplicity to complex shapes and combinations. In recent years, for example, a long, exaggerated closure over the bottle has been popular. Years ago, round and flared closures were fashionable. To be able to interpret trends in design, designers must keep informed in all fashion areas.

A good designer must work productively with technical, marketing, advertising, and production personnel. This may entail exercising restraint and self discipline. Before developing conceptual sketches, the designer must consider all facets of the project: the product, marketing areas and needs, the target consumer, the retail price, possible companion items (e.g., bath products, soaps, bath oil, or dusting powder), and TV and print advertising.

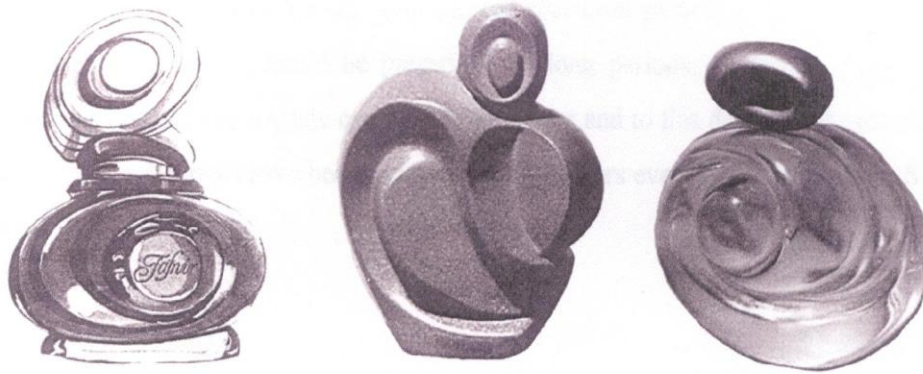


Figure 2.19: Marker sketch for fragrance bottle by Eliana Themistocleous. Fragrance bottle models by Rhonda Cericola. (Roth L., 1990, p:152)

There are two basic approaches to designing a fragrance bottle or container (or any bottle or container): either using an existing bottle, called a stock bottle, with the appropriate closure, or creating an original concept known as a private mold.

Each procedure has its merits. The stock bottle is a wise choice when cost and time are key factors. A wide selection of stock bottles and closures are available at standard prices in flint, opal, and even color. Competent designers recognize that the appropriate stock bottle offers plenty of opportunity for imaginative design. Be aware, however, that the term "stock bottle" does not necessarily mean that they are readily or immediately available. Some stock bottles are manufactured in minimum quantities at infrequent intervals.

The private mold is suitable when a new fragrance (or product) is introduced. It must be unique since its design has to be recognized by consumers for its unusual shape, color, or decoration. Eventually, a private mold will become a visual symbol of the product as well as the corporation or manufacturer.

2.5 Metal Containers

“An army, it is said, marches on its stomach.No one can have known this better than French General Npoleon Bonaparte, who in 1809 offered the fantastic sum of Fr12,000 to the person who could preserve food for his army. The reward was claimed by Parisian chef

and confectioner Nicholas Appert, who showed that food packed in sealed tin containers and sterilized by boiling could be preserved for long periods. In Britain, Peter Durand obtained a patent for the tinplate can about a year later and to this day, sterile cans of tinned or bully beef and carrots have been a staple diet of soldiers everywhere” (Sonsino S., 1990, p:142)

2.5.1 Designing Cans

Cans have generally had labels, but the development of new printing techniques has given rise to using them even more as a selling device. It is important for the designer to be aware of these developments both in printing and in advertising when planning the graphics for a container.

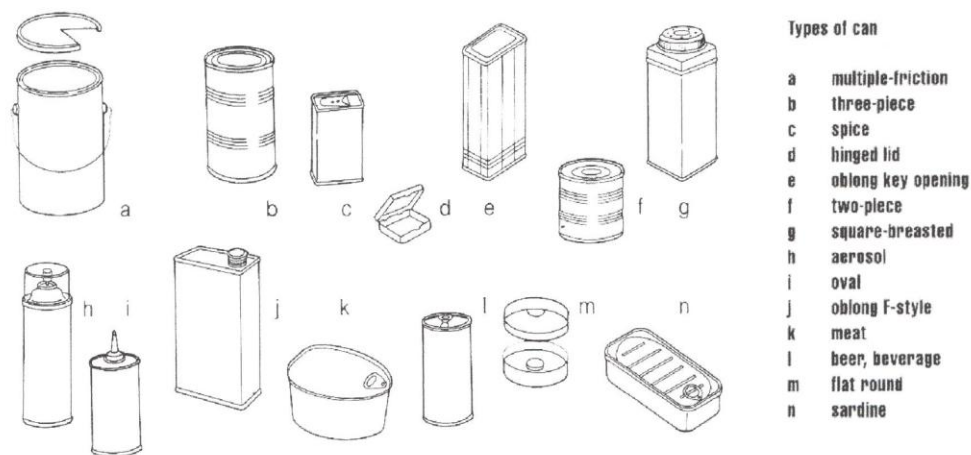


Figure 2.20: Types of can. (Sonsino S., 1990, p:147)

For many years the paper label has been an important part of the soldered metal can. In fact, a large percentage of cylindrical metal cans, especially food cans, still use paper labels. But modern high-speed printing processes now permit lithographic printing of graphic illustrations or photographs in as many as six colors directly on the can. A raised surface (embossing) adds sparkle, and the use of contrasting, transparent colors enhances the appeal and graphic impact of the shiny metal container.

The Brand Name

The most important aspect of the design for a can is the product's brand name. Package identification by brand name is a study in itself. The brand name is the verbal part of the trademark and can be represented in either symbolic or pictorial form.

Because the can is a round object, visibility and readability of the brand name may be a problem. Designers must therefore keep in mind that a flat design appears totally different when it is wrapped around a round object. This is basically an optical problem and must be treated and solved as such.

Thus, a brand name on a round package can be successful only when it is visible, appealing to the eye, and suggests value and quality. Many popular softdrink cans are designed with this important principle in mind. The Coca-Cola, 7 Up, Pepsi Cola, and Sunkist cans are especially striking.

The Label



Figure 2.21: Image of cans and labels. (Eminiş Packaging company Inc.)

Another component of a can's design is the label. The illustration or photo on the paper label must serve as a "transparent" container. It must enable the consumer to "see" what's in the can. Thus, along with type or a handlettered logo for the brand name, there can be a striking product illustration.

2.5.2 Metal Tubes

The first collapsible metal tube was developed in 1841 by an unknown artist seeking a more efficient way to dispense oil paints. In the 1890's a dentist, Worthington Sheffield, invented a new dental cleaner-toothpaste-and packaged it in a collapsible metal tube.

Tubes are lightweight and provide excellent product protection. Today more than half of the metal tubes manufactured are used to dispense toothpaste. They also serve as safe, sanitary dispensers for pharmaceutical and cosmetic products.

The most important consideration in designing a metal tube is compatibility between the package and the product. The type of metal used and the lining must be appropriate for the product the tube will contain. The decision about what materials you choose may require information provided by a chemist or the packaging engineer.

Producing Metal Tubes



Figure 2.22: Labeling and producing process of cans. (Eminiş Packaging company Inc.)

Tubes are produced from stamped or punched metal slugs. The slugs are fed into extrusion presses, and the resulting tubes are conveyed to a machine that trims them for crimping and threads the neck ends for the appropriate closure. The tubes are then conveyed to an offset printing machine that can print in up to four colors. After drying, the tubes are automatically capped they are filled from the bottom and then sealed and crimped.

Materials Used for Metal Tubes

There are three basic tube materials:

1. Aluminum tubes are used for toothpaste, shaving cream, toiletries, and food.
2. Tin tubes are made from real tin and are strong, durable, and chemically inert. They are used when compatibility is critical, such as for dispensing medicinal-pharmaceutical ointments.
3. Lead tubes are less expensive than aluminum or tin tubes. They can be lined with various coatings, depending on the substance they will contain. Paints, adhesives, and chemicals are among the products packaged in lined lead tubes. (Roth L.,)

2.5.3 Aerosols

The modern aerosol can is a result of research in the early 1940's by Lyle D. Goodhue and William N. Sullivan. A metal container was pressurized with gas and fitted with a push-button dispenser to deliver a spray of insecticide.

After the war the aerosol was converted to peacetime applications. It was used to dispense hair sprays, fragrances, toiletries, foods, medications, paints, and many other consumer goods and industrial products. It eventually became known as the pressure packaging system.

Operating Aerosol Cans

An aerosol can is an airtight, valved container made from metal, glass, or plastic and filled with a formulation that consists of a propellant (a gas) and the active ingredient (the product). When the valve is operated, the pressure of the gas pushes both the propellant and

the active ingredient through a small pinhole opening in the valve. A fine, misty spray is produced the fineness of the spray depends on the nature of the product and propellant and the type of valve used.

There was evidence that the chemicals (chlorofluorocarbons) used in aerosol cans were eroding the protective ozone layer of the atmosphere, which filters out ultraviolet light from the sun, and could therefore cause cancer and damage to plants and animals. Today, safe propellants are available for all types of aerosols, and new dispensing systems have become available in Europe. Hydrocarbons (propanes, butane, isobutane) and, more recently, du Pont's Dymel propellant are in widespread use replacing the old chlorofluorocarbons. These new propellants and dramatic package designs promise to make the aerosol packaging system even more popular in the future.

Designing Aerosol Containers

Designing aerosols and aerosol containers can be an exciting graphic experience. The metal can aerosol usually has a plastic cap, which can be painted, labeled, and molded in any color. The can itself can be painted in transparent or opaque colors, much like any other metal can. It can also be labeled. (Roth L.,)

Plastic and especially glass aerosols can be made to look more elegant and therefore more expensive. Glass aerosols should be treated and decorated like glass bottles. For cosmetic products (e.g., fragrances), the glass can be frosted and shiny gold metallic paint used for lettering and other graphic decorations. The cap can be metalized and custom designed, although stock closures are available.

CHAPTER 3

ENVIRONMENTAL IMPLICATIONS OF PACKAGING

3.1 Environmental Concern

We are increasingly aware, however, of the impact that packaging has on the environment. Both the quantity of packaging, and the use of particular types of material, are being questioned. The visibility of packaging in the waste stream has prompted consumer concerns. It accounts for around one-third of household waste in most countries in Europe and America, and is a clearly recognisable component of litter. As packaging materials become more sophisticated and elaborate, disposing of them after they have been used only once appears to be a waste of valuable resources. Producing and disposing of packaging can cause environment problems just like any other product: pollution in the manufacturing process; the consumption of energy and non-renewable resources, and the dangers of hazardous ingredients being dispersed into groundwater or the air during disposal through landfill or incineration.

Under the current structure of manufacturing, distribution and retailing chain, and with current consumer expectations, packaging has a variety of roles. Its main function to ensure that the product inside reaches the consumer in good condition is often taken for granted, but it ensures that as little as possible of the product is wasted or damaged during distribution and storage. Packaging is also delivers the benefits of hygiene and safety, which are increasingly important to consumers because of fears of contamination or tampering. It enables the product to be handled easily stacked stored and transported. Packaging helps consumers identify the product in the store an important function in self-service stores with vast ranges of merchandise. Finally, it is a major communication vehicle, providing information and usage instructions.

Many environmentalists are calling into question the environmental cost of this type of production and distribution structure. They propose a return to more locally based

economies, where the chain between producer and consumer is shorter, reducing the need for so much packaging. However, within the current structure, there are many ways of reducing the environment impact of packaging, often without compromising consumer and producer demands for functional performance and visual appeal.

In many countries, legislation will influence changes. Waste management strategy requires industry to minimise waste overall, with packaging identified as a specific area where there is room for improvement. Targets are proposed for the proportion of packaging, which can be re-used or recycled which will determine material choice in various sectors such as drink containers. The hierarchy of "reduce, re-use, recycle" will underpin the waste approach.

The shortage of landfill sites has stimulated a variety of local laws. These include deposits on soft drinks containers to encourage their return, and the requirement householders separate out waste so that it can be recycled.

The combination of consumer concerns and legislative pressure will ensure that environment impact becomes an essential criterion in the design of packaging material. In this area, as in other design areas, new ways of working will be required, and new aesthetics will evolve. The challenge for designers is to produce packaging that sells the product, and protects it effectively but creates less environment damage.

Designing packaging for minimum impact requires an understanding of the complete life of the pack, from the production of the material through to manufacture, distribution, end use and disposal.

While the overall objective should be to use the minimum resources, the best solution depends largely on context. What type of product is it? How will it be used? Where will it be used? The designer will have to consider a complex range of options to identify the best solution.(Mackenzie D., 1991, p:92)

The material used in packaging, the way the pack is constructed, and the way it is merchandised in the store will be particularly important considerations for the packaging designer. Graphic designers, who often take the lead in packaging design, will have to place more emphasis on technical issues related to production and to the properties of materials if

they are to play a leading role in innovation, to improve environment performance. Close collaboration between graphic designers, industrial designers, technologists and materials scientists will be important. Producers of packaging materials will find it essential to provide clear, objective information about the performance of their products in areas like energy efficiency recyclability and additives.

Products have very different packaging requirements. Delicate items of medical equipment have to be treated quite differently from shampoo, and washing machines differently from food, so generalisation about material usage and packaging construction are difficult to make. Improvements in environment impact can be made in a wide variety of ways it is up to the designer to determine what may be appropriate, feasible and desirable for a particular product. The selection of material may depend, entirely on where the product will be used.

A refillable glass bottle designed for several re-uses may use less energy than a plastic bottle. However, if these bottles are miniatures, as used on airlines, their weight is important. Because glass is much heavier than plastic, using plastic results in a saving for the airline in terms of fuel consumed during flying. This energy saving therefore has to be set against the energy lost when the bottles are disposed of. It is clear, therefore, that the equations can be highly complex.

3.1.1 Recycling

To use *recycling as a* method of "disposal," the material must be capable of being recycled and it must have value both in regard to profitability and to second use. Plastic packages can be recycled.

High-performance thermoplastics, however, can be reused many times. A quality plastic toy can be recycled into material for an automobile bumper, and the bumper can be recycled into material for office building doors. Moreover, the re-usable, refillable bottles made of Lexan resin are being used as many as fifty times and then they are reground, re-processed, and remolded to make other products.

Compatibility, quality, and high performance are the most important criteria in the recycling of thermoplastics. Provided that these criteria are met, recycling could be used to

reduce the accumulation of solid waste. Theoretically, as long as the recycled plastics are of the same quality as the original plastic, that recycled high-quality thermoplastics can replace with high performance of ABS or PET plastics. Recycling the plastics used in packaging should therefore be viewed as an opportunity to increase the profitability of the packaging industry.

Degradation-of plastics in particular is focused on litter. There is no question of the importance of bio- and photo-degradation techniques in outdoor housekeeping. But for plastics, it is not feasible or practical as a bulk disposal method.

The only way to maintain our riches; this richness of material goods, is to recycle materials that have already been extracted and refined from their sources on the planet.

There are two generalized ways to recycle. One is at the alloy level, separately handling steel; bronze, aluminum, clear glass, brown glass, newsprint, and such plastics as PET, HDPE and so on. The second is at the material component level. For plastic, this means recovery of the molecular building blocks-benzene for instance that is used to make polymer resins. The implication is for cooking our leftover plastics in something that might look like a coke oven or petroleum refinery. This would amount to closed-system pyrolysis as opposed to the current open-to-the-atmosphere incineration. (Clemishaw D.,)

Either way, the need for recycling is something responsible design in plastics must take into consideration. In contrast to mankind's usual disregard for the universe, it's most encouraging to see increasing awareness and active involvement in attempts to solve the problems of no-longer-wanted products, especially those made of materials that will not die.

The following comments are the thoughts of world expert, widely known guru and molecular tinkerer Dan Gilead; (Head of the College of plastics Technology of Isreal)

The mounting cost of urban garbage disposal, the rapidly diminishing sites for landfills and the general increasing awareness of the damage the industrial countries are causing to the environment has put the spotlight on plastics. Modern society cannot continue its way of life without plastics, and it becomes imperative to analyze the problem and evaluate the

possible solutions. Plastic materials have had a phenomenal rise in importance. Plastics have not only replaced traditional natural materials, they have created new products and altered the way of life and commerce in an irreversible manner.

As a packaging material, plastics have been instrumental in changing our society into a distributional one. Plastic materials have made it possible to pack, transport and preserve any food product produced far from the place of consumption. Plastic flexible and transparent films and sheets have made the transition from the neighborhood grocery to the supermarket possible. The package today sells itself. You can see inside. It is attractively printed outside. And it can be economically made of a suitably small volume for the "shop and eat" society we have become. Because of the light weight of plastics, transportation costs are held at a minimum and one-way packaging does away with returned containers and their concomitant storage and stock requirements.

These are the physical aspects of plastic packaging materials, but it is their chemical properties, which make them so supremely useful. And yet these same properties are the main cause of the problems we encounter in their final disposition. Plastic materials, especially those used in packaging, are chemical inert, waterproof and insoluble, unaffected by bacteria or fungal growth, impermeable physically and selectively impermeable chemically.

A considerable part of the production of commodity plastics such as polyethylene, polypropylene and polystyrene will be converted into one-way packaging, bottles, trays, plastic bags and other containers. Of these, a full forty-five percent are disposable:

The problems of disposal and pollution of all the above items have to be carefully evaluated. Plastic garbage, which is that part of the material which is properly disposed of and collected by urban authorities, will make up a relatively small portion of urban garbage, by weight not more than six to eight percent. When put into a landfill and properly compressed, it will not take up more space than any of the other constituents except vegetable and animal matter. Once there, plastics will pose no threat to the ground water or surrounding soil. It is litter-plastics haphazardly discarded into the environment which causes the most visible and disturbing impact. What are the ways of ameliorating the problem?

Recycling is the art of transforming plastic waste into a useful raw material. There are two types of plastic waste: Industrial and urban. The former is increasingly regenerated by industry. Industrial waste and scrap is homogeneous and relatively uncontaminated. It is a highly cost-effective way to lower the cost of the raw material.

Urban waste is a heterogeneous mixture of many polymers and is heavily contaminated with other materials. Recycling can and is being improved, a small but important contribution to the disposal problem.

In most plastic materials, an equal weight of plastic contains 125 percent of the thermal content of prime coal. Recovering this resource by incineration requires sophisticated and expensive equipment. Air flow, carbonization and the containment of fumes generated must be carefully addressed. Although at this stage community acceptance is still a problem, the equipment has been developed and is naturally held in high favor by resin manufacturers.

Two types of self-destruct methods are known to the plastics industry. Biodegradation means the eventual breakdown of the plastic product and therefore the polymeric material by the action of microbiological organisms such as bacteria and fungi. Plastics, apart from a few exceptions, are totally impervious to this type of attack. Therefore altering them so they are no longer impermeable poses the danger of losing control. Research has gone into mixing starch and starch-like additives into the polymer matrix causing it to disintegrate when buried in the soil. Primary drawbacks here are the negative changes in its physical properties and the unpredictability of its final disintegration...

It is a paradox that the industry has spent years of research to make plastic products light stable. It is this accumulated knowledge that has made it possible to find ways of using ultra-violet light to cause the controlled disintegration of plastic materials. The time control, which ranges from days to months or even years, makes it possible to adjust this method to a wide range of products without compromising in any way the physical and chemical properties of the plastic. The necessary ultra-violet light at the correct wavelengths and rather large quantity of light energy is only found outdoors in direct exposure to sunlight. Once started, the disintegration process is very rapid, and at a certain stage is supported, sustained and accelerated by microbiological attack, which becomes

possible by the chemical and physical changes the polymers undergo as a consequence of the etro- and thermo-chemical reactions. At an early stage, sunlight is no longer needed as the reaction that was initiated by light can continue in its absence. The end products of all these reactions are very basic compounds such as water and carbon dioxide, which return harmlessly to the natural carbon cycle.

Life is a web. All the different ways of reducing and controlling plastic waste are interconnected and complement each other. No one single method can address all of the varied aspects of the problem. What is needed is a greater understanding of this concept by the plastics industry, consumers and governmental authorities.

3.2 Avoiding Over-Packaging

A frequent criticism of packaging is that more is used than is really needed to meet the requirements of functional performance. This is particularly true of luxury items such as confectionery and cosmetics, and of products packed in single-serve units or blister packs. Significant reductions in the amount of packaging used for some products may be achievable only with some trade-off in consumer convenience, or with changes in usage patterns, or in expectations about product appearance. There may be opportunities for designers to adopt a radical departure from conventional norms. Packaging an expensive perfume or selection of chocolates, in a box made from simple corrugated board may actually be interesting and attractive to consumers!

An elaborate and sophisticated pack may deliver a marginal benefit to the consumer, but simpler alternatives may be preferable from an environmental viewpoint. Aerosol packs are an example of over-packaging, where a small quantity of product is contained within a large pack. The performance characteristics of aerosols may make their use necessary in certain specialized applications such as medicine but they may no longer be considered appropriate for everyday uses when good alternative delivery systems exist. If aerosols could be easily recycled they might cause less environmental concern, but so far recycling appears to be difficult to achieve.

The ratio of product cost to packaging cost varies depending on whether the product is cheap but difficult to package, such as household or garden chemicals, or expensive but

technically simple to Package, like butter. The designer therefore has to consider each application separately, to reduce material and energy usage without compromising the protection of the pack or its other important functions. (Mackenzie D., 1991)

3.2.1 Using Minimum Amounts of Material

Manufacturers have a strong cost incentive to reduce the amount of packaging materials used. Not only are raw material costs reduced with lighter or smaller packs, but distribution and storage costs are also saved. A re-design of the aluminium soft drinks can to reduce the diameter of the opening end allowed a reduction in the amount of material used per can. Removing the base cup of a bottle made of PET lightened it by nearly one third. However, lightweighting has to be considered in the context of the entire life cycle of the pack: creating a very light pack may not be desirable if it is possible to use the pack again, when strength would become important.

In packs which are "one-trip", or which go into the recycling system, reducing the quantity of materials is usually beneficial, because of savings in energy and in materials. The shape of a pack can have a significant impact on the amount of energy used in transportation. The use of a square-sectioned package rather than circular pack gives a more efficient way of transporting products like milk, as more unit product can be contained in the allotted space. An octagonal corrugated box used by one home-delivery pizza chain uses 10 per cent less material than the usual square box, and also delivers a more appealing product because toppings no longer smudge on the pizza lid.

Reduction in the quantity of materials used may also be achieved by considering the packaging requirements in the context of merchandising and in-store dispensing opportunities. A protective outer display at point of sale may reduce the need for a layer of secondary packaging.

The creation of unusual bottle and cap shapes can use more material than necessary. A double-walled cap on a shampoo bottle uses more material than a small screw cap; a complex, novel shape tends to be less efficient than a standard cylindrical shape. The desire to create a novel appearance - to give extra impact or to reflect the image the product wishes to convey - may be at odds with materials minimisation. Striking graphics can add

interest to simple, standard containers. It is possible, as consumers become more critical of the environment impact of packaging, that they will become more approving of simple, straightforward packaging structures, and less likely to place novelty and distinctiveness quite so high on their selection criteria.

3.2.2 Material Quality

Another form of over-packaging is the specification of high-quality materials where functional performance and consumer taste do not require them for example, the use of virgin white card in outer cartons.

Very often, material composition or weight is specified by habit, rather than by a real examination of the needs of the job. The increased use of recycled materials in the packaging industry can play a significant part in reducing overall resource consumption, and thus every effort should be made to specify these where their use is acceptable in terms of functional performance and aesthetic appeal.

3.3 Re-Use and Refill

Resource conservation may take the form of the re-use or refilling of containers, thus extending their functional lifetime. After minimising the use of resources in the first place, this route appears most environmentally attractive. However, the process of re-using and refilling has an environmental cost too, which must be considered. The energy cost of collecting and cleaning containers should not outweigh the energy value of manufacturing them in the first place, and packs may have to be re-used many times before the initial investment in energy is recouped, so durability will be important. Research has shown that (Paul Rankin-*RIPA-Reuseable Industrial Packaging Association*) reuse of packaging in the form it was originally intended is environmentally beneficial and saves significant amounts of energy. For example, it takes roughly ten times the amount of energy to manufacture a steel drum as to recondition the same drum, and numerous studies of consumer packaging have shown that refillable containers are far more energy efficient than those manufactured from recycled or virgin material. Reuse reduces waste at every level, from extraction and processing of virgin materials to package manufacturing and

transport. In addition, reuse provides opportunities to lessen the amount of material ultimately entering the waste stream.

There are a variety of ways in which a refillable system can work. The container can be returned to the manufacturer for refilling; the user can take the container to a refilling point; or the user can purchase a refill pack from which a more durable container can be refilled. Whether any of these approaches is appropriate and beneficial will depend on the manufacturing and distribution systems involved and, of course, on the nature of the product itself.

Return systems that operate in a closed loop between manufacturer and user have traditionally been widely used in the beverage industry. In the food service trade, bottles and casks are returned to the manufacturer and many food items, such as bread, are supplied in re-usable crates. Where it is possible for the delivery system to double up as the collection system, with outlets relatively close to the manufacturer or distribution center, this system can be highly efficient. Difficulties arise, however, if products are internationally traded; then, return systems work only if there is standardisation of packs, with every manufacturer participating in the re-use process.

While the collection of packs for re-use can be relatively easy if large numbers of packs accumulate at one point, as in a restaurant, it becomes more difficult for products consumed at home. Increasingly, however, retailers are accepting returned containers particularly glass bottles are becoming the normal system as bottle deposits are introduced via the retailer.

Many years ago, shoppers would take along their own containers to be filled directly in the shop from sacks or casks of product. In France and other countries, table wine is still sold in this way. This approach can be highly attractive in terms of environment considerations, particularly as there are savings in energy cost by avoiding the "return" route. Although containers need to be durable, they do not need to be able to survive numerous circuits through the distribution system.

The original container may be purchased with the first purchase of the product and replaced when necessary, or a variety of alternative containers might be offered separately, allowing

the consumer to choose whatever is the most convenient size, shape, etc. The only important criterion is that the container should be able to protect the product effectively and should be easy to clean.

Consumers obviously have to be willing to accept a trade-off in terms of convenience, although the refilling process could be offered as an intrinsic part of the attraction of the product.

In the short term, refill packs may offer the most practical way of achieving re-use in many categories. One durable container, appropriate for storing the product and using it, is sold. Additional product requirements are supplied via refill packs, which need have only a short life expectancy, and can therefore be made from a small quantity of lighter-weight or lower-quality material. The refill pack can also be easier and less heavy for the consumer to take home. Soft-sided, collapsible refill packs take up considerably less room in landfill sites.

With detergents, shampoos and other household products which are in very regular use, refill sachets or cartridges could allow the original pack to be more attractively and more intelligently designed, because the extra cost of this will be spread across a much longer life, and packaging costs overall are reduced by avoiding the need to throw away significant quantities of material. (Mackenzie D., 1991)

3.4 Material choice

There is considerable confusion about whether some materials are inherently less damaging to the environment than others. Some may consume more energy or nonrenewable materials in their production, but perhaps have a longer life span. Some are easier to recycle, while others are believed to degrade easily and harmlessly. When disposed of by incineration, some materials are valuable because their energy content can be reclaimed, but there may be concerns about the substances released into the atmosphere during the incineration process. No one type of material can claim overall environmental superiority. Material selection has to be considered, therefore, as part of the total manufacturing and design process, taking into account the entire life cycle of the product and pack.

3.4.1 Use of Recyclable Material

Packaging uses valuable materials, which could be reclaimed and re-used rather than dumped in landfill sites. The contribution made by the use of recyclable materials depends entirely on whether there is an end use for... the materials once reclaimed. Glass may be recycled and reused to make containers that are indistinguishable from the originals. Other materials, however, such as plastic, are more difficult to recycle, and the recycled substances may have very different properties and appearances from the original, making them unsuitable for re-use for the same purpose. *Recycled* materials have to have a market, and this depends on a variety of factors, including the cost difference between recycled and virgin materials.

Most reclaimed materials come from industrial and commercial waste, where there are large quantities of identifiable materials, which can be collected and processed efficiently. Most packaging ends up in household waste, with small quantities of different materials widely dispersed, posing a huge challenge for collection and sorting. Major efforts are being made to encourage the reclamation of household waste. Bottle and can banks are now common in many countries, and many local areas are experimenting with curbside collection schemes. The high participation rates achieved demonstrate the public commitment to recycling, but there are still problems in sorting, grading and reusing many materials.

Designing for recyclability is worthwhile only where there is a recycling infrastructure, or where the manufacturer makes arrangements to collect the used packs. There also has to be an end use to which the recycled material can be put.

Recycling is assisted if composite materials or multiple layers of different materials are avoided. The use of one single material throughout avoids the problems of contamination and unpredictable performance, which can arise from mixed materials.

Identification of the type of material can also be important in sorting. This may be done by consumers at home, or by a mechanical sorting process in a municipal waste site.

While collection and recycling systems are quite well established for glass and cans, plastic is far behind in most places, making it look relatively unattractive as a packaging material if glass is a realistic alternative. However, if plastic can be recycled, its high energy efficiency and other benefits change the picture significantly.

3.4.2 Use of Recycled Material

Packaging materials have used recycled ingredients for years. Cans are manufactured from material, which contains a high proportion of secondary, reclaimed metal; outer packaging such as corrugated board uses waste-based pulp. The production of aluminum cans is made economic by using waste aluminum, as producing virgin aluminum has very high energy costs. The issue for designers now is whether more recycled materials can be used, as part of the process of stimulating demand and encouraging efficient recycling.

Paper and Card

Recycled papers and cards are often adequate to meet the functional requirements of a pack, although the occurrence of contaminants prevents the use of recycled material directly in contact with food or healthcare products since there might be a possible health risk. Recycled paper has performance and appearance characteristics which are very different from those of virgin paper. It can be used to great effect, however, even in the packaging of luxury items. (Figure 1.2)

Plastic

Most plastics are not difficult to recycle if they can be isolated, but changes in chemical structure do occur, and the recycled product may perform unpredictably, making its use rather difficult in applications where precise characteristics are required. The products generally associated with recycled plastic tend to be low-quality, items such as builders sheets, garbage bags and flower pots. However, there may be increasing opportunities to use recycled plastic in packaging materials. PET (polyethylene terephthalate), a clear, high-quality plastic often used for soft drinks containers, can be recycled. Material made from post-consumer PET waste has been used by Procter and Gamble in the packaging of household cleaning products. Designers should be open to the use of recycled materials of

all kinds, where these materials can meet the essential performance requirements of the pack.

The cost of using recycled materials relative to virgin materials varies widely. Difficulties in obtaining high-quality waste, and the small scale of many recycling efforts, can make recycled materials expensive. In the longer term, however, the increased use of recycled material should lower packaging costs. In the meantime, it may be possible to justify the small additional cost because of consumer willingness to support recycling efforts: packaging which is perceived to be environmentally sensitive can deliver an "added value" benefit, and create differentiation among competitors.

3.4.3 Biodegradable Materials

Biodegradability has been proposed as one answer to the problem of the accumulation of ever increasing quantities of long lived materials such as plastics; it has also been suggested that biodegradable packaging could reduce the litter problem. But materials, which biodegrade relatively easily like paper can give only limited protection to a product, and are therefore often coated with substances to make them resistant to decomposition.

A wide range of biodegradable plastics has been developed and promoted as an environmentally sensitive packaging solution. Most of the plastics, however, are biodestructible, rather than biodegradable. They are made by mixing special additives usually cornstarch with plastic polymers. This means that, although they do disintegrate over time, they do not break down completely, but instead leave tiny particles of polymer which may persist in the soil, possibly producing chemicals which may contaminate the soil or groundwater.

Biodegradable plastic is also less durable than conventional plastic, has less potential for re-use, and must be kept out of any plastics recycling stream because it has a destabilising effect. It is also more expensive to produce. For some uses, though, biodegradable plastic may be preferable to conventional plastic if the plastic item will end up in the sewage system, for example.

A new generation of "bio-polymers", led by ICI's Biopol, could provide some solutions. These are produced from bacteria, which manufacture natural polymers when grown on organic waste. These natural polymers can be removed and melted, molded and recycled just like oil-based plastic. Eventually, they decompose into carbon dioxide. High prices and limited versatility mean that applications in the short term will be restricted to specialty uses such as medical apparatus or high-value toiletries. Other attempts to produce 100 per cent degradable plastic involve increasing the starch content, and using vegetable oils as the base ingredient.

"Natural plastics" may in the long term provide a realistic alternative to oil-based plastics, allowing the many benefits of plastics technology to be exploited without the problems that currently exist. In the short term, however, most interest appears to lie in recycling as the most practical way of managing the waste problem.

3.5 Legal Requirements

"Buying a pig in a poke" is a proverb which, roughly translated, means you have not seen what you have bought because it is out of sight. The proverb is often used as a warning. Without effective product and packaging legislation, consumers buying goods today could also be said to be buying pigs in pokes. Modern packaging is so effective at protecting and projecting its contents that today's consumers rarely see the goods on offer, except by design, such as the PVC window in a carton, or the cellulose bag. This could tempt unscrupulous suppliers to exaggerate their wares somewhat in quantity, for instance if there were no laws to prevent that happening.

It may seem that packaging design is being made increasingly easy by the number of new materials available and the variety of processes available for improving them, printing on packaging and filling packs. For the designer to understand how goods must be protected under the law, as well as in practice. But the two are not disconnected. It is as important for modern designers to understand how legislation affects packaging design as it is to understand, for instance, how those designs can be printed. The main thing to realize is that "safety" can be designed into a pack as easily as colour.

3.5.1 Designing For Safety

The way in which the design of safety is organized varies from company to company and from individual to individual. But one approach, used in the electronics industry, is to stage six separate design reviews where the following 12 points are considered: (Sonsino S., 1990, p:165)

reliability

performance

maintenance

manufacture

product test

interchangeability

installation

simplicity

safety

ergonomics

appearance

cost and value

The first review, known as the design concept review, is held before the development work even begins, while the second deals with the design approach and the specification of materials and processes. The subsequent four reviews cover the basic design itself; experimental data and value analysis; the planning of product manufacture, and a final design review. Not all packaging sectors need be as stringent as the electronics industry, but those that do use or implement such safety reviews can only instill confidence in the retailers and, ultimately, the end-user on whom the whole design and manufacturing process depends.

3.5.2 Legal Liability

A general checklist of the areas in which pack designers must consider legal liability includes the packaging of chemicals, where chemical burns might occur if a pack leaks. The products, liquid or powder, may be inflammable, or react with the atmosphere to emit gases or heat. The designer must think of these possibilities in advance. The packaging of

light electrical goods must protect the user from possible electric shocks and not be dented in transit at pinch or crush points. Bottles and containers of chemicals may explode or implode depending on atmospheric pressure. This also extends to aerosols, drums of steel or plastics, barrels and kegs of beer and sparkling wines.

In addition, there are problems of end use. Textiles and empty aerosols may well be inflammable or explode if left near heat sources, so adequate warnings must be given on the pack outer. Products containing water should also be advised on temperature, especially if there is a danger of freezing - as water expands a pack could rupture if stored at a cold site. Besides health and safety warnings, advertising standards rules must be followed. If a battery, say, is defined as re-usable, any process that is necessary to recharge it must be adequately described, on the pack as well as in any advertising material.

The problems of packaging radioactive goods offers an extremely difficult task to the designer involved mainly in consumer work, as all Western countries have extremely strict rules to follow. If faced with a project on radioactive goods, for hospital work, for example, the designer must get expert advice. It is not enough simply to read the available reports and standards material. Needless to say, items such as razor blades, knives, garden implements and tools all require effective, safe packaging. But the designer must also think how to protect consumers against shrapnel and flying objects from bottles, canisters or aerosols, where these are contained within cartons or tins.

Stability can also be a problem tall, thin packs such as halfempty bottles could be described as unstable. If they fall over, will the contents be dangerous? Will the container explode?

Two further points should be borne in mind, though; when considering packaging design and potential dangers that might arise: severity and frequency. If a danger is identified, will it be minor, such as a leak in a carton, for instance, or will it possibly cause blindness, as an exploding pressurized container such as a bottle of soft drink might. Again, what is the chance of the hazard actually occurring? Is it remote, or likely, given the pack's traditional distribution and use? Designers cannot afford to spend all their time worrying about product liability, but they must give enough care and attention or be found liable of criminal negligence.

3.5.3 Packaging Law

The difficulties facing the packaging designer are exacerbated by the fact that there is no distinct collection of laws that may conveniently be described as the laws of packaging. Packaging designers need to consider not only sale of goods acts, but also trade descriptions laws, transport legislation, weights and measures acts, food and drugs law and the many poisons and medicine statutes that exist. In addition, there are laws and regulations that relate more directly to the design process: there are copyright, design and patent laws that help protect against negligence, passing off and fraud, amongst other things. Yet in a sense this bewildering variety of laws and regulations relating to packaging corroborates the thread running, that packaging impinges on all aspects of our lives, both commercially and as individuals. The task of the designer is an extremely important one, then, in tying together all these threads. Perhaps the most important requirements of packaging law are to ease administration. There must be set requirements for food packaging to safeguard every consumer, just as there must be specific requirements for packaging dangerous goods. If designs follow the set guidelines then their ability to pass into society safely and rapidly are guaranteed. Of course, laws must protect the public, and by following the guidelines of neighbor countries, or the countries into which goods are likely to be exported, we protect the public. Packaging law also protects the designer. Designers must do everything in their power to protect the public from injury and to comply with the relevant administration. It is only professional that they should do so.

(Sonsino S., 1990)

CONCLUSION

Today, the word “packaging” has a great variety of meanings and functions. The different roles of packaging are becoming more and more important in industrial design. Packaging’s importance is also growing especially when establishing company or product profiles on the market, when adapting supply flows to production or when giving the customer a tool to handle, to store, to get hold of instructions, etc. In other words, basic within this knowledge area is a systems view where requirements from the society, the ecosystem, production techniques and the distribution system are specified to integrate with packaging design, packaging dimensioning, choosing packaging materials, etc.

Packaging represents an extraordinary case of industrial design. Because of the fact that, products and packages are involved with each other. Packages are everywhere, and by their nature they contain information as well as products. Some of this information consists of words and numbers, directed to the rational mind, while other facets, consisting of shapes, colors, and graphic expressions, bypass the rational and appeal directly to consumers’ emotions. Package design is successful to the extent that it communicates very complex messages to people who give it little conscious thought. This may prevent packaging from becoming art, but it does define a unique strength that is potentially very valuable. Emotion can be seen as a very rapid means by which humans process information. And no field of design deals more effectively with the emotions than does packaging.

When designing for packaging there are several important points should be analyzed. These are basically :

The first, consumer society is to indicate emotional qualities and conceptual aspects of packaging which has importance for our individual being and it is important to remember that packaging is more than containers. It is also a means of conveying information and changing human relationships. Packaging changes the way people understand the world.

Second, material and production techniques in packaging process. In order to provide relative and realistic creativity. From the point of view packaging provides an outstanding post from which to observe the most sophisticated technologies and the latest innovations applied to materials in simple, very low-cost solutions to the final product. Third, environmental problems just like any other product pollution in the manufacturing process and today the concept of reduced consumption puts packaging design ever more among the biggest culprits responsible for the production of urban solid waste.

As can be understood, the intention of this thesis is to analyze the role of packaging in industrial design and to emphasize the package's important aspects.

In this way, we have seen some packaging considerations such as consumption, communication, material, production techniques and environmental concerns.

As it mentioned in introduction, this thesis intended to analyzed the total packaging are and does not attempt to judge packaging as either good or bad, it can be seen as attempt at analyzing packaging chain.



Figure 3.1: Product is used in various position and place. (2nd design award is given to Yankı Göktepe by Promotional Products Suppliers and Distributors Association in 1999)

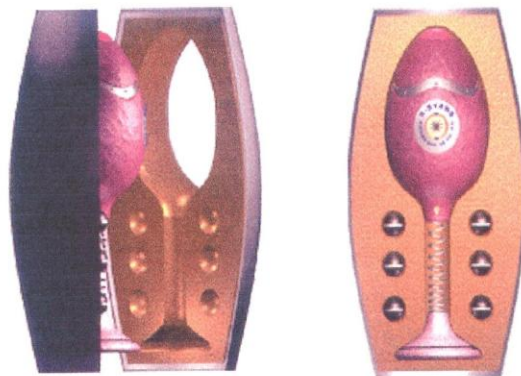


Figure 3.2: Side and front views of package. Polyurethane foam is used with sheet iron

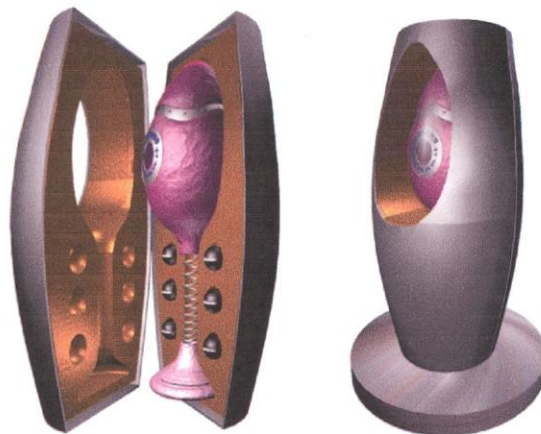


Figure 3.3: Integration of package and product

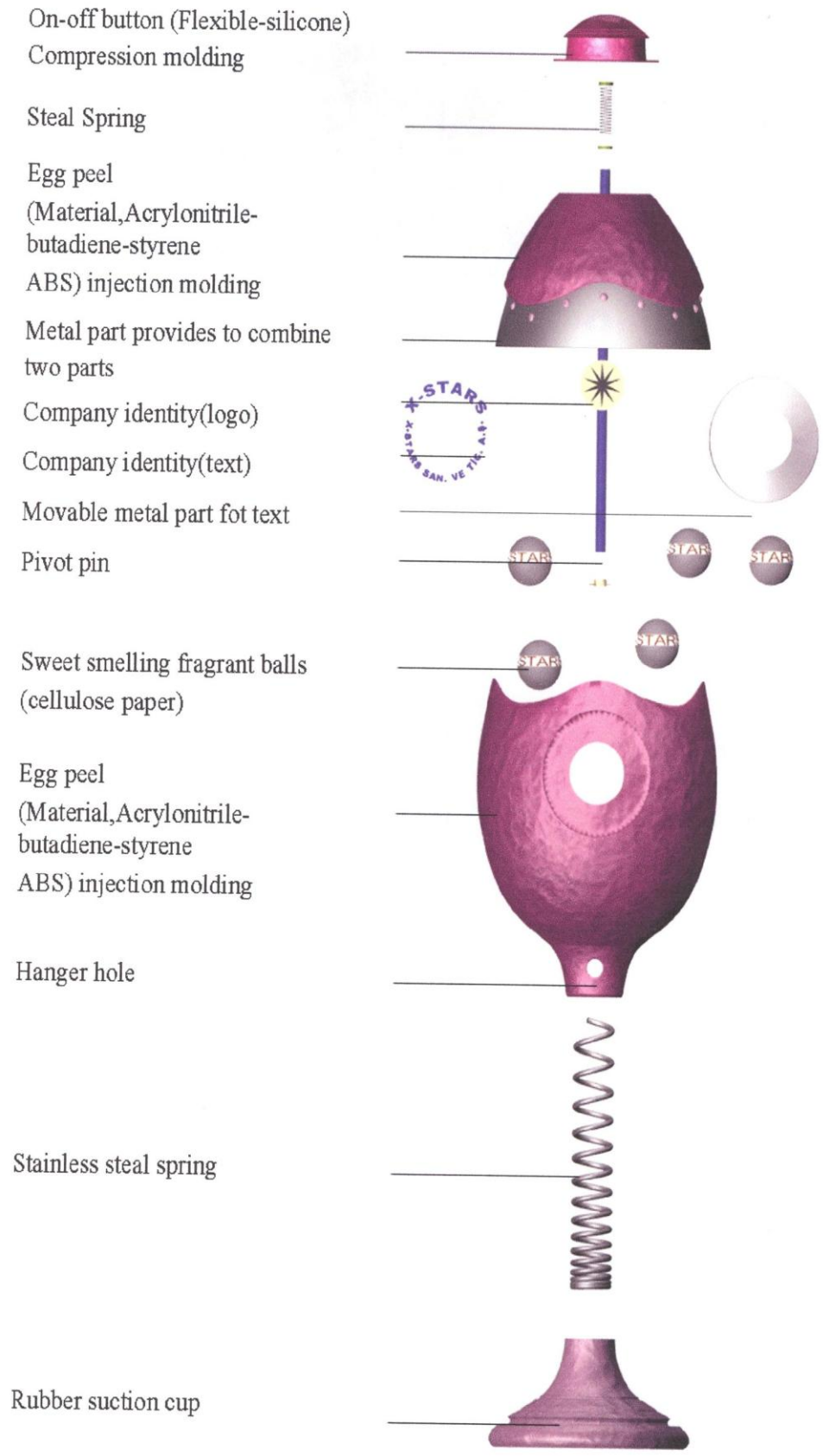


Figure 3.4: The present image emphasizes the package's material and production technique which is the key influence on packaging (it is mentioned in chapter 2).

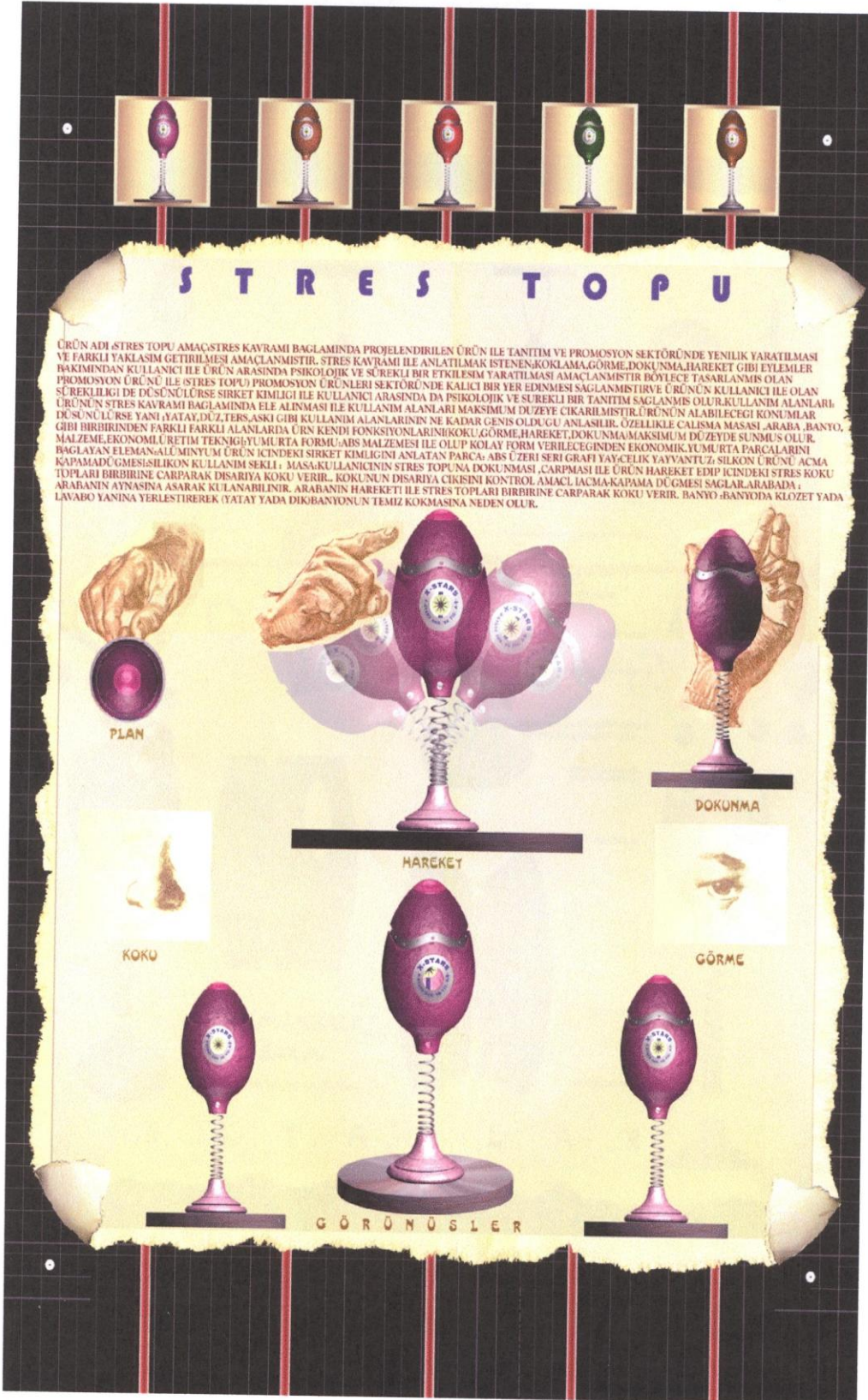


Figure 3.5: (a) Some movements and color options of product is shown in the final graphic presentation of project.

APPENDIX A

Product : Coin Holder

Designer :Yankı Göktepe

Producer : Seçil Press Associates, Inc.

Graphic :Yankı Göktepe

Objective : It is aimed to create distinctive approach with coin holder in promotion sector.

It is marked that coin holder will be used by everybody in everywhere. So, it has long life because of extensive of target consumer and usage field . Visual graphic elements and environment aspect such as reuse, refill is considered. Coin holder gives less environmental damage because of its function.(coins can be refilled)

Company identity (logo)

Upper part (silicon rubber)
producing technique: cast,
molding injection

Coin hole

Pivo point

Mechanism (steel)

Middle part (for compressing the coin)

Material (silicon rubber)
producing technique: cast,
molding injection

Coins
(4 types of coin;10-25-50-100)

Rubber suction cup

Stainless steel spring

Lower part (to store)

Material (silicon rubber)
producing technique: cast,
molding injection



Figure A.1 : Material and production technics of “Coin Holder”is shown in blow-up.



Figure A.2 : Prototype is made of 'Delrin'.



Figure A.3 : Usage and movement of coin.

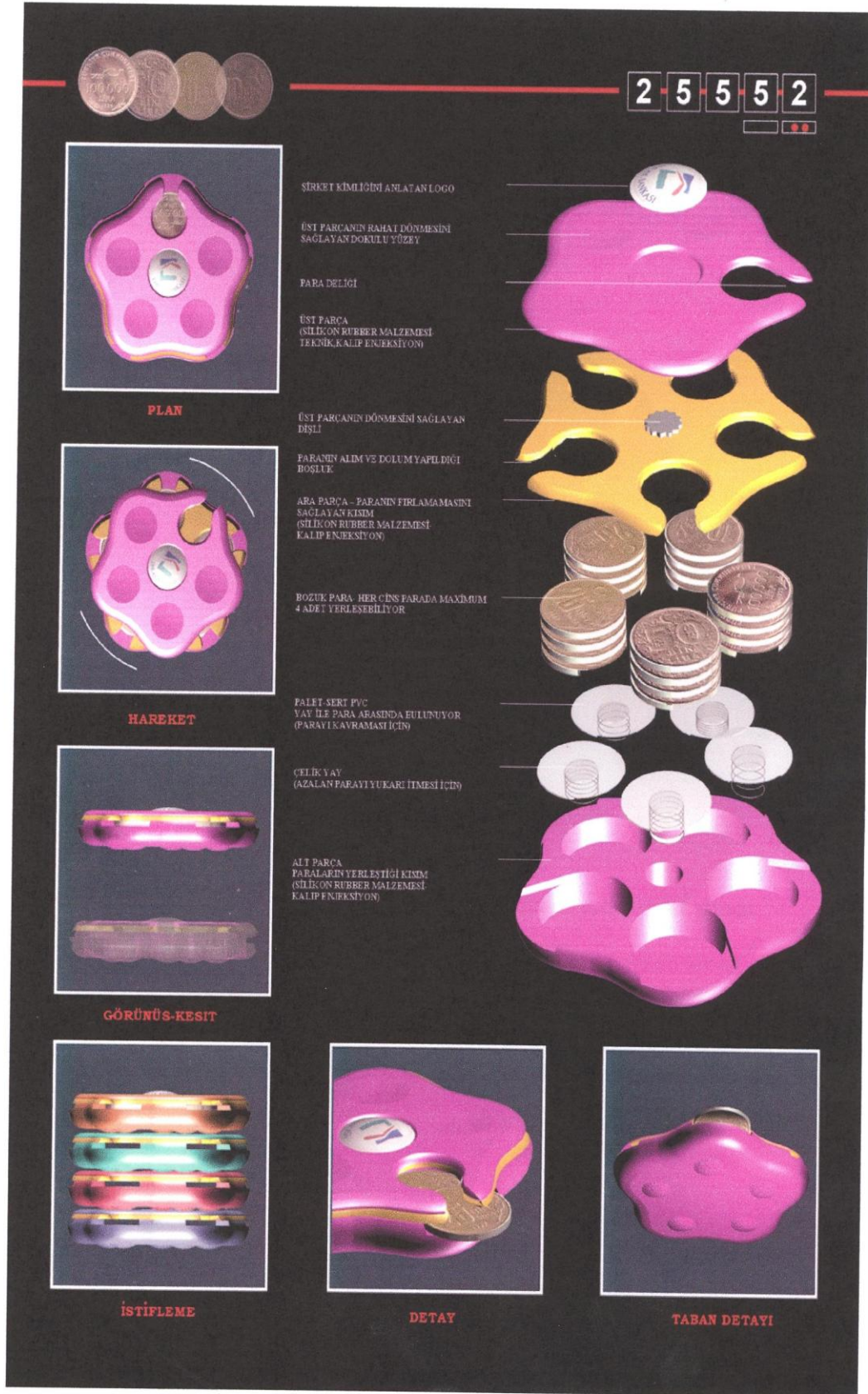


Figure A.5 : (b) Final graphic presentation of project.

Product : Fan

Designer : Yankı Göktepe

Producer : Ece Associates, Inc.

Graphic : Yankı Göktepe

Objective: Fan design is aimed to provide coolness and to present visual value for promotion sector. Product is consist of six modular elements (PVC) which turn around the pivot point.

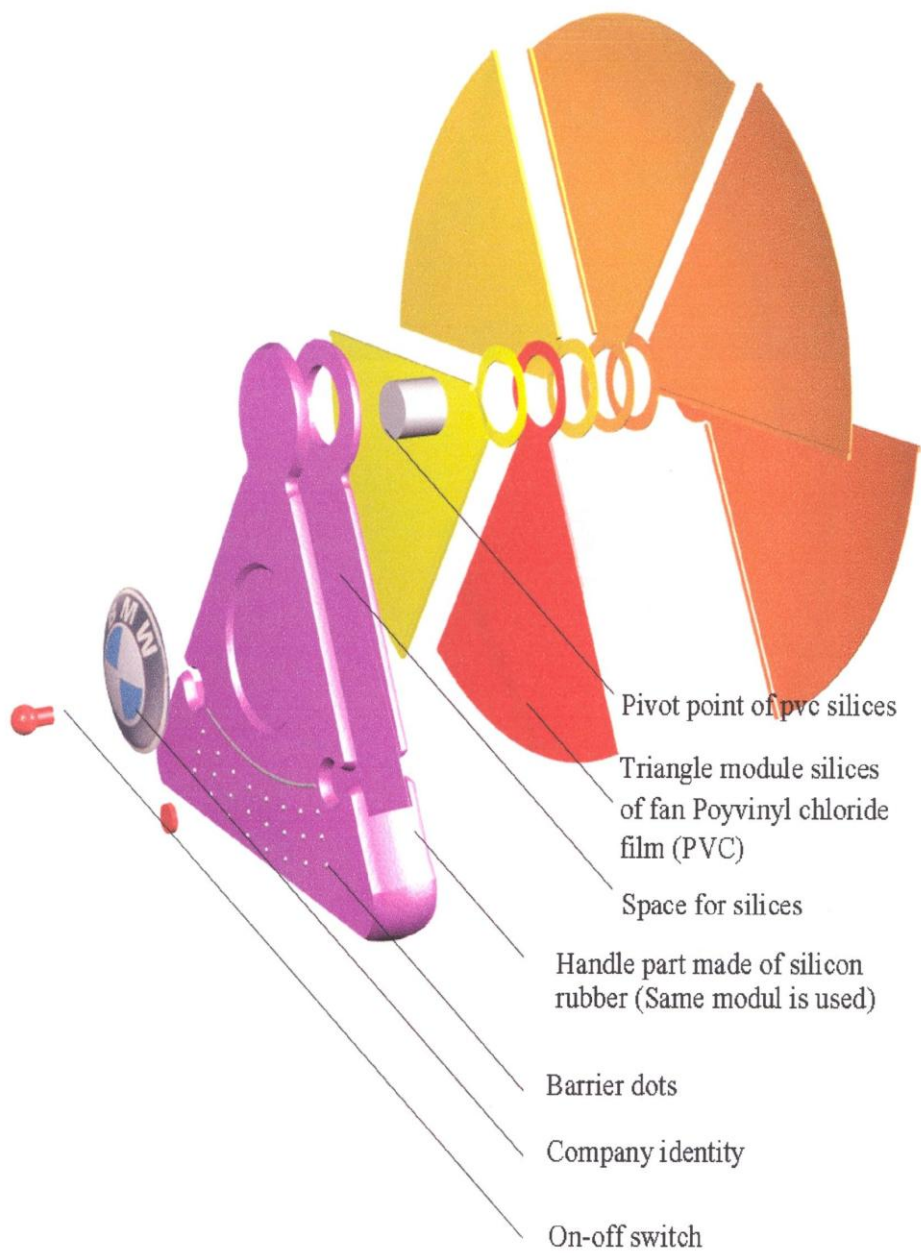


Figure A.6 : Material and production technics of "Fan Project".

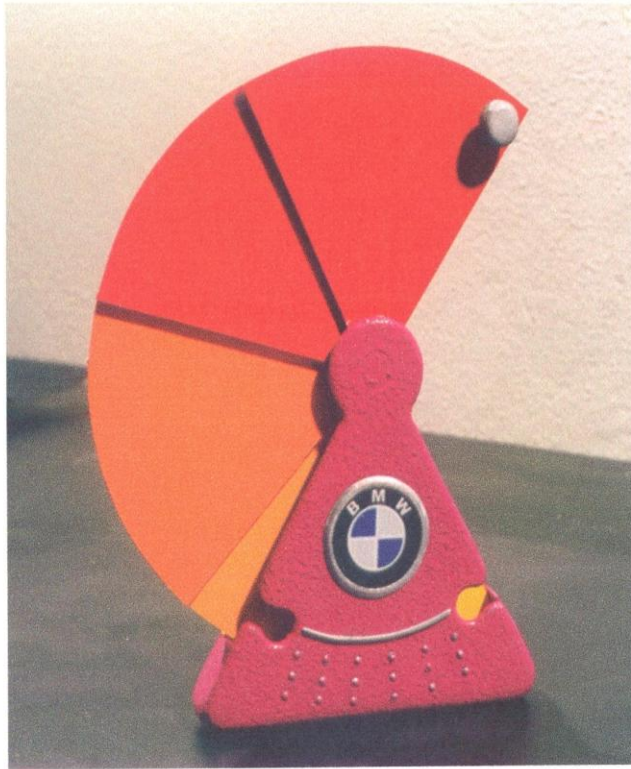


Figure A.7 : Main body of Prototype is made of delrin and modular part is PVC sheet.

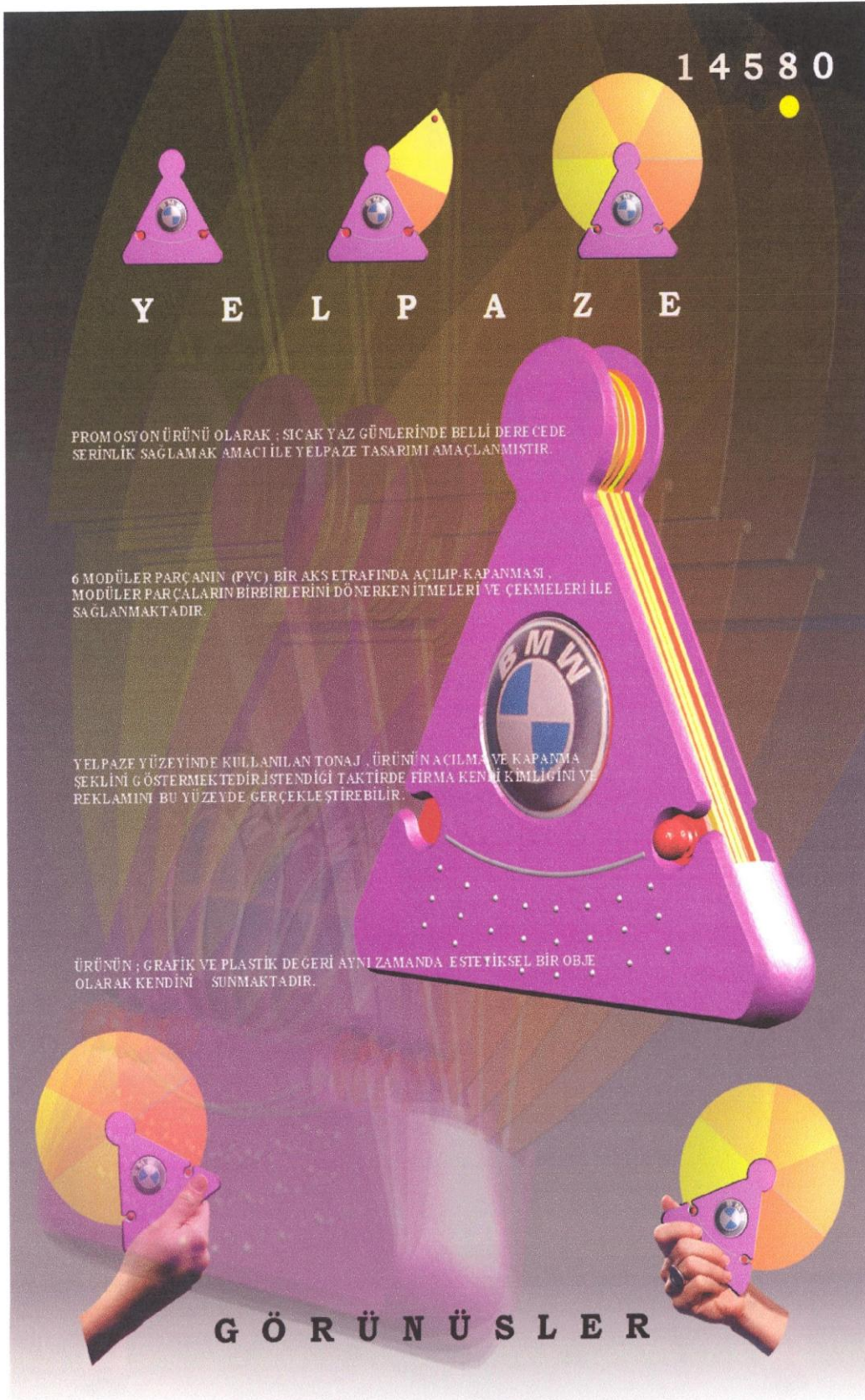


Figure A.8 : (a) Final graphic presentation of project. (First Honourable mention award is given to Yankı Göktepe by Promotional Products Suppliers and Distributors Association in 2000)

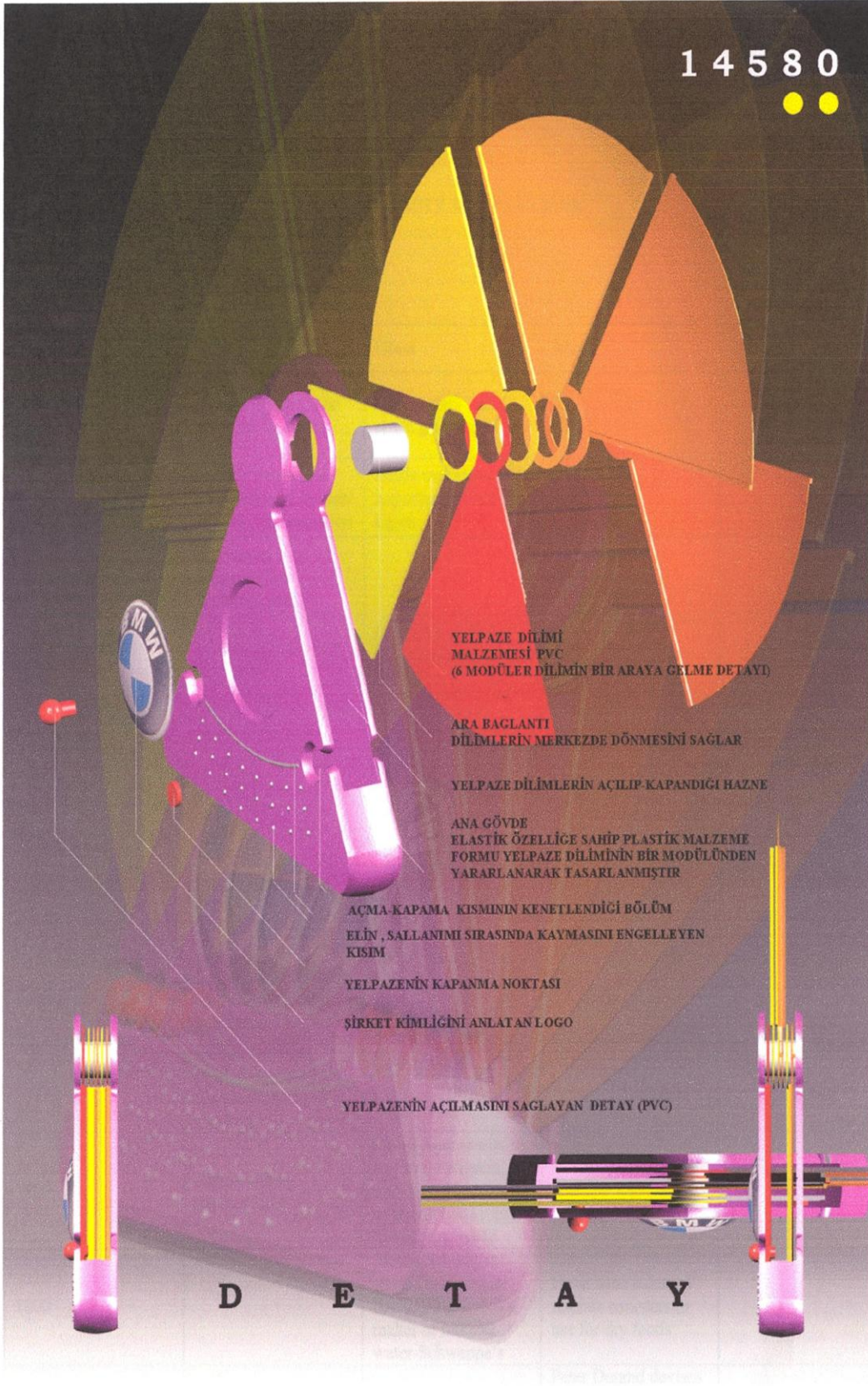


Figure A.9 : (b) Final graphic presentation of project.

APPENDIX B

The History of Packaging

Year	Paper and paper Products	Glass	Metal	Plastics
8000BC	Woven grasses, soon replaced by cloths	Clay pottery and crude glassware		
1550BC	Poultry wrapped in palm leaves to protect against contamination	Bottle making is an important industry in Egypt		
200BC	Developed by Chinese from mulberry bark			
Greek and Roman times	Wooden chests, kegs and barrels	Bottle for perfumes, jars; earthenware urns bottles		
750AD	Paper making reaches Middle East from there reaches Italy, Germany			
868	First evidence of printing from the Chinese			
1200	Paper making reaches Spain from there reaches France, UK in 1310		Tinplated iron developed in Bohemia	
1500	The art of labelling is created. Jute sacks widespread			
1550s	Oldest surviving printed wrapper from Andreas Bernhardt, Germany			
1700	Paper-making reaches USA	Champagne invented by Dom Perignon only possible because of strong bottles and tight-fitting corks		
1800		Jacobs Schweppe started business in Bristol, England as a maker of mineral water-Schweppe's	Handmade soldered tinfoil canisters in use for dry foods	
1810			Peter Durand devises cylindrical sealed container the can Aluminum isolated from ore	

1825	Druggists in the UK adopt regulations for the labelling of poisons			
1841	Paper boxes cut and creased by hand. Screw cap patented		Collapsible tubes first used for artists' paints	
1890s	Printed paperboard cartons appear. Crown cap patented 1892	The first milk bottle appears; Scotch whisky appears in London and is exported; Coca-cola appears in bottles- pepsicola soon follows	Toothpaste invented- starts to appear in collapsible tubes	
1900s	Uneda biscuit package outs the tinplate biscuit barrel. MW Kellogg launches cereal packet	Mayonnaise is bottled in 1907	Aluminium covers made for Mason Jars	
1905s	Composite paperboard cans appear- some spirally wound. Fibre drums for cheese also designed		Steel barrels are designed to carry oil for Standard oil; they replace wooden barrels. Oxo-design white lettering on red tinplate container appeared in 1900s	
1909	Wirebound crates appear for bulk packaging			Cellulose acetate developed for photographic use. First film generating machinery developed in Switzerland 1911

1900-30		Perfume bottles become more adventurous	Foil wrapper used (1913) for US Life Savers candy bar	
1924		The UK's United Dairies becomes Britain's first dairy to switch to bottles for its milk deliveries		Du Pont manufactures first Cellophane in New York
1927				PVC available as a commercial product. Expensive plastics caps are used on luxury items. Polyester- a British discovery- was bought by Du Pont and licensed to ICI for European distribution. Development of polyethylene terephthalate 12 years later
1928		The US baby food industry starts packing products in		

		glass jars		
1933				ICI-develops polyethylene; Germany develops polystrene
1938				Du Pont introduced Nylon
1940			Aerosol devised as DDT spray	A type of polyethylene used to pack Mepacrine tablets in WWII. First tubular bag blown in 1949
1947				Squeezy bottle designed for Stopette deodorant
1948				First shrink-wrapped product: turkeys for deep freeze storage
1950s			First aluminium can is designed	High density PE developed in the UK and the USA, by Phillips Petroleum and Standard Oil Polycarbonates, developed by General Electric and Bayer
1959				Polypropylene developed in Italy, first appears as a film
1960s				LDPE used for heavy duty sacks for fertilisers
1973				Stretch wrapping introduced in Sweden
1977		Glass starts to be used only for high-value products		PET becomes widespread as bottle material for carbonated drinks
1980s			Continued down gauging of tinplate containers; moves to design only two piece cans; resurgence of interest in tinplate as a nostalgic medium	PET used for foods and hot-fill products such as jams. High barrier, multilayer containers increasingly used. Guy la Roche uses pet for perfumes
1990s	Increasing use as designers aim to cash in on the green revolution	Glass regains more attention as a recyclable pack medium		More designs incorporate biodegradable plastics

Table B.1: History of Packaging. (Sonsino S., 1990, p:170)

APPENDIX C

GLOSSARY

Adhesion Sticking objects together (as in pasting or gluing) with an adhesive material. A general term covering cements, glues, pastes and thermoplastic adhesives.

Aerosol A pressurized container with a dispensing valve. There are three basic methods of discharging a material through a valve from a container using pressure true aerosols, sprays such as paints and waxes - and foam products, such as shaving creams and hair preparation.

Aerosol containers These may be reusable, throwaway or single-use - usually made from tinplate or aluminum - and glass bottles with a neck finish to take the aerosol valve.

Aluminium foil A solid sheet traditionally rolled to a thickness of less than 0.006in (0.15cm). This can be laminated on to other materials, such as polyethylene, to provide speciality high-barrier films.

Ampoule A small glass or plastic container used mainly for drugs and food ingredients. The ends are melted to seal the ampoule, and it is opened by breaking the stem.

Aseptic packaging Sterilized containers made of plastic-lined paper-foil and plastic laminations. Aseptic packages have a long shelf life and require no refrigeration in transport or in storage.

Bag A preformed container made from flexible materials, now usually paper or plastics. They are generally enclosed on three sides, and the remaining side may be sealed after

filling. Bags can be made in several plies, using different materials coextruded or laminated together.

Barrier materials A material designed to withstand the penetration of water, or water vapour, oils and certain gases.

Blanks Die-cut and scored paperboard ready to be assembled into cartons. A piece of material from which a container or part of a container will be made by further working.

Blind embossing See Embossing.

Blister pack A transparent thermoformed shape attached to a card. There are several variations of this system.

Bleed To print an area beyond the cut edge or score, so that the design is cut off or, as folding cartons, so that the design is folded under an outside flap.

Blister A small, localized area free from adhesive, used to great effect in the manufacture of the now-widespread PVC blister packs. Also known as strip packaging when small articles such as tablets are packed individually in a continuous strip.

Blister pack A transparent thermoformed shape attached to a card. There are several variations of this system.

Blocking An adhesion between touching layers of material under moderate pressure or temperature. Often used to decorate glass or ceramics. Occasionally occurs unintentionally in storage or use.

Blow molding A process of shaping plastics. Air is blown into a blob of molten plastic inside a mold. The plastic expands and takes the shape of the mold.

Board A heavyweight sheet of paper or other fibre substance usually thicker than 0.006in (0.0' 5cm), although the distinction between board and paper is not specific. Boards for packaging may be made from kraft mixed with waste papers, manilas, fibre, and newsprint

among other materials. Boards may also be laminated or coextruded with other materials such as plastics and foils.

Body The main part of a container, generally the largest part including the sides.

BSI British Standards Institute. A near-equivalent to the US American Standards Association.

CAD Computer-aided design, the technique of using high-resolution computer graphics systems to help design packaging. Also known as computer-aided packaging design (CAPD).

Calendering Pressing thermoplastic material between two or more rolls to form a continuous sheet. Calenders are also used to coat papers and fabrics.

Caliper points Units used to measure the thickness of paper. 0.0012" equals 12 points.

Carboys Large bottlelike containers made of glass or plastic usually encased in a wooden outer crate. They are used for shipping chemicals or other liquid products.

Cardboard A colloquial term, not generally used in the specification of container materials - use paperboard, fiberboard or board as necessary.

Cartons Paper boxes basically of two types: the collapsible folding carton and the rigid, set-up paper box. Both types have several variations. A form of pack made from bending grades of paperboard.

Case A non-specific term for a shipping container.

Catalyst A hardener used to speed up polymerization.

Cellophane A transparent film made from regenerated cellulose. It is inherently greaseproof and with suitable coatings may be made moistureproof and heat sealable.

Cellulose A carbohydrate constituent of plant cell walls.

Cellulose acetate A thermoplastic material made by the treatment of cellulose with acids. It is usually extruded into films and may be extruded or molded into containers.

CFCs Chlorofluorocarbons, the propellants used in aerosols until the late 1980s, when research showed they might be responsible for the depletion of ozone in the atmosphere.

Chipboard Recycled paperboard It is the lowest-cost board, and is adaptable for special linings.

Closures Closing and sealing devices for bottles, jars, dispensers, and applicators. A sealing device or covering that attaches to a container and retains the contents, preventing contamination.

Coextrusion Two or more films are extruded simultaneously to form a multilayered film (see Extrusion).

Coating A covering or layer of a substance deposited in fluid form and dried on to the surface of a material or product to imbue some characteristic, such as barrier properties.

Cohesion Binding the surfaces of objects together through welding or use of a solvent and joining. When dry, the joint becomes a continuous piece of material.

Compression molding A process of shaping plastics using heat and pressure.

Collapsible tube A cylindrical container of thin, flexible materials with integral shoulder and neck. Now almost exclusively made from plastic-foil laminates, but also from tin-lead alloys and aluminium among other materials.

Corrugated board Board that has passed through a corrugating machine. Single-face corrugated board is made from one ply of liner attached to one ply of corrugated medium. Double-face or single-wall uses two plies of liner material sandwiching the corrugation. Double wall has three plies of liner and two corrugations.

Corrugated paperboard A construction of alternate layers of flat and fluted paperboard. Flutes are categorized as A, B, C, or E.

Crimp To squeeze or press the ends of tubes or cans using a series of folds or corrugations. To fold in, squeeze, or tighten by a series of corrugations so as to hold one part against another. Milk bottle tops are one example, but the technique also applies to the tops or bottoms of metal cans.

Crown A metal closure lined with cork, used for narrow necked carbonated beverage bottles.

Deadfold A hand or machine-made fold which remains in place without sealing. Usually refers to soft foils.

Drop test A mechanical procedure to test the safety of a package's contents during shipping.

Die-cutting Cutting shapes from paper, board, and plastics using cutting and stamping dies or lasers.

Die-stamping The process of reproducing a design, figures or lettering from engraved, usually copper or steel, printing plates.

Electroplating Coating plastic or other material with a thin layer of metal.

Enamel A vitreous, paint-like material used to decorate or protect. It is usually baked on to the substrate.

Embossing A process of pressing paper between metal dies to create an image in relief on the paper. It can be used on either printed paper or blank paper (blind embossing).

Extrusion A process of manufacturing rods, pipes, tubes, and film by feeding thermoplastic resin through a heated tube, then forcing the soft plastic through a die to form

a continuous shape. The process of forcing molten materials through an aperture or die to form continuous lengths of sheeting, film, rods or tubes. The material is then immediately cooled to make it retain the new shape. Impact extrusion - as used in the manufacture of one-piece aluminum aerosols - is the process where a die or mould is charged with a pellet or disc of metal and forced by impact to conform to the shape of the die.

Etch To treat a material with acid, leaving part of the material in relief to form a design.

Fiberboard Fiber sheets produced or laminated to a thickness providing stiffness. Fiberboard for the manufacture of cartons may be corrugated or solidboard.

Films Transparent or opaque flexible packaging materials.

Finish The opening of a bottle designed to accommodate the closure. The quality of a surface - including colour, brightness and texture. In paper and paperboard specification finish has a special meaning: it is a measure of smoothness ranging from 1 to 4. Number 4 is smoothest and most dense.

Flexible packaging Packaging that uses flexible materials such as foils, films, paper or sheeting to form the container.

Flexography A rotary letterpress printing method that uses rubber plates and fastdrying transparent inks. It is a relatively cheap process and so is often used for short-run, lowvolume products, or in the execution of flashes or special promotions.

Flute A rib or corrugation on a surface

Foils Metallic-coated packaging papers. Unsupported thin metal membrane less than 0.006in (0.015cm) thick. Above 0.006in (0.015cm) the metal is called a sheet. In many European countries the word foil - from the French, feuille- means any thin material, including Cellophane and plastics films as well as thin metals.

Folding cartons See Cartons.

Gauge A method of indicating the thickness of a film or metal in which the numerical prefix is related to the thickness of the material. In films, for instance, 88-gauge is equal to G.00088in (0.0022cm).

Glassine A smooth, dense, transparent or translucent paper made mainly from chemical wood pulps. Made in white and various colours, it can be considered a high-quality greaseproof paper for wrapping foodstuffs, tobacco, chemicals, and metal parts such as sharp blades.

Grain The direction in which the fibers line up in paper.

Gravure printing An intaglio process using tiny engraved wells. Deeply etched wells carry more ink than a raised surface can so offer darker, higher quality printing. The process is more expensive than flexography and so is only used on long-runs, where the cost becomes economical.

Halftone A printing plate used to reproduce a photograph or other continuous tone design by dots of varying sizes. The term also refers to the impression that results from the printing process.

Heatsealing Process by which layers of plastic film are melted together to form a seal. A means of uniting two or more surfaces by fusing them or their coatings together.

Hologram Three-dimensional image reproduced on foils and films - recently becoming more widespread on cartons and magazine or book covers.

Hot stamping Transferring a design from a thin foil or film onto a product through the application of heat and pressure.

Hydrocarbons Chemical compounds used as aerosol propellants.

Injection molding Molding method whereby melted resin is forced into the mold by a plunger.

In-mold process Method by which a design is transferred to a plastic product during the molding process.

Imprint The informative legend printed on a container during the manufacturing process. This should contain the maker's name, container capacity, material quality, freight classification, and any other information depending on the regulations that apply in the country in which the product is sold

Labels A variety of die-cut, self-adhesive applications to decorate or identify packages or products.

Lacquer A type of coating applied in liquid form, which dries by evaporation.

Laminating Layers of material are impregnated with thermosetting resin, then pressed together, using a laminating press, to form a solid laminated mass.

Laser A device that produces a very narrow beam of extremely intense light. Lasers are used in industrial processes and medicine and can also be used in packaging for die-cutting.

Lithography A printing process using flexible metal plates whose printing surfaces are partly water and partly oil-repellent. The process is especially adapted for fine halftone colour effects on a variety of papers and boards as well as on metals.

Machine glazed (MG) A treatment for paper and board.

Master cartons Larger sized cartons used in industry for shipping smaller cartons.

Metallized film A film or paper substrate coated with vapourised molecules of metal in a vacuum chamber is said to have been metallized. This improves the barrier properties of the material and is cheaper than using foil.

Modified atmosphere packaging (MAP) Generally, food packaging, in a container where the normal air has been replaced by a special gas mixture of ordinary gases that extends the shelf life of the food naturally.

Multiwall Having more than one wall or ply. In the case of bags, this tends to mean more than two walls or plies; two-ply constructions are usually called double-wall or duplex.

Multiwall bag A flexible packaging form consisting of several layers of paper, plastic, or foil and used mainly for heavier bulk products.

Neck The narrow upperpart of a container, between the shoulder and the opening. Hence 'neck in', to form a portion of a container to a smaller size than the main part or body. This is used to great effect in the production of beverage cans, where smaller aluminum ends are used, thus saving on the costly metal.

Newsback Chipboard with one side. It is used for inexpensive cartons, die-cuts, etc.

Pack To put material or goods into a container for storage or transportation. Also, a complete range of one product in a container, e.g. the toy pack.

Package One unit of a product, wrapped or sealed in a sheath or container. A container in which a product is packed.

Pallet A low, portable platform, usually of wood, but increasingly now of metal, fiberboard or plastics.

Paper A general term referring to matted sheets of vegetable fiber. Synthetic papers from mineral, animal, or synthetic materials can now be manufactured quite cheaply.

Paper bags These come in several varieties, with or without side gussets (pleats). Paper bags are used for groceries, shopping bags, and inner containers.

Paperboard Sometimes called *cardboard*, paperboard is made from laminated layers of paper in sheets of 0.0012" (12 points) or more.

Parchment A sheet of material obtained from the skin of goats, sheep, or other animals. Vegetable parchment is a counterpart, made from chemical wood pulp.

generation of cling-type films and lidding materials for modified atmosphere packaging among other things.

Polyvinylidene chloride (PVdC) This material is tough, transparent and resists the passage of a great many chemicals and gases. Du Pont's proprietary version is called Saran and the film is often used as a coating, of PET or glass bottles for example.

Polypropylene (PP) This material was chiefly used as a rigid material for components, but has since become a major medium for the designer of biscuit and confectionery packaging. Oriented polypropylene has largely replaced paper wrappers in these two areas.

Polymers Chemical compounds that make up plastics.

Pouch Flexible container made from film, foil, or paper.

Primary package A container such as a can, bottle, or jar, which directly holds the product.

Private mold A bottle mold created for an original concept.

Pyrolysis A waste-recovery system that burns refuse in an oxygen-free atmosphere.

Recycling The use of previously used materials to make new objects.

Regenerated cellulose This term refers to films made from a cellulose base.

Register To have one part positioned correctly with respect to another. Most often applied in printing.

Resins The raw materials for plastics.

Resource recovery The use of materials that would otherwise go to waste.

Retort package A polyester-foil-polypropylene laminate package with thermal adhesives. It allows the contents to be sterilized in the package.

Rotational molding A slow molding process used for large objects. Plastic resins or liquids are placed in a hollow mold that is then rotated until all the material is fused to the mold's walls.

Sheet film (qv) thicker than 0.01 in (0.025cm).

Shelf life The expected timespan a product—often food—remains saleable. The current trend is to declare shorter and shorter shelf lives, so that foodstuffs are consumed before potentially harmful bacteria from the air can have any deleterious effects.

Shoulder That part of a container between the main body and the neck, as on a glass bottle or collapsible tube.

Shrink-wrap or shrink-film A low-cost plastic wrap that is sealed around an object with heat. A wrap of flexible film, PE or PVC usually, on an object or collection of objects to hold them in place - a piggyback promotion offer for instance, or a tray of 20 cans of beer.

Skin packaging A method by which a thin plastic film is drawn over a product on a card.

Silk screen printing Ink is forced onto a container through a design on a taut silk screen. It is usually used for printing ceramic labels on glass containers, or for printing on polyethylene containers.

Slush molding Liquid plastisol is poured into a preheated hollow mold. After the material begins to gel, the excess liquid is dumped and the rest allowed to cool in the mold.

Solid fibreboard Heavy solid board, commonly available at 0.06in (0.015cm), 0.08in (0.02cm), 0.10in (0.025cm), 0.12in (0.03cm) and 0.14in (0.035cm) thick. Made of two liners and a filler of chipboard. Used largely in shipping containers, but also in spirally wound tubes and packs for powdered detergents.

Stamping or hot stamping A decorative process in which a roll of leaf is stamped with heated (or nonheated) metal dies.

Stock bottles Bottles (glass or plastic) available ready-made in many shapes, sizes, and colors.

Tear tape A strong tape, glued to the inside horizontal circumference of cassette tapes, biscuits, pharmaceutical packs and corrugated cartons, with one end protruding. Pulling the tape rips open the container.

Thermoforming The shaping of heated thermoplastic sheets or films through forced contact with the mold.

Thermoplastic polymers Polymers that can be shaped and molded by heat. Since the bonds between molecules in these polymers are weak, they can be molded over and over again.

Thermosetting polymers Polymers that set in a hard or rigid form. The bonds between molecules are strong, and these polymers do not soften when heated.

Tinplate Sheet steel of a special formula and temper, coated on both sides with a layer of pure tin. Its use as a container has revived in recent years, spearheading the nostalgia trend in container packaging

Transfer molding A system of molding thermosetting materials. It is similar to compression molding.

Tubes Extruded glass or plastic products used for packaging.

Tumblers Glass or plastic containers shaped like drinking glasses with lids.

Typography The style, arrangement, and appearance of typeset matter.

Underprint To print in register before the final design is printed.

Universal product code (UPC) A code printed on packages that provides information on the product for inventory control and retail pricing.

Vacuum forming See Thermoforming.

Vacuum metalizing A process of coating plastics with metal.

Vacuum packaging Packaging from which almost all the air has been removed prior to the final sealing of the container. The pack-whether rigid or flexible - must be constructed from barrier materials that retain the vacuum. The process usually extends the expected life of the product by protecting it from gases or water vapour in the atmosphere.

Vial A small glass container for medical and pharmaceutical products.

Web A roll of paper, film or foil as it moves through a processing machine.

Welding A method of heating or spinning the edges of two plastic containers or components and then joining them together.

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