

Campus Paper Complete Recycling Temperature Control Box

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Abstract

Colleges and universities, as prestigious social institutions, are also significant consumers of paper resources and waste paper production. Based on the dual pressure of large amounts of paper and severe waste on campus, paper recycling is particularly important. The World Wide Fund for Nature has pointed out that there are as many forests as 36 football fields deforested every minute in the world. Every year, the global paper production and consumption has reached 320 million tons, and nearly 1.3 billion such trees disappear from the earth every year. As a renewable resource in China, paper plays a pivotal role in China. For the domestic paper industry, which has a severe lack of production resources, it is urgent to increase the recycling rate of paper.

1. Research Background and Implementation Plan

1.1. Research Background

At first, forests covered 2/3 of the earth's land area, but after the 20th century, the rate of forest decline further accelerated. If it continues in this way, it will not take many years for the world's tropical forest resources to be destroyed.

Jiang Shengsan, senior chairman of the China Recycling Resources Recycling Association, stated in his speech: "The report of the 19th National Congress of the Communist Party of China said that it is necessary to promote green development, promote comprehensive conservation and recycling of resources. It has become an indispensable raw material. However, the domestic waste paper is not sorted and recycled in place, resulting in insufficient utilization of a large amount of recyclable waste paper. The recycling of the front end in the recycled paper chain is decisive. Whether the recycling process is complete or not is determined. Whether the paper industry can develop in a green and healthy way, and I also hope that the content of the proposal can be translated into action, and all parties should start from the beginning and start from around to make the resource cycle more efficient and environmentally friendly. "

The existing thermal ink erasing devices are roughly divided into two types. One is to reach a high temperature by frictional heat generation so that the handwriting disappears. The existing problems are: rapid friction can cause the temperature to rise quickly, and fast friction can easily cause paper damage; the other is rolling contact, which has the disadvantages of incomplete removal of traces, residues, and long erasing time. The above problems cannot give full play to the advantages of thermal inks, leading to its constant neglect. The small temperature-controlled erasing system is based on thermal inks, which can easily and quickly reuse paper in a small area.

With the development of the education industry, the demand for paper is getting higher and higher, and the traditional paper recycling is simply to recycle waste paper into the furnace and turn it into pulp for remanufacturing. This method has high costs, complicated processes, and low waste paper utilization. It has caused more serious environmental pollution. Moreover, office paper such as A4 paper is directly converted into household paper, causing enormous waste and reducing the recycling rate of writing. Based on the above situation, we plan to design a small temperature-controlled erasing device that can be used in a small area (such as

offices, classrooms, libraries, etc.), and the operation is simple, convenient, and fast. Our device is based on "thermal ink" and its temperature control system as its main body, which is very suitable for effectively increasing the utilization of paper in a small area, reducing individual office costs, and achieving the goal of saving paper as a whole.

1.2. Implementation Plan

1.2.1 Overall structure

We adopt a box structure, so whether it is more beautiful from the outside, more comfortable to use, and a more reasonable mechanical structure. The overall device consists of three parts: thickness measurement device, central control system, heating device. The heating box is the main structure. The upper box cover can be opened. The thickness measuring instrument is installed in the box cover. The measured data is transmitted to the bottom control system through the line to control the heating time. After the heating is completed, the power is automatically turned off, and a tone sounds.

1.2.2 Heating method

It is found through experiments that the spot-shaped area is heated. This method leads to uneven heating, local temperature is too high, and the temperature fluctuation range is uncontrollable, which affects the use effect. Besides, the wiring of the heating plate is complicated, which will increase the failure rate of the device and reduce the safety factor of the invention. Moreover, the use of heating tablets will lead to poor flatness and local voids, which will lead to poor thermal insulation effects. After consulting the data, we switched to the heating method of the panel. The heating plate has a soft structure and is suitable for various spaces. Also, it can be processed again, and the surface heating method is adopted for uniform heating. At the same time, an external numerical control display can be connected to control the heating temperature.

1.2.3 Heat conduction box

The material and dimensions of the heat conduction box have been changed. The content of the heat conduction box has been altered and thickened to achieve better heat conduction. The heating device adopts a rectangular parallelepiped heating box. The central heating resistance wire is installed at the bottom of the heating box. The resistance wire current is changed by a varistor to control the heating temperature. The box structure adopts a copper heat conductor. The upper cover is composed of upper and lower parts. The top layer is a thermal insulation layer, and the lower layer is a copper plate in close contact with the sidewall. The heat conductivity of copper is used to ensure uniform heating. The cover plate is connected by a mechanical arm and can be moved up and down to prevent heat loss. The main body shell and the heating box are filled with insulation material to form a thermal insulation layer to save energy as much as possible. The box body includes a power port, a transmission part, and the main body shell. The thermal conductivity can be found by querying the data: silver> copper> aluminum, but based on careful considerations of economy and performance, copper is finally selected as the thermally conductive medium. The insulation material to be selected is rubber-plastic insulation material, which has the advantages of low thermal conductivity; Class B1 flame retardant material, which is safe and reliable; easy installation, which ensures the beautiful and flat appearance; at the same time, in the environment of -60°C to $+89^{\circ}\text{C}$, Does not cause physical changes and meets the needs of the device.

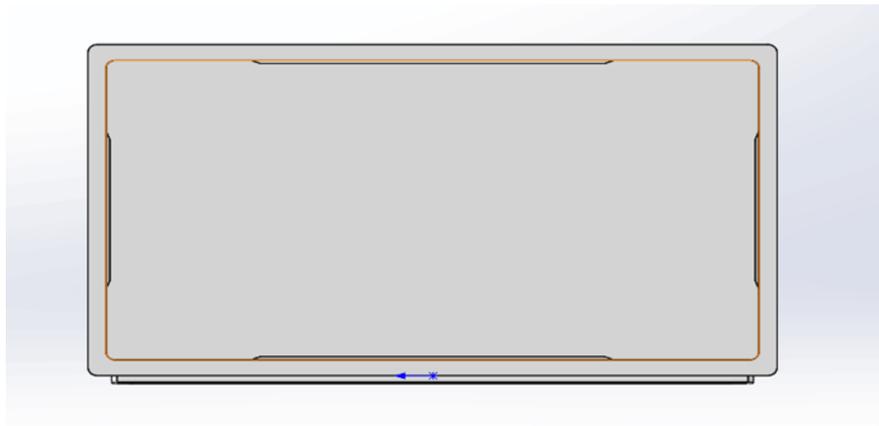


Figure 1. 1.2.3 Heat conduction box

1.2.4. Material research

The parameter used to measure the thermal conductivity of materials is "thermal conductivity." Thermal conductivity refers to a 1m thick material with a temperature difference of 1 degree (K, °C) on both sides under stable heat transfer in seconds (1s), the heat transferred through an area of 1 square meter, the unit is watt/meter · degree ($W / (m \cdot K)$), where K can be replaced by °C).

The coefficient of thermal conductivity is only for the form of heat transfer with thermal conduction. When other types of heat transfer exist, such as the composite heat transfer relationship of multiple forms of heat transfer such as radiation, convection, and mass transfer, this property is often referred to as apparent thermal conductivity.

The metal copper that we come into contact with in our daily life is copper alloys, mainly copper, brass, bronze, and white copper. Among them, the copper content in copper is exceptionally high, so copper refers to pure copper. Among them, the thermal conductivity of brass, bronze, and white copper varies. Still, the maximum is not more than $250W / (m \cdot K)$, so it is only used as other building materials and not used as a heat conductive medium.

Copper, also known as red copper, is pure industrial copper (but not necessarily pure copper, and sometimes a small amount of deoxidizing elements or other elements are added to improve the material and performance, so it is also classified as a copper alloy). Its melting point is $1083^{\circ}C$, which is not the same. Isomerization, density is $8.969 / cm^3$, which is five times that of magnesium. The mass of the same volume is about 15% heavier than ordinary steel. The thermal conductivity of copper is as high as $381 W / (m \cdot K)$. The electrical and thermal conductivity of copper is second only to silver. It has good electrical and thermal conductivity, excellent plasticity, and is easy to process by hot and cold pressure. They were used in the manufacture of wires, cables, brushes, electric sparks, copper, and other products that require good electrical conductivity.

Chinese copper processing materials can be divided into ordinary copper (T1, T2, T3), oxygen-free copper (TU1, TU2, and high-purity, vacuum oxygen-free copper), deoxidized copper (TUP, TUMn), and a small amount of alloy elements. Four types of special copper (arsenic copper, tellurium copper, silver copper) are widely used in the production of conductive and thermal equipment.

Silicone rubber heating plate is mainly composed of nickel-chromium alloy electric heating wire and silicon rubber high-temperature insulation cloth. The silicone rubber heating plate is thin, lightweight, and flexible. The silicone rubber heating plate can be made into various shapes according to the size of the workpiece and can be completed in close contact with the object

being heated. It can allow heat to be transferred to any desired place, improve heat transfer during processing, accelerate temperature rise, and reduce power requirements.

At present, there are two types of circuits. One is the etching circuit method. The maximum width can be 360mm, and the length is unlimited. The heating element is a sheet-shaped electric heating element structure. It provides a more uniform thermal field than a filament-shaped electric heating element. Fast response time, low power load, and longer service life compared to filamentary heating elements. Besides, the insulation layer of the silicone rubber heating plate is composed of silicon rubber and glass fiber cloth, which has high insulation performance and a breakdown voltage of 20-50KV / mm. The continuous heating power of the silicone heating plate can reach 2.1W / cm², and the heating is more uniform.

Silicone heating plate has the characteristics of good waterproof performance, fast heating, uniform temperature, high thermal efficiency, good toughness, conforming to the American UL94-V0 class flame resistance standard, easy to use, safe life up to ten years, and not easy to age. The quality of the silicone rubber heating plate is stable, moisture-proof, and chemical-resistant. The temperature can be used from -62 to 235 ° C. The maximum power load can be 3.1W / cm². Because this product is fragile, the heat transfer effect is good. It is widely used in industrial, medical, laboratory, food and aviation fields.

However, there are some points to note during use:

1. The maximum continuous use temperature of the pressure-sensitive adhesive must not exceed 150 ° C, and the instantaneous maximum temperature must not exceed 230 ° C;
2. The constant working temperature of the heating plate should be less than 240 ° C, and the instantaneous working temperature should not exceed 300 ° C. When the temperature in the working area does not exceed 240 ° C, its current density can reach 3W / cm², and there is a risk of damage;
3. Under paste installation conditions, the allowable operating temperature is less than 150 ° C;
4. The working voltage is selected from high power-high voltage, and low power-Low voltage is the principle.
5. Calculated data

Thermal ink is a special thousand-color discoloration ink that senses color through temperature. Its properties change with the formulation, and its heat for color development and decolorization will also change. The following is a parameter of a thermal ink found on the Internet: the ink is colored at room temperature, heated to 50 ° C-60 ° C to decolorize, cooled to -5 ° C-20 ° C to develop color, and has reversibility. Specifically, the initial decoloring temperature is about 45 ° C, and the full decoloring temperature is about 55 ° C. The initial color development temperature is about -5 ° C and the full-color development temperature is about -20 ° C. The microcapsules in ink have an average fineness of 2-3 microns.

The power of the heating device used in this device is estimated to be 600w. It takes about 0.1 kWh for ten minutes to heat, and the unit cost is about 0.05 yuan. This project is intended to be used in high school classrooms. It is assumed that a class of 40 people uses thermal ink. Pen, it is estimated that 200 sheets of paper to be recovered can be produced in one day. The unit cost of using the device to recycle paper once a day is about 0.2 yuan. A sheet of paper can be recycled 5 times at a price of 1 yuan, which is equivalent to a total of savings. The total value of 1,200 sheets of A4 paper is 35 yuan, which shows the practicality of the project.

1.2.6 Overall structure

Because of the need to implement a fast, simple, complete, low-cost solution for recycling paper. As shown in the figure, the appearance of the temperature control box is a rectangular parallelepiped. The inner box wall is equipped with a temperature-adjustable heating plate for temperature heating. The paper to be recovered is placed in the temperature control box. After

taking the time, you can take out the recovered paper and rewrite or use it for other purposes. Simple, fast, and easy to use.

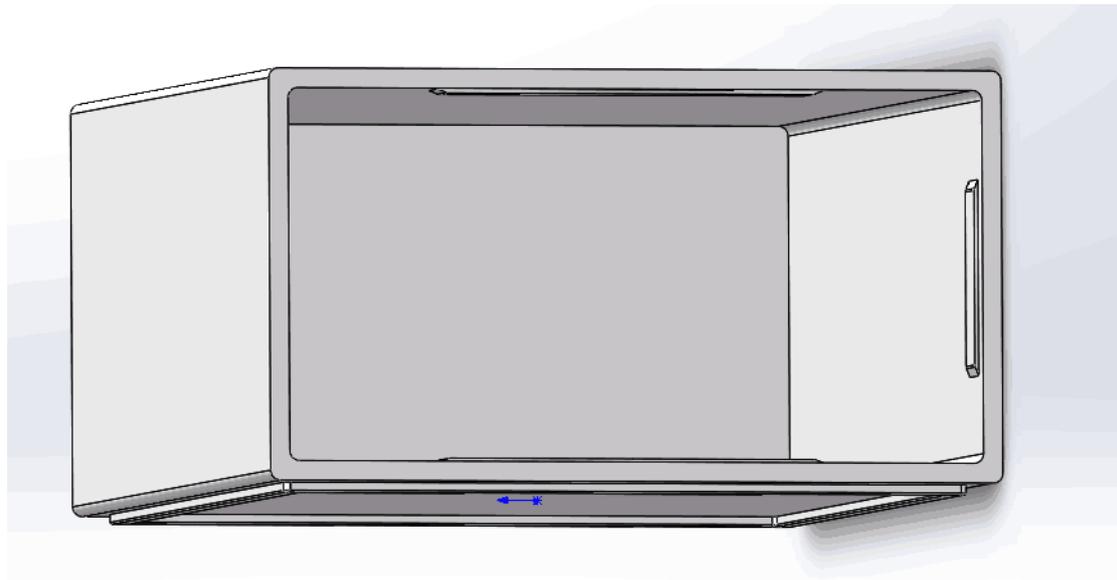


Figure 2. The overall structure

2. Conclusion

The recycling of paper is beneficial for protecting the environment and saving resources. As a renewable resource in China, writing plays an essential role in our country. For the domestic paper industry, which is severely lacking in production resources, increasing the recycling rate of paper is imminent. Therefore, how to improve the recycling of paper has paramount practical significance and broad application prospects. The small temperature-controlled erasing device can realize the purpose of recycling paper in a low range, and understand a virtuous cycle of using-recycling-reusing paper resources.

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