Analysis the Development and Market Prospect of Multifunctional Face Mask

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Abstract: Air pollution is becoming more and more serious, which leads to the rapid development of the protection market. In China, a large number of industrial masks are filled with civilian sales channels, but most of them cannot meet people's needs. With demand and a market, there is now a huge untapped market for multifunctional dust masks. This paper briefly discusses the current situation of air pollution in China, mainly describes the design of smart masks, and analyzes the market prospect of smart masks.

1 Introduction

With the development of industry, air pollution is becoming increasingly serious. Although air quality has improved in recent years, there are still a lot of harmful substances in the air. In addition, people's awareness of environmental protection and health preservation is becoming stronger. There is a growing demand for professional multi-functional dust masks in the market. And now in the market more masks supplemented, respiratory disease experts, the Chinese academy of engineering academician Zhong an interview with reporters said that although the ordinary surgical masks only can prevent the PM10, N92, N95 respirator can stop PM2.5, but the latter is good in sealing, easy to result from a lack of oxygen to the body, which feature, so wear time cannot too long, dustproof function is not perfect, more lack of multi-functional intelligent masks.

2 Multifunctional Dust Mask Introduction

2.1. Dust Mask Structure

This dust mask consists of fixed belt, nose clip, mask and other parts. In order to have a better wearing effect, dust mask will have a breathing valve. The fastening belt is two long belts that pass through the clamps on both sides of the mask. Usually, the elastic rubber belt or elastic belt can be used to fix the mask on the face. The nose clip is placed in the center of the upper part of the mask. It is usually placed on the outside of the mask. It is made of metal-plastic complex, which is both plastic and strong enough to be easily sealed between the mask and nose. The exhalation valve is a check valve on the mask. Only exhaled air is allowed to exit the mask through it. When inhaling, the valve closes to filter air. The goal is to make it easier for the user to breathe. The mask of dust mask should ensure that there is enough three-dimensional space between the mask and the nose and mouth to provide enough oxygen for the user to prevent hypoxia. In order to make the edge of the mask close to the face, some masks also use elastic easy to fit material (generally elastic knitted fabric composite material) to form a ring of tight edge. Under the action of the mask headband, a certain amount of pressure will be generated between the mask and the face. The excellent deformation of the elastic envelop gives the edge of the mask a certain degree of plasticity, which can make the whole mask form a perfect covering of the face in all parts, and effectively improve the sealing performance of the whole edge of the mask. The mask of dust mask is composed of special filter material, which is the main part of dust mask. This part determines the protective properties of the mask .When filtering the air, the "gradient filtration" method is adopted, in which the outermost layer filters out the coarse dust particles, while the inner layer of the mask filters out the fine dust, until finally the vast majority of dust particles of various sizes are filtered out. This

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design is beneficial to give full play to the filtration function of each layer, ensuring the filtration efficiency and the maximum dust capacity at the same time.

2.2. Filter Material for Smart Mask

With the development of synthetic ultrafine fibers and nonwovens, the improvement of raw materials and the improvement of electrostatic technology, synthetic fiber nonwovens have been widely used in filter materials of dust masks and have replaced traditional woven and knitted materials. Its features are: the complex three-dimensional structure, especially made of superfine fiber nonwovens, small pores between fibers and uniform distribution, the total porosity is high, the fiber specific surface area is big, therefore with the environmental air contact area is large, high risk of contact with the air flow of dust particles, at the same time filtering resistance is small, high dust content. The internal structure of the filter material of nonwovens can enhance the dispersion effect of the fluid, so that the dust particles to be filtered have more chances to collide with the single fiber and be captured, so it has higher filtration efficiency. It can increase the flow speed of fluid and speed up the filtration process. Nonwovens filter materials have the advantages of short production process, high output, low cost, easy to compound with other filter materials and easy to make holes, folding, molding and other deep processing in the production process.

2.3. Nonwovens Processing Technology

There are many processing methods of nonwovens, such as wet method, chemical bonding method, needling method, spun-bonding method, thermal bonding method and melt blasting method, which are almost all applicable to the production of filtration materials. As for the filtration performance of the material, the filtration efficiency increases with the decrease of fiber diameter. This is because the finer the fiber is, the larger the specific surface area of the filter material is, and the better the adsorption effect is. At the same time, the finer the diameter of the fiber, the smaller the diameter of the average fiber mesh formed, the better the blocking effect on the particles, so the dust mask filter material is basically made of ultrafine fiber. The microspores inside the nonwovens are small and many, and the fiber aggregates play a strong role in trapping and retarding the particles, thus achieving a higher filtration efficiency. Therefore, the filter layer, which is the core component of the dust mask, is usually made of melt blown nonwovens. The filter material of mask mostly uses polypropylene as raw material. This is because polypropylene has a series of characteristics, is very suitable for dust mask filter material. First of all, polypropylene fiber has the advantages of abundant raw materials, low production cost, light weight, high strength, good wear resistance and elastic recovery, good hot-melt performance, excellent ultrasonic welding performance and low price. It has been widely used in the production of melt-blown nonwovens. Secondly, polypropylene also has the advantages of stable chemical performance, its fiber material moisture absorption rate is zero, the production of melt-blown nonwovens with acid and alkali resistance, resistance to organic chemical solvents, resistance to moth, resistance to mildew and non-toxic characteristics, very suitable for a variety of different conditions under the operating environment. Polypropylene fiber is also very suitable for high pressure electret treatment, after the improved process treatment can have a long effect of static electricity, can greatly improve the air filtration efficiency of filter material. Finally, as the structure of polypropylene melt-blown nonwovens is formed by thermal bonding of polypropylene fiber itself, most of its subsequent processing also adopts ultrasonic welding process, and few other chemical agents are used in the production process, which is less polluting to the environment and belongs to environment-friendly products. The above factors lay the incomparable advantages of polypropylene melt blown nonwovens in the field of filtration materials. As the filter material of dust mask, melt-blown nonwovens also have their own performance defects, such as low structural strength and poor wear resistance. In practical application, the strength of the mask cannot be maintained only by the filter layer of melt-blown nonwovens. Therefore, other materials should be used to reinforce the mask. The face mask is usually made by the combination of melt - blown nonwovens and spunbonded nonwovens. Spunbonded nonwovens have the advantages of high strength, good wear resistance and so on.

2.4. Future Development Direction of Dust Mask

With the development of material science and processing technology, the development of dust masks in the future has the following directions: nano-microfibers with a diameter of less than 100nm have entered the stage of industrial application. The fiber can be used to make filter materials with smaller pore diameter and higher porosity. The fiber has a larger specific surface area than ordinary ultrafine fiber, so it can block dust particles and aerosols with smaller particle size and achieve extremely high filtration efficiency. In the future, the design of mask shape will be more humanized, aestheticized and practical, more in line with ergonomics principles, so as to enhance the wearing comfort. Breathing valve is an important part to improve the wearing comfort of mask. The exhalation valve of the dust mask of the future will be made of high-performance engineering plastics and synthetic rubber diaphragm. Diaphragm of the mechanical performance is excellent, more sensitive to mask the pressure difference between the inside and outside, in a very small torque under the action of opening and closing action can be realized, so that it is easier to discharge the gas exhaled, makes the environment always keep fresh air inside the mask, and itself can experience of tens of thousands of times bending deformation of diaphragm is still maintain the basic mechanical properties have no obvious change. The processing precision of the valve body can reach a high degree, when the breathing valve is closed diaphragm and valve body to achieve a high degree of tightness, to prevent leakage when breathing in. Both valve body and diaphragm have excellent resistance to chemical erosion, high and low temperature, aging resistance, can adapt to a variety of different operating environment.

3 The Development Trend

At present, the number of mask industry brands in China is large, and there are few influential mask brand enterprises. Industry brand market share is low, the first three brand share of less than 20.Major domestic enterprises and brands: leading shares (three guns, conch) tianjin teda (teda), Shanghai meike non-woven products co., LTD. (yi shu, ji ke, gang kai) dongguan rongxin anti-static technology co., LTD. (rongxin), etc. Today, and in the global environment worsening, places in the world, in many cases have repeatedly haze weather, serious harm people's health, in such an environment, to develop a lightweight, breathable, and has good anti dust and smog masks becomes necessary, from the data mask big brands have not occupy the market, the market is now entirely in an unsaturated state, into the mask market at the moment there will be a very big development space and development prospects.四、Conclusion

This article mainly expounds the structure of the multifunctional masks, the material, the development direction, analyses the market prospect, and made a simple marketing strategy, to a large extent, to solve the serious environmental pollution in modern times and the problem that the damage to human respiratory tract, and now just lack of this kind of performance and excellent masks, so wide prospect of market, quickly set up the brand, it is important to keep ahead. The article also briefly describes the marketing method of multifunctional mask, which is helpful to establish a larger brand emerging industry.

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References

[1] Zhu Hua. Discussion on dust mask structure/material and processing technology. Science and technology of safe production in China.2013

[2] Mask report _report on the operation situation and development trend of China's mask market from 2014 to 2019 _ China industry information network

[3] Zhu Hua. What do you know about dust masks. Modern occupational safety.2013

[4] Xin Ying, Yang xuefu, geng yanfei, cui zhenjie. Development and application of non-metallic materials for vehicles. Heavy vehicles.2003

[5] Study on structural properties of melt-spun PBT porous fiber. Beijing institute of fashion technology.2015

[6] Sun Ji. Study on damage mechanical properties of hybrid polypropylene fiber concrete. Chongqing university.2013