Research Article

Evaluation of Sustainable Environment-Friendly Interior Decoration Design from the Perspective of Low-Carbon Economy

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With the rapid development of economic and social productivity, the living standards of our people have been continuously improved. As human society enters industrialization and urbanization, in order to meet the increasing needs of life, people have higher and higher requirements for the environmental quality of their lives. People spend nearly 90% of their time indoors. Therefore, the environmental quality of indoor spaces has become an issue that cannot be ignored. The interior space environment of the building is closely related to everyone’s life. However, when people decorate their rooms luxuriously and warmly, the subsequent interior decoration sequelae are also seriously affecting people’s health. The pollution caused by indoor decoration is serious, whether it is the use of decoration materials or improper indoor design that will cause indoor air pollution. Based on building materials and interior design, this paper systematically analyzes the pollutants in the fully decorated interior space and proposes that from the perspective of low-carbon economy, interior space design should be based on the ecological environment, and the focus of the design is on the rational use of nature. Resources and decoration methods should start from the application of natural colors and natural materials and organically combine green materials and green decoration designs to create a more comfortable, healthy, safe, and environmentally friendly indoor space environment.

1. Introduction

People have become more and more aware of the importance of improving the quality of the living environment of human settlements. In order to meet the ever-increasing needs of life, they have also proposed higher quality of life requirements [1]. Because the indoor space environment is closely related to everyone’s healthy life, people spend most of their time indoors, so the indoor space environment is particularly important. With the continuous improvement of people’s material and spiritual requirements, people’s aesthetic awareness about the quality of the ecological environment of the indoor space has a higher pursuit [2, 3]. Low-carbon economy is based on low energy consumption, low emissions, and low pollution. Low carbon means energy saving, and a low-carbon economy is an economy based on low energy consumption and low pollution. Since the beginning of the twentieth century, China’s economy has developed rapidly, and the living standards of Chinese people have been improving day by day. It is very common to buy a house, to renovate, and even to renovate. As a result, China’s interior decoration industry has been undergoing rapid development. However, in a populous China, it is urgent to improve the ecological environment caused by interior decoration [4, 5].

In building materials, clay bricks, lime, cement, and surface bricks all contain trace amounts of “radon” elements. Radon easily enters the human lungs with human breathing, harming the human respiratory organs and causing respiratory diseases. Building materials containing radon can cause radioactive damage to the human body indoors, causing the human body to become cancerous [6]. Among the decoration materials, artificial wood panels, wallpaper, paint, carpet glue, adhesives, etc., will release formaldehyde,
benzene, and total volatile substances. Nowadays, composite wood floors and PVC wood floors in indoor space decoration use powders containing formaldehyde. These harmful substances continue to volatilize indoors. If the air circulation in the indoor space is not smooth, the concentration of formaldehyde will continue to increase [7–9]. Benzene is often present in paints and coatings. Benzene is extremely harmful to the human body. When the benzene in the indoor air exceeds 2.4 mg/m³, the human body may have headaches, chest tightness, nausea, and vomiting symptom in a short period of time. Therefore, the harmful pollution caused by indoor space decoration has become a problem that cannot be ignored [10].

50% of the harmful substances that cause global warming are generated during the construction and use of buildings, and China only generates 40 million tons of construction waste every year [11]. Decoration has become a necessary process before the house is used, and every 5–7 years is a renewal cycle. Generally, 0.3–0.4 cubic meters of garbage will be generated per square meter of building area during the decoration process. Nowadays, the quality of decoration in China is improving year by year, and the materials are becoming more and more complex. The construction waste generated by house decoration is difficult to estimate, and its amount has accounted for 30%–40% of the total urban waste [12].

The development direction of China’s interior decoration industry plays a vital role in the deterioration and relaxation of the natural environment caused by interior decoration and affects the health of every Chinese [13]. We need to plan new directions for the development of the industry in terms of technology, systems, and development concepts by improving energy efficiency and using newer environmentally friendly energy materials. It is an inevitable choice to realize the sustainable development of interior decoration industry in China to create healthy, comfortable, and beautiful room environment while reducing resource consumption [14–17]. This article attempts to seek a low-carbon and sustainable development direction, evaluates the environmental pollution of existing decorations, and proposes corresponding sustainable development countermeasures.

2. Materials and Methods

2.1. Research Object. This article selects a newly renovated house in Xi’an as a case study. Xi’an City, Shaanxi Province, is located in the Guanzhong Basin in the middle of the Yellow River Basin, with an area of 9983 km². It has the Qinling Mountains, an important geographical boundary between the north and the south in China, in the south, and the Loess Plateau in the north. The difference in altitude in the territory is the highest among cities in the country, and the west is open and flat. The narrow and unique topography in the southeast gives Xi’an unique characteristics of air pollution. The primary air pollutant in Xi’an has always been inhalable particulate matter (PM10), and its annual average concentration still exceeds the level 2 standard. The frequent occurrence of sand and dust weather in spring largely determines the concentration of PM10, which also seriously affects the air quality in Xi’an.

The environment of the test community is well planned, the transportation in the residential area is convenient, and the greening is in place. It has a good purification effect on harmful substances in the outdoor air and has become a safety barrier for the residential environment. Through the air detection data of the actual case indoor space, combined with the theories of indoor green decoration materials and green art design, comprehensive research and discussion of the environmental problems brought by materials and design in indoor space design are carried out [18].

2.2. Research Method

2.2.1. Questionnaire. This questionnaire survey mainly includes the following contents: (1) the respondents’ awareness and attitude towards indoor pollution. Through this survey, it is possible to understand the household’s degree of concern about indoor pollution and improve the awareness of indoor pollution. Respondents’ understanding of indoor decoration pollution problems and their attitudes can help everyone raise awareness. (2) The subjective feelings of the respondents in the indoor space, through whether they have an abnormal sense of smell and vision to understand the quality of indoor air. (3) Learn more about the interior decoration materials of the respondents. By understanding the interior decoration style and the selection of decorative materials, the situation of harmful substances contained in the indoor space is analyzed. The decoration of the residence of the respondent is used to determine the households to be tested. (4) Whether they are willing to accept testing and other content. Those who are willing to accept the test will leave their contact information for subsequent testing [19, 20].

2.2.2. Testing on the Spot. A household in Xi’an was used as the inspection object, the living room area in the test site is less than 50 square meters, and the shape is rectangular. The real-time tracking inspection of home decoration was carried out from March to July 2014.

(1) We close the doors and windows before the measurement. Generally, the doors and windows should be closed for 2 hours before the test. We keep the doors and windows closed during the test and try to avoid opening the windows.

(2) The number of pilots in the test depends on the area of the room. In order to achieve the most accurate detection results, it is recommended to set up 13 test points in an indoor space less than 50 square meters. Since the living room area in the test site is less than 50 square meters, we chose a test site that can avoid vents, and the distance from the wall is greater than 0.5 m.

(3) A air quality detector is used to test, and after the instrument is switched on, we set the test time to 60 minutes. This family prefers the European classical
The indoor floor is decorated with floor tiles. The bedroom wall is decorated with wallpaper. The kitchen and bathroom are decorated with ceramic tiles. The furniture is solid wood furniture. The top surface is plastered and painted in white. The plaster is decorated in a European style.

In this test, the indoor air quality test was conducted one week after the interior decoration, and some furniture was in place. The main harmful substances tested were formaldehyde, benzene series, total volatile organic compounds, radon, sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, inhalable particles, temperature, relative humidity, and air velocity. During the test, the occupants are prompted to close the doors and windows twelve hours before entering the room, and the room is kept closed [21].

3. Results

3.1. Analysis of Questionnaire Results. A total of 200 questionnaires were distributed in a community in Xi’an. Among the 150 questionnaires recovered, nearly 75% of the residents did not know about the air pollution in indoor spaces, and only a few residents were aware of the air pollution in indoor spaces. This survey reflects the necessity and importance of green interior design. At the same time, the investigators expressed their willingness to accept the popularization of knowledge about indoor air quality purification, indicating that most people still have higher requirements for indoor air quality.

3.2. Analysis of Test Results

3.2.1. Unrenovated House Test. The indoor space inspection data in Tables 1 and 2 are carried out under a standardized air inspection system. Before the indoor air quality inspection, the inspected users are required to close all doors and windows indoors for more than 10 hours, and all indoor spaces are enclosed spaces. In an indoor space where there is basically no ventilation, the newly decorated indoor air will contain a lot of harmful substances. The concentration of these harmful substances is relatively large, and the total volatile organic compounds and formaldehyde in the indoor air will pass through the decoration materials. Due to the closeness of doors and windows, the airflow value is basically zero, so harmful substances are not easy to be discharged. In this way, the monthly data of real-time detection are sorted to obtain the base data of VOCs and inhalable particles.

3.2.2. Indoor Space Inspection Data after Decoration. Through the real-time tracking and detection of the decoration of the detection case from March to July, the value of the indoor air harmful substances in the different stages of the decoration process of the case (Table 3) is recorded, and the impact on indoor harmful substances due to the indoor space design is further analyzed according to the data changes at the different stages of the full decoration of the indoor space. Data from April show that when the indoor temperature rises slightly, interior decoration materials enter gypsum board and cement sand. As a result, the value of indoor inhalable particulate matter has increased significantly. By the end of interior decoration the period, the pollution value of indoor inhalable particles has been controlled, and the later decorative materials such as wallpaper, wallpaper adhesive, and wall tiles still contain a large number of harmful substances. Therefore, the value of VOCs in the indoor air detection data has increased significantly.

It can be seen from the above test report that the values of pollutants in different stages of interior decoration are constantly changing, and the values of various pollutants in undecorated rough houses are low. During the renovation process from the end of March to the beginning of July, the extensive use of decorative materials has significantly increased the number of indoor harmful substances. From the analysis of the changes in the value of formaldehyde, it can be seen that when indoor wallpaper and wallpaper glue were entered in March, the indoor formaldehyde data increased.
by 0.23 mg/m³ compared with April. It can be seen that the pollution caused by decorative materials in interior decoration cannot be ignored.

3.3. Interior Design Strategy

3.3.1. Design Oriented. The design plan of interior decoration is the most important link in determining the energy consumption and pollution degree of interior decoration, and the designer plays a pivotal role in it. The interior designer should follow the principle of low energy consumption and less pollution as much as possible in the whole process of the scheme design and timely grasp the information of the latest environmental protection materials and design methods to create a safe, comfortable, and ecological indoor space environment.

Nowadays, many interior space designs blindly pursue luxury and complexity. Too much design will increase resource energy consumption and environmental pollution. Designers are obliged to persuade some owners to switch from cumbersome and complicated decorations to simple and bright design styles and promote sustainable interior decoration design schemes.

Creating an ecological interior decoration design scheme requires interior designers to gradually change the concept of traditional interior design by combining new ecological environmental protection technologies and exploring new ecological design styles that conform to the spirit of environmental protection through design techniques under the premise of low energy consumption and pollution. For example, we can moderately regulate the scale of space and furniture. The design plan makes full use of the original building space pattern, ventilation, daylighting, and other basic conditions, reforms to make up for the deficiencies of the original state, and creates a pleasant indoor environment. We can emphasize decoration—light decoration—strictly controls indoor building materials. The number of furniture and installations, and the use of soft decorations to reflect the atmosphere of the space, is also convenient for future renovations, minimizing the toxic and harmful gases and radioactive pollution of the indoor environment. The design plan should improve the efficiency of natural ventilation and reasonably control the comfort of indoor sound, light, and heat. Plants are indispensable and decorative necessities in modern cities and modern indoor spaces. In addition, plants are also a good helper for purifying indoor air. Through many cases of modern interior decoration, it is not difficult to find that many interior designers have begun to introduce many plants in the design of interior space for space decoration. Common plants are green pineapple, chlorophytum, white palm, aloe and so on. This method not only has a good effect on creating a small indoor environment but also can create a kind of natural atmosphere (Figure 1).

3.3.2. Material Selection. In the selection of materials, in addition to the above-mentioned control of the amount of use and avoid unnecessary waste of resources, the selection of decorative materials that are beneficial to human health and environmental protection is also a very critical issue (Figure 2). Nowadays, some artificial synthetic materials containing a lot of harmful substances are widely used in interior decoration, which has a serious impact on the indoor environment and human health. When some of these nonrenewable materials are discarded due to secondary decoration and demolition, they will also cause outdoor pollution to the environment. Therefore, controlling the quantity of materials and choosing safe and environmentally friendly decorative materials to reduce environmental pollution are the direct conditions for achieving an ecological indoor environment.

In addition, the use of renewable decorative materials is also very important. For example, bamboo is a fast-growing natural material. We can process bamboo flooring. Bamboo can be cut into circles, sheets, silk, and other forms, which can be arranged and combined to create different wall texture effects (Figure 3). We can also use other natural materials. Hydrated lime can adjust the indoor humidity, and the new technology can support the natural slaked lime to support the slaked lime wallpaper. While controlling the number of lighting in the design of lighting facilities, attention should be paid to selecting high-efficiency and energy-saving lamps, electrical accessories, and wiring equipment and adopting hierarchical and zoning control

| Time       | Material condition                        | VOCs (mg/m³) | Formaldehyde (mg/m³) | Respirable particles (PM10) | Temperature (°C) | Humidity (%) | CO (ppm) |
|------------|------------------------------------------|--------------|----------------------|-----------------------------|-----------------|--------------|----------|
| 3.21       | Basic test, unrenovated                  | 0.54         | 0.19                 | 0.95                        | 20.7            | 47.5         | 0.6      |
| 4.08       | 8 sheets of gypsum board, cement sand    | 1.79         | 0.64                 | 3.36                        | 27.3            | 48.7         | 0.8      |
| 4.3        | Wallpaper 72 rolls, base film, glue, glue | 2.56         | 0.87                 | 1.16                        | 26.8            | 45.9         | 0.6      |
| 6.04       | Indoor floor tiles, 5 sets of finished doors, plaster suspended ceilings of 7 square meters, aluminum gusset ceilings of 30 square meters | 4.54 | 1.55 | 0.67 | 28.9 | 55.6 | 0.7 |
| 6.04       | Furniture in place                       | 5.91         | 2.31                 | 0.24                        | 28.8            | 57.5         | 0.9      |
| 6.15       | The decoration is complete               | 5.09         | 1.68                 | 0.32                        | 32.5            | 58.6         | 0.7      |
| 6.30       | Inspection after renovation              | 5.63         | 1.78                 | 0.26                        | 32.9            | 62.6         | 0.7      |
methods to meet the environment and atmosphere while saving energy as much as possible.

3.3.3. Material Recycling. Decoration materials are generally divided into inert materials (such as sand, brick, and concrete) and noninert materials (such as plastic, paper, and wood). The existing decoration waste is usually recycled in the form of inert and noninert mixed materials. Most of the garbage is all disposed of by landfill. The decorative waste materials discarded from indoors are actually relatively easy to convert and can be used as renewable resources to produce new products that can be used. However, decoration waste is not recycled by category, decoration waste cannot be recycled, and energy is not used in a targeted manner, resulting in huge waste. If these waste resources can be recycled and all reusable decoration materials can be reused as much as possible, not only can energy consumption be reduced but also a large amount of decoration waste can be reduced.

In order to reduce environmental pollution caused by decoration waste landfill and reduce the burden of waste disposal costs, residential communities should provide...
appropriate recycling facilities to match the treatment and classification of decoration waste and facilitate the recovery of decoration waste so that it can be recycled into useful resources. In the recycling of decorative waste materials, we must use all possible reuse waste materials, including decorative waste materials, furniture, and electrical parts. Decoration waste includes concrete blocks, wood blocks, wood shavings, lime soil, waste ceramics, and waste hardware. The utilization rate of wood material recycling can reach more than 90%. The waste bamboo and wood chips can be reused to make various man-made boards (Figure 4). Man-made fiberboard mixed with soil can be used as filling material for road base or making new fiberboard. The concrete waste can be used instead of sand for masonry mortar, plastering mortar, and concrete cushion and can also be used to make various outdoor floor tiles and decorative tiles. Metals such as scrap steel bars, scrap iron wires, and various scrap steel accessories can be sorted and concentrated and can be reprocessed into metal products and steel. In this way, a recycling model of decorative raw materials-decorative objects-decorative scraps-recycled decorative materials is realized.

4. Conclusion

(1) Through the environmental assessment after interior decoration, this paper found that under the decoration of different decorative materials, harmful substances in indoor spaces will change, and different decoration styles in indoor spaces will bring different harmful substances. The test results of the house after decoration show that the content of formaldehyde and other harmful substances in the air exceeds the national safety standards, so it is imperative to use sustainable environmental protection interior decoration.

(2) From the perspective of low-carbon economy, this article points out that the design of indoor space is not only in terms of artistic design, but the decoration materials of indoor space are also an important issue in interior design. Unilateral consideration cannot achieve the best indoor effect. If we comprehensively consider both art and materials, we can create a more comfortable and healthy indoor space environment for people.

(3) This article has made a preliminary exploration of the development direction of several links to ensure the sustainable development of the current interior design industry in China. However, it is a long-term project to build a sustainable interior decoration industry system, and it will take time to build a sustainable interior decoration industry system. The progress of the company has been continuously updated and improved.

Data Availability

The figures and tables used to support the findings of this study are included in the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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