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Research and Design of Appearance Model of Household Dehumidifier

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ABSTRACT. *With the continuous development of the dehumidifier industry, the types of dehumidifiers are becoming more and more abundant, and the dehumidification performance has been strengthened. However, domestic research in the field of dehumidifier appearance design is not perfect. Operability, portability and safety will affect the development of dehumidifiers. In terms of design, the appearance of the dehumidifier is designed to be beautiful and user-friendly. At the same time, other factors such as cost, material, technology, etc. are added to grasp the design points. In terms of user operation methods, portability and ease of operation need to be further improved to enable users to have a better product experience. In-depth exploration and research are needed in the future.*

KEYWORDS: *dehumidifier, appearance, portable, operation*

China has a vast territory, and the humidity varies greatly in different places. In southern China, the climate is warm and humid throughout the year, especially in the rainy season, the temperature is not high, but the relative humidity of the air often exceeds 90%, people always feel sultry and uncomfortable, and feel very comfortable. difference. At the same time, in my country's south of the Yangtze River and some coastal cities, the air humidity is high, clothing, furniture, etc. are prone to damp and moldy, and the humid and hot environment is conducive to the propagation of bacteria, and people in them are also prone to various diseases. Therefore, dehumidification is particularly important in improving people's living environment. China has also promulgated regulations for the control of comfortable indoor environment: the indoor temperature control range in summer is 24-28℃, and the corresponding relative humidity is 40%-65%; the winter indoor temperature control range is 18-22℃, and the corresponding relative humidity the range is 40% to 60%.

Dehumidifiers have entered the Chinese market for more than ten years, but the market scale is still in its infancy, and large-scale production and sales have not been formed, and the overall capacity is very limited. Dehumidifiers are divided into household dehumidifiers and commercial dehumidifiers. Household

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dehumidifiers produced by domestic manufacturers are mainly used for export. China's export volume of household dehumidifiers was only over 200,000 units in 2001, and reached 5 million units by 2015. However, the domestic market has not been fully opened. According to statistics, domestic sales account for about 20% of total sales. The reason is People living in the south have a relatively large tolerance for humidity. Only two to three months of the summer have high humidity during the year, and air conditioning is usually used for dehumidification. With the development of the economy, the increase of population flow and the improvement of living standards, people have higher and higher requirements for the quality of life, especially in the high humidity area of southern China. Dehumidification is used in industrial and agricultural production and family life. The position occupied is becoming more and more important. With the continuous improvement of people's awareness and the diversification of dehumidifier products in performance, appearance and function, dehumidifier products will develop rapidly in the future.

1 Introduction to dehumidifier

1.1 Common dehumidification technology

Different types of dehumidifiers on the market have a variety of dehumidification methods. At present, the dehumidification methods of dehumidifiers can be divided into freezing dehumidification, solution dehumidification, rotary dehumidification, and membrane dehumidification.

1.1.1 Freezing and dehumidification

The principle of freezing and dehumidification is to refrigerate by a refrigerator, and pass the high-humidity air to be processed through a low-temperature cooling device to reduce the air temperature to below the dew point temperature. The supersaturated water vapor at this temperature will be condensed and precipitated on the cooler, and then cooperated The heater heats the cooled air to increase its temperature, thereby achieving dehumidification. Among all dehumidification technologies, freezing dehumidification technology has the earliest application and the most mature production technology. Moreover, the initial cost is low, the heat utilization rate is high, the operation is reliable, the operation is convenient, and no heat source is required. Frozen dehumidification is used in places where the humidity requirements are not very high. The dehumidification effect is obvious under high humidity conditions, the performance is stable and the energy consumption is relatively low.

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1.1.2 Liquid dehumidification

Liquid dehumidification skillfully utilizes hygroscopic solutions such as lithium chloride and calcium chloride, which can absorb moisture in the air to achieve dehumidification of the air. During the operation of the liquid dehumidification system, the relative humidity of the liquid surface of the high-concentration hygroscopic agent is extremely low. When the humid air passes through the hygroscopic agent, a large amount of water vapor is absorbed by the hygroscopic agent solution, but at the same time the concentration of the hygroscopic solution gradually decreases, and the dehumidification capacity is also Then fell. At this time, the dilute solution needs to be heated and regenerated. After the dilute solution is heated, part of the water evaporates, the concentration of the solution increases, and the moisture absorption performance is restored. The solution is sent to the dehumidifier for repeated use. The solution is continuously circulated through the dehumidifier and regenerator to achieve continuous dehumidification.

1.1.3 Wheel dehumidification

Runner dehumidification means that when moist air passes through a honeycomb dehumidification runner made of lithium chloride, silica gel, molecular sieve and other materials, the partial pressure of water vapor on the surface of the solid adsorbent is much lower than that in high humidity air Partial pressure. Under the action of this partial pressure driving force, the water vapor in the moist air is adsorbed on the solid moisture absorption material. There is a temperature difference between the dehumidification rotor itself and the dehumidification air, and adsorption heat will be generated during the adsorption process, so after dehumidification The temperature of the air will rise. When the moisture absorption of the dehumidifying material becomes saturated, it will no longer absorb moisture. Driven by the motor, the moisture absorption area of the runner will slowly enter the regeneration air duct and use high-temperature air to regenerate the dehumidifying material, so that The dehumidification wheel continuously dehumidifies.

1.1.4 Membrane dehumidification

Membrane dehumidification uses the driving force of selectively permeating both sides of the membrane to allow water vapor to pass through the dehumidifying membrane to the other end of the membrane from the humid air end to separate it from the air to achieve the purpose of dehumidification. Thanks to the continuous innovation and development of membrane technology research, the application of membrane dehumidification has become more and more extensive. The dehumidification membrane can be an organic membrane,

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an inorganic membrane, or a liquid membrane. Since the dehumidification membrane needs to have the characteristics of selective permeability, the dehumidification membrane usually adopts a hydrophilic membrane. Although in practical applications, the driving force of membrane dehumidification is mainly the pressure difference and temperature difference, the general dehumidification efficiency is not high, and it is not suitable for places with high air humidity requirements. However, membrane dehumidification basically meets the humidity requirements of general industrial production and living environments, and the amount of dehumidification is relatively large, so membrane dehumidification has broad application prospects.

1.2 Composition of household dehumidifier

At present, most of the household dehumidifiers sold on the market are mainly refrigerated dehumidification. Such household dehumidifiers include filters, refrigerants, compressors, condensers, evaporators, and other auxiliary equipment. The filter is used to remove dust and impurities in the air. Generally, non-woven filter material or polypropylene ultra-fine fiber filter material is used. When selecting a filter, it should be configured according to the performance requirements of different occasions, mainly from filtration efficiency and filtration Consider the speed, resistance and dust holding capacity. Refrigerant is the carrier of heat in the refrigeration cycle. It absorbs heat in the evaporator to vaporize, releases heat in the condenser to condense, and realizes the energy cycle. It is an indispensable substance in the dehumidifier. The performance evaluation of refrigerants is mainly considered from several aspects such as ozone depletion potential (ODP), global warming potential (GWP), and coefficient of performance (COP) under ideal cycle conditions. When selecting a compressor, it is usually considered from the unit specifications and performance, the impact on the surrounding environment, and operation and maintenance. Commonly used compressors are divided into piston compressors, screw compressors, centrifugal compressors and lithium bromide absorption types. compressor. The condenser is used to cool the superheated high temperature and high pressure refrigerant gas into saturated liquid or supercooled liquid. According to the medium that absorbs heat, it is divided into air-cooled condenser, water-cooled condenser and evaporative condenser. The cooler used in the dehumidifier is an air-cooled cooler. The advantage of this type of cooler is that the heat is taken away by the air and does not require cooling water. The air-cooled type is due to the use of a fan, and the dehumidifier needs to maintain a small volume and convenient Mobile, so power consumption and noise are relatively large. The evaporator is a very important equipment in the refrigeration cycle of the dehumidifier. The liquid refrigerant in the evaporator absorbs heat and vaporizes, which makes the evaporator have a higher heat transfer coefficient and a smaller volume. The evaporator and condenser are similar in structure, and both are finned heat

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exchangers. The fin type evaporator is divided into flat type, louver type, corrugated type, punched sheet and other forms. Straight fins are simple in structure, in terms of manufacturing, and have good durability, high heat transfer performance, and low resistance, so they are currently widely used.

2 Exploration of the appearance design of household dehumidifiers

With the prosperity and development of the commodity economy, the success of commodity packaging not only lies in the ability to display and expand the basic commodity characteristics and uses, but also to infect people emotionally. In order to attract consumers, designers must systematically master the basic knowledge of patterns and colors, starting from the positioning of goods and market demand, thinking about the psychological impact of colors on consumers from multiple angles, and striving to achieve the form and content of patterns and colors. Unification means that the basic characteristics and information of the product must be accurately transmitted, and it must also surprise consumers in a new form, enhance their desire to buy, and achieve the functional effects of protecting and beautifying products and transmitting product information.

2.1 Early conceptual design plan

At present, the appearance of mainstream brands of dehumidifiers on the market is shown in Figure 1. In the early conceptual design stage, a series of tentative explorations have been carried out based on the appearance design of dehumidifiers on the market, with divergent thinking to obtain diversity, Changeable design concept.

2.2 Conceptual design of dehumidifier

In the conceptual design stage of the dehumidifier, an tentative exploration was carried out based on the design inspiration of the current dehumidifier and related electrical appliances, combined with divergent thinking to obtain diverse and changeable design concepts, and conceived different modeling directions.

As shown in Figure 2, the dehumidifier of conceptual design 1, the entire product image is like clothes blown up by the wind, conveying a sense of comfort to users; the dehumidifier is designed with a simple and clean design technique, simple and atmospheric. The top of the dehumidifier is equipped with high-end touch buttons and a hidden display to enhance the user's control experience. As shown in Figure 3, in the dehumidifier of conceptual design 2, the product has the air inlet hidden inside, which makes the image of the front and back of the product achieve a perfect sense of unity; when designing the

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dehumidifier, the front image of the colored part is like a waterfall moving. Straight down, so as to give the user a good visual impact, the high-end touch buttons set on the top enhance the user's control experience. As shown in Figure 4, the dehumidifier of conceptual design three, the entire product can be integrated with other household appliances in the room with a calm image and a sense of affinity; the design adopts a large area of curved surfaces stacked to form a straight surface, which makes the product The appearance is rigid and flexible, and the LED light on the front of the product can accurately indicate the functional status of the product and improve the visual effect of the overall product. As shown in Figure 5, for the dehumidifier of conceptual design four, the air outlet on the top of the product is inspired by the image of a volcano, and the spray effect radiating from the inside to the outside is used to express the strong dehumidification effect of the product; the surroundings of the product gradually change from soft to strong The rich curved surface changes make the product present a variety of visual effects at different angles. The control panel part of the product adopts touch buttons, and an LED display is arranged on the top to improve the product quality. As shown in Figure 6, the dehumidifier of conceptual design five can move the air outlet of the product up and down, which can visually convey the dehumidification state of the product; the front of the product adopts a metal drawing effect and the LOGO part adopts an inlaid metal strip, which highlights the brand's At the same time, the high-end product sense is improved, and the strong LED lighting effect makes the product have a certain sense of technology.

2.3 Determination of the design plan

Select and optimize the conceptual design plan, and perfect the shape, details and structure. The appearance of the product is the first element to attract users. Therefore, spend time on the choice of appearance design to investigate, and at the same time, it is necessary to consider the three-dimensional and specific relationship between appearance and internal structure. Finally, the appearance design of the dehumidifier is as follows As shown in Figure 7 to Figure 10, the dehumidifier designed by this design is like clothes blown up by the wind. The top is equipped with high-end touch buttons and a hidden display screen. The bottom is equipped with a roller that facilitates the movement of the dehumidifier. In addition to portability and ease of operation, the overall simplicity of the product, simple and clean design, has a high popularity.

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3 Attached drawings

Figure 1: Schematic diagram of the appearance of mainstream brand dehumidifiers

Figure 2: Conceptual Design One

Figure 3: Conceptual design two

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Figure 4: Conceptual design three

Figure 5: Concept design four

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Figure 6: Concept Design Five

Figure 7: Design 1 of dehumidifier

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Figure 8: Dehumidifier appearance design two

Figure 9: Dehumidifier appearance design three

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Figure 10: Design four of the dehumidifier

4 Conclusion

The appearance design of the dehumidifier will continue to change with the changes of the times. From the actual design and application point of view, the appearance design of the dehumidifier should be continuously adjusted according to the needs of consumers, and innovative. The market is the only criterion for testing the success of the design of dehumidifiers. The hot-selling dehumidifiers must have achieved perfect unity in the comprehensive integration process of shape design and function use. It is foreseeable that in the future development of dehumidifiers, consumers' aesthetic psychology will become the key to the design of the appearance of dehumidifiers.

With the integration of cloud computing, big data and Internet services and other technologies, the design of dehumidifiers will also tend to be intelligent, diversified and personalized. Through the investigation and analysis of the relevant conditions of the dehumidifier, the model, structure, color and material of the dehumidifier are experimentally explored to allow users to operate more flexibly, and to improve the convenience of users as the main design goal to meet the psychological needs of users , To bring a good sense of use to users.

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