

普通高等教育包装工程专业教材

包装工程导论

(双语)

Fundamentals of Packaging Engineering

马爽 主编 孙彬青 副主编

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内容提要

随着我国科学技术的发展和水平的提高,包装工程高等教育也取得了长足的进步,同时也给教学提出了新的要求。教育部提倡用外语对公共课和专业课进行教学,很多高校在包装工程专业教学上已采用双语(主要是中英文)。目前双语教学的模式主要采用以英文教材作为主要参考书,老师用中英文讲授的课堂教学方式。然而,目前国内包装工程方面的英文教材较少,在某种程度上限制了双语教学的发展。

本书为英文教材,共分8章,即包装综述、包装材料、包装容器及制造工艺、包装技术、包装设计及印刷、包装物流和包装测试、包装标准与法规、包装整体方案设计与执行过程。全书选材新颖,内容连贯。为拓展学生的知识面,各章正文后面都配有与本章内容紧密相关的阅读材料。同时,附录内容提供了部分包装行业和教育信息,如考虑到学生进一步深造的需要,增加了国内外知名院校的介绍等。既可作为包装工程专业教师、大学本科生学习专业基础课双语教学或专业英语教学用书,也可作为从事本行业及相关行业专业技术人员学习国外先进技术、提高业务能力和专业英语应用水平的参考用书。

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前 言

随着我国科学技术的发展和教育水平的提高,包装工程高等教育也取得了长足的进步,同时也给教学提出了新的要求。教育部提倡用外语对公共课和专业课进行教学,很多高校在包装工程专业教学上已采用双语(主要是中英文)。目前双语教学的模式主要采用以英文教材作为主要参考书,老师用中英文讲授的课堂教学方式。然而,目前国内包装工程方面的英文教材较少,在某种程度上限制了双语教学的发展。

本书共分八章。第一章是包装综述,主要介绍了包装的定义、功能及分类;第二章是包装材料,主要介绍了纸、塑料、金属等常用材料;第三章是包装容器及制造工艺,着重介绍了软包装和硬包装的类别、应用以及常见包装容器的制造过程;第四章是包装技术,主要介绍了一些新的包装技术,如气调包装、无菌包装和智能包装等;第五章是包装设计及印刷,阐述了设计图像到印刷的工艺流程及印刷方式;第六章介绍了包装物流和包装测试;第七章是包装标准与法规;第八章介绍了包装整体方案设计与执行过程。全书选材新颖,内容连贯。为拓展学生的知识面,各章正文后面都配有与本章内容紧密相关的阅读材料。同时,附录内容提供了部分包装行业和教育信息,如考虑到学生进一步深造的需要,增加了国内外知名院校的介绍等。

本书由马爽主编,孙彬青副主编,王冬梅参编。其中,第一章、第二章的部分内容、第四章、第五章、第八章主要由马爽编写;孙彬青主要负责第二章部分、第三章、第六章、第七章的大部分内容;王冬梅参与编写第二章、第三章和第四章。这里要特别说明的是,本书的编写过程中,三位编者都搜集整理了大量的资料,因此很多内容是编者共同编写的结果。全书由马爽统稿。

本书可作为《包装工程导论》的双语教学用书,也可作为包装工程专业的专业英语教学用书。建议学生在初步接触包装专业知识时翻阅此书,这样可以使学生同时掌握专业知识的中英文表达方式,从而为以后搜集和吸收英文专业信息打下基础,同时也有利于增强学生用英语进行专业交流的实际能力。本书也可作为从事包装工程及相关专业的技术人员提高专业英语水平的参考用书。

本书是编者结合自己的教学实践编写的,在整理过程中,广泛听取了上海理工大学、天津科技大学、深圳职业技术学院以及江南大学包装专业师生的宝贵意见,并得到了上海理工大学王晓红老师、陈景华老师和徐敏老师的帮助,在此一并致谢。这里要特别感谢陕西科技大学陈满儒教授的大力支持,还要感谢印刷工业出版社吴嘉编辑的辛苦工作。

由于编者的知识水平有限,书中难免存在错误和不足,敬请读者批评指正。

主编 马 爽

2007年1月于上海理工大学

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Chapter 1

Perspective on Package

Lesson 1 Development of the Packaging as a Marketing Tool

Primitive Packaging

No one knows for sure when the first container was fashioned by man. The earliest ones, no doubt, were used principally to hold liquids, wild berries, and other foods provided by nature. Later, as man began to cultivate the soil, they were probably employed to hold crops. Shells, leaves, hollowed pieces of wood, earthenware, and animal skins probably made up the earliest packaging materials.

Although there are records of urns and other vessels being used by the early Oriental and other civilizations, the beginnings of packaging as we know it today probably started around 4000 B.C. with the exchange of goods between Egypt and Mesopotamia. Agricultural products from Egypt and manufactured items from Mesopotamia, along with some from India and possible China made up the early trade.

In spite of these early uses of packages to contain cosmetics and related products, the principal use of the package through the years was to store, protect, and held transport the product. Leather bags gradually replaced the earthen jars which were prone to breakage, and about 300 B.C. the technique of using the blow pipe to make hollow glass articles was developed. This made it possible to blow large containers at a much faster production rate than had been possible before.

Product and package identification became widespread with the perfection of the printing press by Johann Gutenberg about 1450. This made possible the use of printed paper labels for packages.

During the 1600's, the manufacture of glass containers became widespread in England, and glass largely replaced leather and earthenware containers of liquids. One of the earliest American industries was a glass container factory established in Jamestown, Virginia, in 1608. The availability of glass containers and paper labels gave rise to the patent medicine industry. As early as 1740 such remedies were being sold in England. The early bottles were usually corked and sealed with wax. Crude paper labels printed in black and white were fastened on the bottle or tied around the neck with

a string. The patent medicine industry was probably the first industry to utilize packaging to any great extent in the sale of consumer product. Other items began to be packaged in consumer quantities and unit packages, although the package was still used primarily to hold and protect the product without attempting to merchandise it.

Developments of great significance to packaging were rapid during the 1800's. In 1810, food was first preserved in a glass container sealed with a cork wired in place. This is the first instance of food preservation packaging. In 1812, metal cans were also used for the preservation of food products by means of packaging.

Packaging innovations were concerned mostly with protecting products better and for longer periods of time. The ability to produce large volumes of merchandise transformed many producers from local to national and international distributors.

It is worthy to note that as late as the 1890's unit packaging of consumer products was still not prevalent. The retail stores of that time still stocked most food items in bulk containers. Customers carried home tea, coffee, spices, sugar, flour, butter, and other items in paper bags or wraps. Bulk containers were best in this situation, as far as the producers were concerned. Because of the voluminous amount of products produced, the ready markets, and the methods of distribution in use, few saw any benefit in packaging to appeal to the consumer.

During the 1890's and early 1900's a change took place in England and the United States. With continued improvements in production and ever-increasing numbers of competitors, a greatly increased volume of output was realized, in fact, overproduction had arrived. Products were no longer automatically consumed. People could, and did, exercise selection in the marketplace. The seller's market had shifted to a buyer's market. A considerable number of marketing and packaging changes took place as a result of this shift to a buyer's market. Many of these innovations originated in the United States.

Partially as a result of consumer demands for better quality goods at lower prices, and worker demands for higher pay and fewer hours, the system of mass production was developed in this country. The result of mass production was to enable more people to afford the things they produced. This of course, expanded the total demand for goods.

Modern Packaging

Modern packaging had the effect of allowing consumers to minimize their human interactions in the marketplace. Consumers could get information from package labels that they had previously relied upon shopkeepers for. Shopping became less time-consuming and less of an emotional drain when shoppers no longer felt compelled to share personal information with the grocer each time they visited his store. Packages were especially attractive to people newly arrived in cities because labeled packages could often be trusted more.

Fast-food outlets made their appearance in the 1950s and created a demand for new kinds of packaging. The consumer met disposable single-service packaging for the first time, while the fast-food outlets demanded the bulk delivery of ready-to-cook food portions in their own special type of

packaging. Fast-food outlets boomed and later joined by increasing levels of public health care and a rapidly growing trend toward eating out rather than at home. Today this market is large enough to form its own sector, sometimes called the HRI (Hospital, Restaurant and Institution) market.

The 1950s also saw the growth of convenience and prepared food packages, such as cake mixes, TV dinners, boil-in-bag foods, and gravy preparations. A rapidly growing technology added petroleum-derived plastics to the package designer's selection of packaging materials.

The 1970s and early 1980s brought numerous changes, many of them legislated. Child-resistance closures were mandated for some products. Tamper-evident closures were brought in for others. Labeling laws required listing of ingredients, and in Canada, language equality laws were tightened. Standards for the acceptance of new packaging materials were raised. Consumerism and a concern for the environment started to be important factors for those who watched for future trends.

The last decades of the 20th century witnessed rapid change. The population aged, and many social habits changed. Families became smaller. Single-person households became common. The domestic housewife became a relic of the past as both partners in a marriage sought professional careers or higher income levels. For the modern urban dweller, "convenient" and "fast" became the operative words.

Today's packages are often complex, inside and out. Inside, they are often a sophisticated sandwich of micro-thin plastic layers, as many as nine or more, with each doing a special job such as helping with clarity, barrier control, physical strength, interlayer adhesion, or peel/seal performance. Outside, packages are engineered for printability, folding or forming requirements, special needs such as sterilization, puncture resistance, and acceptance of zippers, dispensing valves, caps, pull tabs or other features.

Today, there are many kinds of modern packaging materials, such as many of the plastics, coatings and other materials that make packaging work, and also many packaging innovation technologies, such as intelligent packaging, active packaging and safe packaging, etc. with graphic arts, packaging machinery and packaging service development, package will make much progress.

Development of Packaging in Modern China

China was one of the birthplaces of the human civilization, and Four Inventions were all created from this land, including paper and printing which have close relations with packaging. Furthermore, paper packaging got its application in China firstly. But many factors, just like the feudalism, slowed the pace of the national capitalism, so packaging industry in past was very poor and most of them was still staying in the state of small handicraft workshop.

After being built of New China, packaging industry had made a few progress. However, it was not still taken seriously. Although some design bodies and packaging educational institutions were founded by government, there was huge disparity between in China and abroad.

From the later of 1973, government of China began to have high regard for packaging industry. The First Packaging Exhibition was founded in Guangzhou which helped Chinese people to learn advanced ideas for packaging and feast their eyesight. At the end of the 1970s, China Packaging

Technology Association (CPTA) was established and all kinds of packaging magazines and newspapers were published successively.

China Packaging Federation (CPF) is one of the national industry federations with the approval of the State Council, its predecessor CPTA was established in 1980, and on September 20, 2004, with the approval of the Ministry of Civil Affairs, CPTA formally changed its name to China Packaging Federation (CPF). CPF holds 20 professional committees, and a national-wide industrial network has been set up consisting of the local associations from provinces, autonomous regions, municipalities, cities specifically designated in the state plan and major cities all over China, and there are approximately 6000 group members of various levels.

China Packaging Federation has established contact and cooperation relations with packaging organizations in more than 20 countries and regions. It represents the People's Republic of China in the World Packaging Organization (WPO), Asia Packaging Federation (APF) and international packaging organizations such as International Corrugated Case Association (ICCA), Asian Corrugated Case Association (ACCA) and European Aerosol Federation (FEA).

Lesson 2 Packaging Conception and Functions

What is Packaging?

Packaging is best described as a coordinated system of preparing goods for transport, distribution, storage, retailing and use of goods. Also, packaging may be defined in terms of its protective role as in "packaging is a means of achieving safe delivery of products in sound condition to the final user at a minimum cost" or it can be defined in business terms as "a techno-economic function for optimizing the costs of delivering goods whilst maximizing sales and profits".

What Makes a Packaging?

Of course, in principle a packaging (system) is just a clever way of constructing a container out of a selected material or combination of materials. A wide variety and choice is available, and selection is not an easy job.

A range of parameters, varying from product characteristics to consumer (client) requirements and trends, affect this selection. These parameters can be grouped in three categories as is illustrated in figure 1.1: Parameters in the micro or product environment, parameters in the ambient or distribution environment, and parameters in the macro or market environment.

The parameters in the macro environment are constantly subject to change and have, to a certain extent, an effect on the ambient environment (e.g. a change in distribution method can have an impact on mechanical impacts exerted on the packaging system).

Because of this dynamic environment, packaging systems are continuously due to optimisation, a permanent search for the optimum between functionality and cost. This value analysis includes relating the packaging system's technical, economical and environmental performance to requirements from

product, manufacturing and packaging process, warehousing and distribution, retailing and marketing operations, consumer demands and behaviour, and post-consumer waste management.

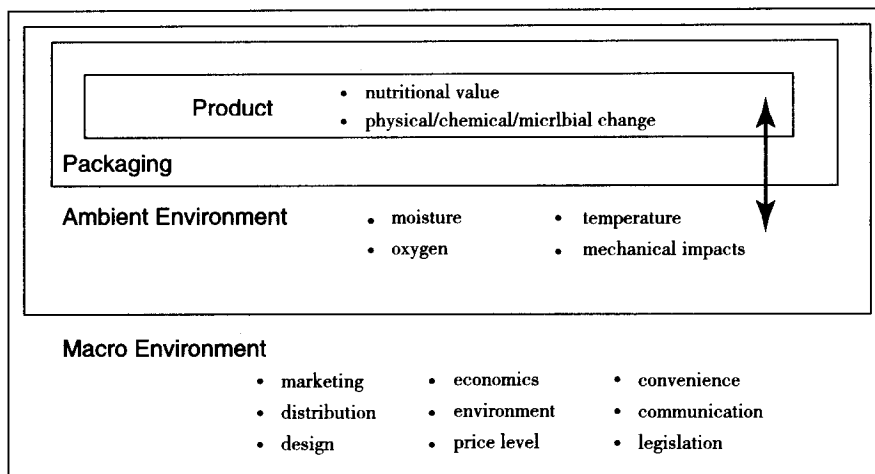


Figure 1.1 Interaction of a packaged food product with the environment

(Ref: Kooijman, 1996)

Meeting this complex of varying and often opposing demands is obviously not an easy task and requires a thorough understanding of issues involved and ability to balance them in anticipation on the pull of a changing market. Packaging research and education can and will support the packaging chain in their efforts to evaluate the complexity of demands and create adequate solutions.

Functions

Packaging is the enclosure of products, items, or other packages in pouches, bags, boxes, cups, trays, cans, tubes, bottles, or other container forms to perform one or more of the following basic functions:

- Containment
- Protection
- Convenience
- Communication
- Utility

Containment

The basic reason for having any package is for containment of any given product, if there is only one reason for having a package, it is to contain the product in such a way that the produce can be moved safely from one place to another.

This is, without doubt, the package function that has existed from the development of the first container. While it is true that the fundamental reason for having a package is to contain a product, other writers on packaging have not listed it as a basic function. Perhaps this has happened because it is so obvious, not needing mention, or because containment is viewed as passive, not fitting the defi-

inition of function which requires active influence.

Protection

Although it is conceivable that certain commodities could be transported and sold without any form of protection provided, the great majority of consumed goods need some degree of protection from one or more hazards and, therefore, must be packaged.

The protection function of the package has two aspects. First is the protection of the product from all hazards from the time it is packaged until the consumer of the product uses it in its entirety. This is the primary function from an engineering and technological standpoint.

The second aspect of protection-coequal with protection of the product is protection of the environment surrounding the item in the package. This is true not only for people who may come in contact with the packaged product, but for storage and transportation facilities as well. In the first instance, people need to be protected from toxic chemicals and explosives, for example. And metal parts such as machinery, warehouse racks, or other manufactured goods require protection from packaged acids, for example.

Two important points must be considered with regard to the protection function:

- The package must give protection to the product prior to the use of, and in many cases, during the use-life of the product. Therefore, the life of the package must exceed the anticipated life of the product.
- Protection is a specific way because each product needs protection only for its own specific vulnerabilities.

Convenience

The package should aid in the transportation, storage, selling, and use of the product. It should provide the means to move the product safely and efficiently through the channels of distribution to the point of use, and then aid in the use or consumption of the product. This function is of primary importance in considering packaging as a necessary business activity.

This function includes such things as proper orientation of the product, appropriate quantity, ease of identification, ease of price marking, ease of stocking shelves, ease of opening and closing, ease of dispensing, ease of disposal, and many more.

At one level of concern, this role of packaging is utilitarian: the package does something for the product or assists the user of the product in a functional, efficiency-oriented manner. This aspect of package performance is typically observed in industrial, institutional, or military packaging. In this case, the package is designed with a specific job to do in a specialized use situation: to present a product in a way that aids the work of a trained user. One example of packaging utility is demonstrated by surgical procedure kits which are designed to help a medical professional in a highly specialized use situation.

In the second area of concern, convenience is a very important service rendered within the performance function. Today's consumers have been conditioned to expect and demand convenience of use. They want the package to do something for them. Features that were considered a packaging bonus a few years ago are taken for granted today. Tear tapes, boil-in-bag, freezer packages, and

bake-and-serve food products, portion packaging, and nondrip pour spouts are just a few of the many convenience features expected in consumer packaging today. In this situation the package design for convenience is generalized, presenting the product in a convenient manner for an untrained or unskilled user of the package and product.

Communication

The best protective package in the world with the most advanced performance features is absolutely valueless if it never moves off the shelf. It must identify the product to the prospective purchaser, inform the user of the product about product/package features, and motivate people to buy, use, and repurchase over and over again. This function of the package is of primary importance to those concerned with successful promotion and marketing of products in packages.

First of all, the package must according to federal law for many products, identify the product to the consumer. A statement of the usual or common name of the product and how much of it is contained in the package must be conspicuously displayed on packages. Even where it is not required by law, it seems self-evident to be in the best interest of the packager to inform the consumer regarding what the product is, and how much is contained in the package.

Secondly, the package should inform the user about many product or package features. In some instances, directions on how to open the package should be displayed prominently. This is especially true for packages with safety closures.

Information about the number of servings, how to prepare or use the product, and how to take advantage of special offers, deals, or guarantees should be communicated to the buyer and eventual user.

Thirdly, and most importantly in a competitive consumer marketplace, the package must help sell the product. This is true for all kinds of retail outlets, but is of utmost importance in self-service situations. Since there are few sales persons to give advice or recommend products or brands, the package must help the customer make the decision to choose one item over another. The package must attract the shopper, appeal to her emotions, inform, and trigger the sale.

Having helped make the initial sale, the package must motivate the purchaser to use the product frequently. It must be so designed that it is a pleasant experience to use the package and the product; it must look good in the home or other place of use. A good example would be the well-designed bottle of salad dressing, with a nondrip pour spout. This is likely to be placed on the table frequently because it looks good and is suitable as a serving utensil.

Most importantly, the package should motivate the consumer to repurchase the product again and again. Profits are seldom made on a one-shot basis; they are made on repeat sales. The package must perform all of its functions in such a manner that there will be no question as to what brand to buy next time.

There are three major categories in packaging: consumer, industrial, and military. Consumer packaging, which can be subdivided into retail and institutional, is characterized by small units of products handled in large numbers. When the packaging is for retail purposes, its appearance should be emphasized. For institutional use, protection, cost, and convenience are much more important