

Aimed at the Indoor Air Pollution: Air Guard

Siyu Yu

Electrical and Electronic Engineering Department, North China Electric Power University, China

winccey@163.com

Keywords: Air pollution; Formaldehyde; Indoor decoration; Door to door service; Photo catalyst

Abstract. At the same time of China's fast growing, the phenomenon of the air pollution has gradually become a serious social problem, which has aroused a great concern. And at the same time, the indoor air pollution is much more severe than the outdoor air pollution. Photo catalyst is a catalyst, which breaks down pollutants into eco-friendly substances, without any loss itself. According to the related data, various kinds of similar products in the market have many drawbacks. Based on reasons above, the product is aimed at developing the improved version of photo catalyst and dealing with the indoor air pollution.

Product Origins

Environmental protection is always the hottest topic in home improvement industry. Relevant data of the world health organization show that the indoor environment pollution is the cause of 2.8 million people's deaths each year in the world. [1] According to the data collected by Association of Chinese Interior Decoration Environmental Testing Center, the danger of the indoor air pollution is 2-3 times that of the outdoor air pollution. In addition, it is also reported that 90% of the newly furnished houses and furniture are detected to have exceeded the standard of formaldehyde content. [2] What's more, in China, the annual death toll caused by indoor air pollution has reached up to 111 thousand, which means that approximately 304 people are killed each day on average. [3] At the same time, decoration industry becomes more and more popular and develops with a rapid speed. In 2014, the gross product of house interior decorations in China has reached up to 1.5 trillion, increased by 10.2%. [4]

Five main materials of the indoor air pollution are formaldehyde, benzene, ammonia, TVOC and radon. [5] Among them, formaldehyde is the most common pollutant. Long-term exposure to low doses of formaldehyde has a better probability to cause chronic respiratory disease, nasopharyngeal carcinoma, colon cancer, brain cancer, leukemia, the decline of memory and intelligence and so on. [6]

On the one hand, the condition of the indoor air pollution is terrible and the toxic substances in the indoor air are dangerous. As the outdoor air pollution has aroused so many attentions, there is a tendency of solving the indoor air pollution problem. On the other hand, at the same time of the increase of people's life, decoration industry becomes more and more popular and develops with a rapid speed.

Driven by the sense of social responsibility to solve the social issues, here comes the product-Air Guard. Based on the basis of good appearance and impressive effect, the product aims at solving the indoor air pollution problem.

Development of the Product

Investigation Phase. There are various kinds of similar products in the market, which can be divided into two types: traditional ones and mechanical ones. The traditional type mainly includes the plant absorption ones and the activated carbon absorption ones. And the mechanical type is the air purifier. [7]

According to the related data, we found that the traditional ones like the plant absorption and the activated carbon absorption ones have some drawbacks, such as: long time before coming into

effect, existing the limit of effect because of saturation, small range of processing, halfway of eliminating and so on. [8]

As for air purifier, it costs electricity and makes noisy.

Through investigation and research, we found that though photo catalyst is really effective in solving indoor air pollution problem. However, in China, the market of photo catalyst started only several years ago and the industry remains new. At the same time, as the lack of necessary regulations and laws, the market seems to be in a condition of disorder.

In other words, the product has broad prospects.

Photo Catalyst. The photo catalyst is a catalyst, which breaks down various organic pollutants into eco-friendly substances like water and carbon dioxide under the stimulation of light, without any loss itself. It's obviously an ideal way to terminate air pollution.

As for the effects on cleaning the indoor air, the capacity of photo catalyst to clean the indoor air is 150 times that of the activated carbon. Comparing the same amount of photo catalyst and activated carbon refrigerator deodorant, the photo catalyst equals 500 activated carbon refrigerator deodorants.

Also, compared with the air purifier, photo catalyst is non-stop, pollution-free, energy-free, and noise-free.

Based on the reasons above, combining with relevant data, the product chose the photo catalyst as the product object.

Development Phase. In combination with the group members' professional majoring background, the product got the opportunity to get the help of school's lab, and started to develop the photo catalyst to solve the indoor air pollution problem independently.

After a year's research and work, the product finally developed the advanced version of photo catalyst.

By our creativity, we combined good appearance with function, pushing out series of products including photo catalytic artificial flowers and furniture.

Aiming to the increasingly serious in-car air pollution, we upgrade the product into the formaldehyde treating agent and photo catalyst hanging drop. At present, this advanced photo catalyst has gained three patents granted by the National Patent Bureau and one patent of usability and novelty.

Product Objectives

Now, compared with the primary ones, several characteristics of the advanced photo catalyst are as follows:

1. More realizable.

The advanced version of the product is able to take the catalyzing effect in ordinary visible lights under room temperature, while the primary ones cannot decompose effectively even under ultraviolet.

2. More lasting.

The primary ones cannot last for long time and are easier to rebound the effect, but the advanced version of the product can exist on the surfaces of other substances for a long time after the first exertion.

3. More effective.

According to the statistics, the advanced version of the product works 30% more effectively in decomposing formaldehyde.

4. More secure.

In the photo catalyst market, many normal photo catalyst products are not eco-friendly. The advanced version of the product does not contain substances like additives, which may generate critically secondary pollution. After the US Food and Drug Board of Food Testing research, the main ingredient of the product is safe and harmless.

Product Service

Meanwhile, the product service mainly concentrates on room formaldehyde elimination.

Product Service. The processes of the product service are as follows:

1. Customers' appointment.
2. Door-to-Door Detection.
3. Provide treatment method.
4. Sign a contract.
5. Door-to-Door formaldehyde elimination according to the scheme.
6. Finish the elimination and detect, set up the files.
7. Provide the after-sale service

Product Using Process. The processes of using the product are as follow:

1. Detection
Before using the product, workers will use detectors to test formaldehyde content in these rooms, and then record the content figures
2. Cleaning
Clean the room and make sure there's no dust in it.
3. Spraying
Use specific instruments to spray photo catalyst materials on walls and furniture. There will be a membrane covered on its surface. And this membrane will keep decomposing formaldehyde automatically under light.
4. Close
The room will be closed for 24 hours after spraying the photo catalyst.
5. Irradiation
After 24 hours' catalyzing effect, let the room be illuminated thoroughly.

Product Statistics

In June 2013, the product group came to a community near a university, seeking for possibilities of cooperation. With school's guarantee the quality of the product and the certification of the product's patents, we reached an agreement with a property company for cooperation and tested our photo catalyst product in the community.

After detecting the content of formaldehyde of the community's newly furnished houses, the product group took ten polluted seriously families as testing samples.

Before using our products, compared with the national standard was 0.08, the formaldehyde content point was at most 4.8 with an average point of 2.4. After a week's purification, all of those families are under the national standard. We then took detection every two weeks for half a year. The formaldehyde content eventually reached a stable status of 0.06.

The experiment proved that the advanced version of the product is able to solve the indoor air pollution problem effectively.

Conclusion

Based on delightful result of the formal trail, we started the product promotion and looked for cooperation communities.

During the product service process, we took the low-income people around us into consideration. As a result of their previous factories closing down, these laid-off workers with low level of education could not find stable jobs. They could only find part time jobs in the construction site to make a living. And their salary is less than 2000yuan, which can't meet the consumption demand in Beijing.

Then, we decided to recruit five laid-off workers and taught them the necessary knowledge for further professional work. After the training, the five workers have mastered the basic skills. In that way, they could expand related business by themselves.

In April 2014, two of the five workers came to a community, providing formaldehyde elimination service for four families. In that month, they eliminated formaldehyde about 2784mg effectively and achieved the sale money for more than 32,000RMB. And at the same time, they make a profit for nearly 4,000yuan. This service lasted for nine days and everyone's average income equaled the previous income in one month.

After the product group's discussion, we formulate a complete model of the workers employment——professional training——managing service independently industry chain. That is to say, after those workers' mastering the specific skills, they could communicate with the customers by themselves and get the earnings apart from the cost we collect for equipment and products.

So far, the processing area reached up to 3,000 square meters. The product has eliminated about 6800mg formaldehyde and made a profit of more than 136,000yuan. The contract of intention was 200,000yuan and the product created income of 17,000yuan for each worker. Meanwhile, those workers also communicated with customers by themselves and completed 32 more orders and made 14920yuan per person.

In order to make more residents benefit from the product, we introduced a radiation pattern, which means setting up work station rely on communities as reservation station for counseling and free testing to make more residents understand their indoor environmental condition and deal with it.

Reference

- [1] <http://jiankang.163.com/15/0313/16/AKJOR2790038002T.html>
- [2] <http://www.haokoo.com/else/3533371.html>
- [3] <http://news.163.com/12/0510/03/81458R7T00014AED.html>
- [4] <http://www.cbda.cn/html/yj/20150306/53633.html>
- [5] http://news.ifeng.com/gundong/detail_2011_07/13/7665204_0.shtml
- [6] X.K. Shi and M.H. Lin: The harm of formaldehyde on human body and remove method [J]. *Modern Women*, Vol.2 (2014) No.1, p.16.
- [7] <https://m.douban.com/note/286909736/>
- [8] X.M. Chen, Z.J. Liu, H. Zhen, H.L. Chen and S.B. Wang: Indoor air purification methods and research progress [J]. *Light Industry Science and Technology*, Vol.4 (2014) No.4, p.62-63.