

Design and Application of Humanized Pencil Sharpener

Xia Zhi-Liang¹, Tian Qi-Ming²

Wenzhou Vocational & Technical College, Wenzhou. 325035

Xia441@sina.com

Keywords: Humanized; Pencil Sharpener; Design; Material

Abstract. In the world, pencils are more and more widely used, which meanwhile leads to the constant increasing of resource consumption. Because the main raw materials of pencil are wood and graphite, numerous wood and graphite are used for pencils every year. However, pencils are always not utilized well. Amounts of pencil stubs are constantly discarded, resulting in huge resource waste. Many enterprises try to research and develop environment-friendly pencil, but to avoid the waste of pencil, we should perform control to the source, constantly recovering resources from the pencil-sharpening process. So a new type of green design of pencil sharpener emerges.

1. Analysis on Chinese pencil industry.

1.1 Status of Chinese pencil industry

At present, output of pencil of the whole world is about 0.22 billion grosses (1 gross equals 144 pieces), 316.8 pieces. Chinese output of pencil accounts for about 80% of the world's, about 253.44 pieces. Output of pencil of the other countries is only about 63.36 pieces. . As shown in figure 1.

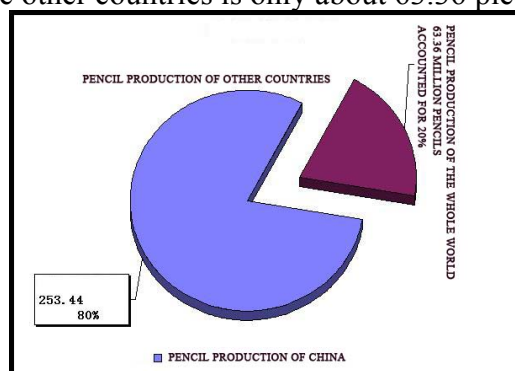


figure 1 Pencil production of the whole world

According to results of the second national economic census in 2008, there are totally 294 pencil-production enterprises, among which there are 106 production enterprises above designated size (amount of sales is more than 5,000,000), and 188 production enterprises below designated size (amount of sales is less than 5,000,000).

Output of pencil enterprises above designated size is 13.719 billion pieces, and output of pencil enterprises below designated size is 10.755 billion pieces. In 2008, the national total output of pencil is 24.4 billion pieces (this number is basically close to the above one estimated according to global output of pencil). As shown in figure 2.

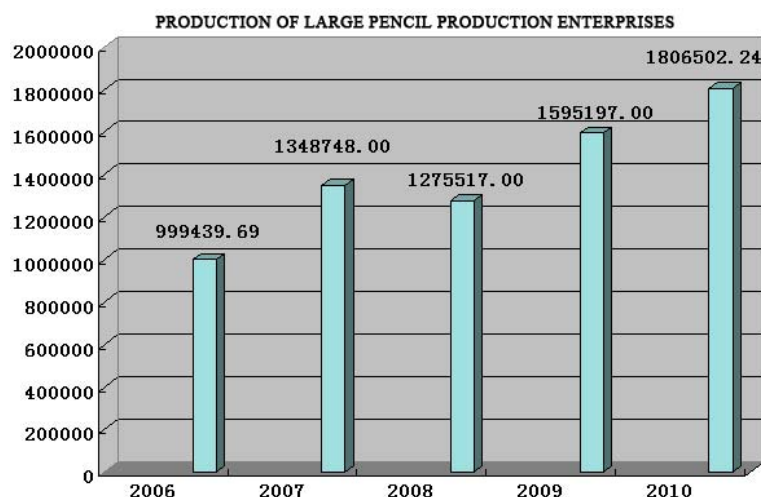


figure 2 Production of large pencil production enterprises

1.2 Status of pencil stub waste

I have estimated the actual using conditions of lead refill of wooden pencil. After deducting length of the pencil stubs, I got that the weight of the actually used lead refill in a wooden pencil is 0.488g. After processing the data obtained in the study process, I got data about the using conditions of wooden pencils. It is showed in Table 1.

Table 1 Condition of use

Weight of oil paint	Weight of wooden closure	Weight of lead refill	Weight of actually used lead refill	Use ratio of lead refill
0.237 g	3.367 g	1.190 g	0.488 g	41%

By studies, I got that our using each one piece of wooden pencil would waste 3.367g wood, 0.237g oil paint and 0.702g lead refill, while just 0.448g pencil stub is utilized. The use ratio is just 41%. There are so many people using wooden pencil, so, how much wood, oil paint, graphite and clay are consumed by our using wooden pencil every day? We should reduce the waste of raw materials of pencil, and make efforts to enable the wasted raw materials to be reused, which can better protect our environment.

1.3 Analysis on characteristics of pencil sharpener

Structure: a pencil sharpener consists of organic body, pencil holder, sharpener and chip box. At the bottom of the chip box, there is a groove for the pencil knife, which is inserted into the groove and then fixed. Users can use the main pencil knife in the sharpener, or take out the chip box, and use the pencil knife on it. If the main pencil knife of the sharpener is a plane one, after it is passivated, the pencil knife on the chip box can be taken out to replace it, forming a sharpener with a sharp knife edge.

Shapes: most sharpeners in the current markets are of lovely shapes, which is dominant by cartoon animals. But they are crude on the whole, and lack the sense of design. Some even directly insert the sharpener's functional parts into its cartoon-shape body, which seems very weird and weaken the functions.

Colors: Colors of the current existing sharpeners are multifarious, and there is not a uniform standard for them. But colors of a great part of sharpeners have a common point that they have high-level brightness and look pinky and cute, corresponding to their lovely shapes.

Positioning: sharpeners in the current markets are basically positioned as products used by pupils, and lack users such as office workers and professional designers, so they are not commercialized enough.

Characteristics: the current consumer group of sharpener products is mainly pupils, so the shapes are dominated by cute styles. However, we find that in groups of a little old age, for example, our young office worker or college students seldom use sharpeners, but directly use pencil knife. The main reason is that the current sharpener can not satisfy their aesthetic demand. Some may think the sharpeners are childish and are just designed for pupils. Therefore, the sharpener markets lack products for these groups of people.

1.4 Material and craft of pencil sharpener.

(1) Texture: the materials used are mainly ABS, PP, and PC. Certainly, some special types may use metal material.

PMMA is the polymer generated by polymerization of acrylic acid and its esters and is called by a joint name acrylic resin. The corresponding plastics is called by a joint name acrylic-acid-type plastics, among which PMMA is most widely used. PMMA is the abbreviation of PMMA, and is commonly called organic glass, and has excellent translucency, being able to penetrate more than 92% sunshine and 73.5% ultraviolet ray; it has high mechanical strength and a certain level of thermostability, cold endurance and corrosion resistance; its insulativity is excellent, its size is steady and it's easy to be molded. It has fragile texture, and easy to be dissolved in organic solvent. Its surface hardness is not good enough, and is easy to fluff. Some transparent structural parts with a certain level of intensity such as oil cup, lamp, installation parts, optical glasses and ornaments and so on. Putting some additives into it can enhance its performance to a certain degree, such as heat resistance, friction resistance and so forth. It is one with most excellent performance among synthetic transparent materials. At present, this material is widely used to make advertising lamp box, nameplate and so on.

ABS resin, as one of the five major synthetic resin, has excellent impact resistance, heat resistance, low temperature resistance, chemical resistance and electrical performance. And it also has such characteristics as being easy to be processed, steady product size and excellent glossiness and so on. It is easy to be painted and colored, and can be reprocessed by metallization, electroplating, soldering, hot-pressing and splicing and so on. It is widely used in industrial fields like machinery, automobile, electronics, instrument and apparatus, spinning and building and is a kind of widely used thermoplastic engineering plastics.

(2) Craft: enclosures of the current existing sharpeners basically adapt paint spraying method, and the patterns on them are mainly finished by heat transfer printing. Both of them are simple crafts and the costs are low.

2. Positioning of consumer groups

The groups positioned for this design are mainly office workers, especially the designers, because designers draw and sketch by hand a lot, so pencils are important tool for them. Therefore, designing a kind of practical and commercialized sharpener can greatly shorten the designers' time and enhance their efficiency. Meanwhile, combined with energy-saving and environment-friendly concepts, it is more suitable to the modern people's life styles. The design that integrating the recycling and reusing of pencil shavings and wood chips into one realizes pencils' value in the whole process of being used. This saves much resource, and is also helpful to protect environment, and is in accordance with the concept of ecological civilization.

3. Positioning of functions

3.1 Positioning of styles

First, let's talk about shapes. The current sharpeners have amounts of cute shapes, and are basically crude and lack sense of design. Now that we want to create products centering on the younger, we need to know about what elements the modern younger like. And then, by design, they can be embodied on the sharpeners. Besides, when designing the shape, we should consider about its connection with functions.

In aspect of functions, the current sharpener is just a tool to sharpen pencils. I hope that, except the tool function, the sharpener designed has many other functions, such as the recycling and reusing of pencil shavings and wood chips. Because lead refill is mainly made of graphite and clay, and by transformation, it can be made into black fountain pen oil, so the design that inject the transformed lead refill into empty fountain pen refill can make best use of the lead refill, and meanwhile reduce the waste of empty fountain pen refill.

In aspect of colors, although the current sharpeners have various colors, they lack a sense of unity and are crude. I hope that the sharpener designed can be made into a series, just like some digital products, and has the sense of unity as well as difference, and the consumer group can select them by their color preferences.

3.2 Innovations

- (1) The brand-new positioning would be a great feature of this product.
- (2) Ingenious and reasonable sharpening structure.
- (3) Reasonable energy-recycling and -reusing system.
- (4) The process of injecting oil into empty fountain pen refill.

Innovative appearance design would make up the immaturity of current products. . As shown in figure 3.

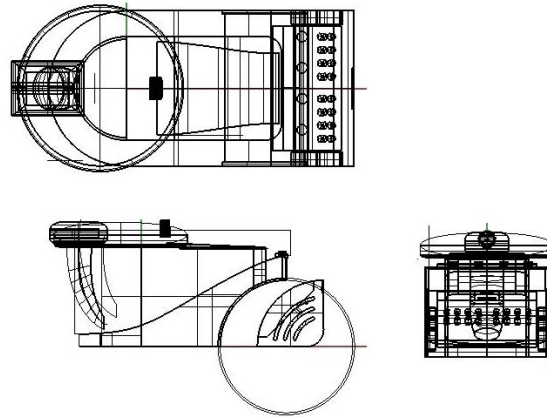


Figure 3 Structure

Shapes: this factor should be the center. The current sharpeners have amounts of cute shapes, and are basically crude and lack sense of design. Now that we want to create products centering on the younger, we need to know about what elements the modern younger like, and then, by design, they can be embodied on the sharpeners. Besides, when designing the shape, we should consider about its connection with functions.

Functions: the current sharpener is just a tool to sharpen pencils. The sharpener designed here, except the tool function, has many other functions, such as recycling and reusing pencil shavings and wood chips, which is the greatest innovation. We must grasp this chance to expand new market, publicize new concepts and quickly capture the market. As shown in figure 4.

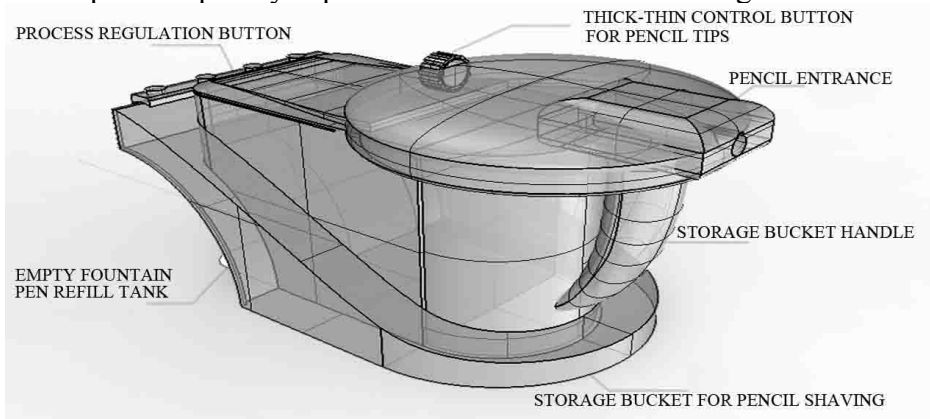


Figure 4 Functions

Colors: although the current sharpeners have various colors, they lack a sense of unity and are crude. I hope that the sharpener designed can be made into a series, just like some digital products, and has the sense of unity as well as difference, and the consumer groups can select them by their color preferences.

4. Model making

The physical model adapts the proportion of 1:4 and the 3D printing technology. The overall material is PLA plastics. PLA is the abbreviation of polylactic acid.

PLA is also called polylactide, and belongs to the polyesters. PLA is the polymer generated by the polymerization of materials with lactic acid as the main raw material. The raw materials have adequate sources and is reproducible, and the main raw materials are corn and cassava and so forth. The production process of PLA is pollution free and the products are biodegradable, realizing circulation in nature. So, it is the ideal green high polymer material.

PLA has good heat stability, and its processing temperature is 170~230℃. It has excellent solvent resistance and can be processed in many different ways, such as extruding, spinning, biaxial drawing and injection blow molding. Except being biodegradable, products made by PLA has good biocompatibility, glossiness, transparency, hand feel and heat resistance, and has a certain level of bacterium resistance, fire resistance, and ultraviolet resistance, so it is very widely applied. It can be used as packing material, fiber and non-woven materials. At present, it is mainly used in the fields such as clothing (underwear and outerwear), industries (architecture, agriculture, forestry and paper-making) and medical treatment and public health and so forth.

The largest manufacturer of PLA is American Nature Works Company with the present output of 70,000 tons, and the second is Chinese Hisun Biology, with the current output 50,000 tons. PLA has many applications in various fields such as extruding, injection molding, film-drawing spinning and so on.

5. Conclusion

The appearance design completely abandons the cute and exaggerated shapes and crude colors, but adapts more easy, concise and commercialized shapes and pure light colors, making the sharpeners in the markets not simply the pupils' study tools any more, but occupy the commercialized field dominated by the designers.

Fund program

Zhejiang higher vocational colleges young and middle-aged professional leaders' professional leading project (lj2013043) ; 2011 Zhejiang planning project on educational technology research (JB078)

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