A Brief Analysis on Packaging Design for Consumer Electronics Products

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Abstract. Purpose: to accommodate new progresses such as light and thin of consumer electronics products, online shopping, logistics, as well as new package materials and technology and to promote the overall competitiveness of the products. Methods: analysis and discussion. Conclusion: Protection functions, materials consumption, and environment pollution due to the packages of consumer electronics should be improved by the applications of new package materials and technology, as well as ecological design. The images and texts printed on the surface of package should be simplified. To meet with the logistics need of online shopping, new smart tag technologies such as radio frequency identification (RFID) should be integrate into the package design. Besides, the appearance of package should be distinct and highlight the brand and product.

Introduction

The product value can be achieved by product packaging design. Consumer electronics products are mainly defined as three categories of products: display (flat-panel television, laptop), image (digital cameras, printer), and mobility (phone, PDA and MP4 player). Integrating the computer, information and communication, consuming areas, it is also known as 3C products. As electronic components are becoming increasingly integrated, new electronic products of new materials and new technology continue to emerge [1]. The size of electronic components is becoming more and more precise and the alignment of the board is becoming more and more complex, which puts forward higher requirements on the electrostatic, mechanical, moisture-proof and other packaging protection. At present, environmental factors surrounding consumer electronics products such as online shopping, logistics and distribution, environmental protection requirements, cultural and creative design, packaging, new materials, consumer aesthetic and consumer attitudes have changed a lot. It is especially important for the packaging design of electronic products to adapt to these changes. This paper summarizes several development trends that should be paid attention to in the electronic product packaging design.

The Use of Packaging New Materials and New Technologies, Targeted to Strengthen the Electronic Product Packaging Protection

The electronic component is becoming more and more precise, and the circuit is becoming thinner. Some electronic products such as flat-panel TVs, the machine is becoming bigger, but the product thickness is getting thinner. Therefore, the introduction of new packaging materials and new technologies is needed to improve the protection ability of electronic product packaging. (1) Shock-proof: the structural design of the box and the high-performance buffer packaging materials is used to improve the shock-proof ability of the electronic products. For example, the use of natural raw materials can be completely degraded light pulp molding material instead of foam and corrugated gasket, the use of air-cushion film to reduce packaging material consumption. (2) Water-proof and moisture-proof: the electronic components are getting smaller and closer to each other. In the wet environment, they are prone to condensation of the capillary, damaging electronic products by short circuit. Adding a layer of plastic film, aluminum foil, wax paper and other waterproof packaging materials in the product packaging can prevent electronic products from rust or condensation. In recent years, high barrier plastic film, with infrared reflective function of aluminum foil and nano-
modified high insulation barrier paint and other new water-proof material, is gradually employed in
the electronic product packaging applications. Some electronic products with water (tide) graphic or
graphic display or graphic blur and other smart labels show that whether the electronic products
have experienced water (tide) process or not. [2] (3) Anti-static electricity: With the increasing
integration of electronic components, the thickness of the insulating layer in the circuit becomes
thinner and thinner, the ability to withstand static voltage is getting lower and lower, and a large
amount of polymer materials are used to generate and accumulate static electricity, which makes the
electrostatic more and more serious. The four main aspects of electrostatic damage to electronic
products are as follows: the static electricity absorbs dust, thus reducing component insulation
resistance; static electricity discharge directly destroys circuits or components; the heat generated
by static electricity discharge or electric current causes damage to the components; electrostatic
discharge produces a very large, wide spectrum of electromagnetic fields so that electronic products
can be damaged by electromagnetic interference. It is rather difficult to completely eliminate static
electricity, for the electronic products can accumulate new static electricity by way of vibration,
friction, collision, extrusion in the process of loading, transportation and storage. Anti-static
electricity protection of electronic products can only rely on is the packaging. The International
Electro-technical Commission (IEC) classifies electrostatic packaging into three grades according to
the level of electrostatic sensitivity and performance requirements of the product [3]: electro-
statically shielded packaging requires that the packaging material has a volume resistance of less
than 1000 Ω; the body resistance of electrostatic conductive packaging is10000Ω; the volume
resistance of electrostatic fugitive packaging is between $10^4 \sim 10^{11}$Ω. Electrostatic sensitive electronic
components are usually multi-layer anti-static shielding bag packaging: the inner layer is not easy to
produce static or dissipative static material; the middle layer provides conductive shielding material;
the outermost layer is electrostatic shielding materials, reducing the external electric field on the
impact of electronic components. The development of new materials technology provides a variety of
cost-effective new anti-static materials [4]. (4) Anti-oxidation: the use of air-conditioning technology to
reduce the packaging of oxygen and water vapor content, product packaging, especially some of the
military printed circuit board spare parts, should be installed in the anti-static aluminum foil bags and
sealed with nitrogen to prevent the printed circuit board and oxidation of components. Sichuan
Changhong Machinery Factory production of military electronic equipment used a polyethylene film
dry air sealed storage technology, not only extending the product storage period, but also saving the
machine repair costs. The military products packaging of Nanjing Changjiang Machinery Factory
promoted and applied the VCI and oxygen storage technology, not only improving work efficiency 3
times, but also reducing the cost of packaging for about 30%, and extending product storage period to
ensure the stability and reliability of the products.

The Eco-design of Electronic Products Packaging, Applying New Environmentally Friendly
Packaging Materials

Eco-design refers to the environmental attributes and resource attributes of products in the whole
life cycle of product design, material selection, production, packaging, transportation, use and
disposal. The eco-design combines detachability, recyclability and manufacturability and so on as
the design goal. In the product design, the environment friendly material, the mechanical structure
and the manufacture craft is chosen to lower the energy consumption and the side effect. The
overall impact on the environment and resource consumption after disposal is minimized [5].
First of all, a comprehensive understanding of the structural characteristics of the product is
necessary. It includes the structural strength of the product design, the bottom structure of the
product, the wear resistance, the internal structure of the layout and strength, the fixing fastness of
wire, the length of components installed, the strength of various stents and the material of chassis.
For electronic products, a comprehensive buffer design is used. The buffer form can be left and
right sets of lining or the upper and lower covering.

Large electronic products’ commonly-used packaging is corrugated boxes, some large and heavy
products using honeycomb cardboard boxes. Gasket structure is generally in the form of forming cushion structure of electronic products for local buffer packaging. Gasket structure should help enhance the compression performance of the box, conducive to protecting the product of the bulge and fragile parts. Edges should be protected by pads, gaskets and other protections; the outer box should be filled with shredders, broken foam and other buffers. Packing box should be to be fully filled, leaving no gaps, thus reducing shaking and improving the shock-proof and moisture-proof abilities. The main function of the inner packaging is to provide the fixing and buffering of the contents. A variety of internal packaging materials and methods are available. (1) Foam plastic is a traditional buffer packaging materials, with characteristics such as light in weight, good protection performance, and wide application. In particular, foam plastic can be pre-fabricated in accordance with the shape of the relevant buffer modules. At present, electronic products packaging materials use polystyrene (EPS) and polyethylene (EPE, Zhenzhumian) as the mainstay, trying to choose the low-cost degradable materials. EPE is currently recognized in the international community. It is mainly used in the packaging of fragile goods, and the cost is relatively high. EPS can be molded, but it cannot be degraded and recycled, thus resulting in white pollution. Air cushion buffer film employs a special method to enclose the air between a two-layer plastic film so that the bubbles can be evenly formed between the films. The bubbles can be round, semi-circular or bell-shaped. Bubble film can provide good protection for light objects. As a soft cushioning material, the bubble film can be cut into various sizes and can be packaged in a variety of products of any shape or size. A disadvantage of air-cushion films is that they are susceptible to expansion or contraction due to the ambient temperature. Expansion will lead to damage to the outer box and the packaging, and shrinkage will lead to the movement of the contents of packaging, which will cause packaging instability and ultimately result in product damage. And its anti-puncture strength is poor, which is not suitable for packing fragile products with acute angles. Small electronic products commonly use packaging cartons for packaging. Cartons have single-core, dual-core corrugated cardboard and cardboard.

In the premise of ensuring the protection ability of electronic products packaging, the use of packaging materials is minimized and the lightweight packaging materials or other industrial waste (paper trim after the scrap) are selected. Meanwhile, the production of packaging materials and the waste can be further recycled. At present, paper honeycomb, pulp molding and other environmentally friendly materials have been widely used in Gree, Changhong, Haier, Hisense, Midea and other well-known household electrical appliance enterprises, and they achieved good results [6]. Shrink and stretch film packaging is promoted and widely applied in the Haier Group [6].

**Simplifying the Graphic Printing, and Using Smart Labels to Adapt to Online Shopping Logistics Needs**

In the Internet, the Internet of Things era, the proportion of online shopping electronic products is getting higher and higher, so electronic product packaging design must adapt to online shopping product sales model and logistics. When doing online shopping, consumers focus on product images and performance, caring less about the appearance of the packaging. Therefore, the printing graphics of the packing box' surface should be simplified as much as possible, reducing the printing costs and the environmental pollution in the printing process.

For online shopping commodities, the logistics is much more complicated and the temperature and humidity environment is even worse in the storage and transportation process. In addition to further improve the protection ability of packaging, you can also use smart tag technology, such as radio frequency identification tags (RFID), near-field communication tags (NFC) to achieve full electronic product packaging tracking and monitoring, streamlining manual labor. For temperature or humidity sensitive electronic products, We can also use the temperature and humidity instructions to record the label or the temperature and humidity test results into the RFID or NFC chip return logistics management system.
Packaging Appearance of Distinct Personality to Highlight the Brand and Product Theme

Packaging has some characteristics such as having a creative image, being a model lead and reflecting the corporate brand awareness. The emergence of new products, the changes in consumption patterns, the development of commercial circulation, the emergence of new materials, production processes, technology improvements, marketing and other development will promote the emergence of new packaging. Even people’s attitude towards life, the change of aesthetic taste will also have an impact on the packaging form.

Emphasizing on the enrichment and comfort of the visual design, the design creativity is in pursuit of the aesthetic effect —“friendly” and “cordial”. Integrating product packaging and creative design, the product packaging design is considered completely from the user's point of view. For example, the packaging of iphone series, the graphic is very simple and the color is easily recognizable. Digital electronic products have a strong brand effect in the packaging. Especially in the packaging paper, the structural design is carefully deliberated. In the visual design, well-known foreign companies have a unique logo of their own, using a unified brand, a unified model, a unified packaging and packaging design and unified packaging structure design, to establish the image of the product producers, simply and clearly [7].

Conclusion

Different electronic products have different electrostatic, mechanical buffer, humidity, temperature and other packaging protection requirements. Green multi-functional new packaging materials as well as logistics applications of new technologies like RFID enable electronic packaging to move towards a safe, green, intelligent and personalized direction. The overall consumer electronics market competitiveness can be enhanced through the packaging.

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References


