WEP Warwick Evans Publishing

International Journal of Materials Science and Technology Studies

ISSN: 3006-7693 (Print), ISSN: 3006-3744 (Online) | Volume 1, Number 1, Year 2024
DOI: https://doi.org/10.62051//ijmsts.v1n1.06
Journal homepage: https://wepub.org/index.php/IJMSTS/index

Application Status and Development of Green Coatings

Qing Ji, Xuejiao Zhang

Chemistry and chemical institute, Jining Normal University, Inner Mongolia, China

ABSTRACT

With the progress of modern society, people's awareness of environmental protection is gradually enhanced, and the problem of environmental protection is also increasingly paid attention to. At present, various green environmental protection coatings have become popular in many countries and regions. Green environmental protection coating as a new, efficient, safe and pollution-free environment-friendly coating, on the premise of sustainable development, through continuous innovation and research and development, can not only protect the natural environment, but also beneficial to human health. The purpose of this paper is to give a brief overview of green coatings, introduce the application status and production development of green coatings, and summarize the possible development trends and prospects of green coatings in the future.

KEYWORDS

Green coating; Volatile organic compounds (VOC); Application status; Production development

1. INTRODUCTION

At present, with the increasing awareness of people's environmental protection, low pollution, pollution-free, no negative impact of the green coating has become the development direction of the global coating. And the green coating with low VOC content will certainly become a development trend in the future. The demand for paint in daily life is great, so paint is indispensable in life. But a large number of use of paint will make the problem of environmental pollution more and more serious, but also have a bad impact on the human body. So "green coating", has become the premise of the 21st century coating industry, and only manufacturers to produce "green paint", to improve the ecological environment, reduce environmental pollution as the innovation, both meet the demand of consumers, also conforms to the green road, can in the future paint market for a long time.

2. OVERVIEW OF THE GREEN PAINT COATING

2.1. Concept of Coating

Paint refers to the film material constructed on the surface layer of the object with various coating processes. Generally composed of chemical complexes in the film of chemical substances (including chemical resin, emulsion), pigment (mainly including the national standard system of special pigments), solvent and other coating additives (including coating additives) and other four main coating basic components directly combined composition.

2.2. The Influence of the Coating on the Human Ecological Environment

Generally speaking, in the traditional paint will contain a variety of VOC, they will release to the surrounding environment to the human body and the environment of harmful gas. The content of

organic solvents will account for more than 40% of the overall quality of solvent-based coatings, so we should add a certain cosolvent to regulate the viscosity of the solution, so that the normal use of subsequent coatings. After construction, the gaseous organic solvent emitted by the paint will fill the air in the room, and from the data point of view, 70% of the time in the long river of human life is indoor, so the traditional paint will cause irreversible damage to human health, but also a serious threat to the whole natural ecological environment[1].

(1) A large number of organic solvent content seriously exceeds the standard, which will undoubtedly bring great harm to our human body. Although the VOC content contained in the current interior decoration paint that has an impact on people's health is far less than the concentration of the maximum environment, but if people live and work indoors for a long time, long-term contact with the environment containing low concentration of VOC, it will also seriously threaten people's health.

(2) Some organic solvents and other organic chemical pollutants in the air environment will be directly converted into a more toxic secondary chemical pollutant under the action of strong sunlight exposure, forming a photochemical smog, which will also cause greater environmental damage to the living environment.

(3) a variety of architectural decoration coatings are also the root of air pollution, a variety of toxic substances contained in the coating will be slowly released in the process of use, not only pollute the environment and damage people's health. Coating plays an important decorative role in the daily life of modern people's home, and plays a great role in our life, but at the same time, it will cause great harm to human beings and the environment. The main reason is that the traditional paint contains a large number of toxic chemicals, such as various heavy metal ions and some negative ions, which are harmful to health. For example, heavy metal ions containing lead, mercury and chromium have great chemical toxicity or carcinogenic effect. Red Dan, zinc chromium yellow and high curic acid and other pigments are one of the basic components of paint, they contain copper, copper can directly inhibit the synthesis of hemoglobin in the human body, reduce the hemoglobin concentration, cause hemolytic anemia, and cause serious damage to the brain, cerebellum and central nervous system; and the synthesis of hemoglobin can cause anemia, damage the nervous system, and is also likely to directly lead to cardiovascular and cerebral vasospasm and brain lesions. Therefore, high quality, easy construction, energy saving and environmentally friendly green coating has become the focus of the coating industry, is the common expected goal of people [2].

2.3. Concept of Green Paint

"Green coating" refers to the use of performance and various safety indicators all meet the national requirements of the environmental marking products. That is, in the production, manufacturing, recycling and treatment of waste and other links of the natural environment without any pollution, beneficial to the maintenance of human normal living environment of environmental health green energy saving environmental protection coating[3].

2.4. Characteristics of Green Paint

Green coating is a kind of high performance environmental protection coating, does not contain toxic solvent completely harmless to our human body. Its basic characteristics can be mainly manifested in the following three points:

2.4.1. Low toxicity

Green environmental protection coating in the human body toxic chemical substance content is very low, basically no chemical toxicity. Because the basic materials directly from our nature, is a kind of inorganic coating. Compared with organic coatings, this point greatly reduces the direct pollution to the natural environment. Water as a considerable part of the green paint dispersion medium, it will not have adverse effects on our body and ecology.

2.4.2. Functionality

The use function of green paint has important links to the use of paint synthetic agents and additives. Such as: nano calcium carbonate, titanium dioxide, zinc oxide, rare earth composite materials, white carbon black, calcined kaolin and other products, for the development of high-tech green environmental protection coatings to provide a solid foundation. In addition, at present the paint market a popular chameleon series of green green paint, make full use of a variety of nano materials with different angles of automatic color unique characteristics, so that the green paint is more popular with the public.

2.4.3. Natural nature

Green environmental protection coating not only has the solvent of filling pigment, but also its adhesion ability, flexibility, waterproof, and resistance to impact, so that the coating film formed is bright and plump, in the design of our decoration coating engineering effect is very good. At the same time, there are no aromatic compounds, heavy metal salts, formaldehyde and other harmful substances in its main ingredients, and the volatility of harmful substances to human body is much lower than the general traditional coatings. In addition, the content index of VOC in green coatings and the national provisions on the overall requirements of the coating industry standards are in line with. Accordingly, indoor and outdoor decoration all can apply green paint.

2.5. Advantages of Green Coating

Compared with traditional paint, green paint has many advantages, Guo Jun et al. made a detailed summary[4]It is mainly reflected in the following aspects:

2.5.1. Small pollution

This is because the key raw materials in the production are mainly derived from the nature, such as: silicate aqueous solution, silica sol, etc. In addition, water, as a dispersed medium of inorganic coating chemical products, will not damage human health and natural environment. Therefore, in the production and processing of the use are conducive to the protection of the environment. At the same time, compared with organic coatings, inorganic green environmental protection coatings also have a strong durability.

2.5.2. Coating safety

Through the author's investigation and research, green environmental protection coating belongs to thermal insulation building materials, namely both the strong cold and hot impact force applied on the wall, the phenomenon such as fracture will not happen easily. In addition, the following aspects also reflect its safety:

(1) It is not directly affected by the changes of weather season and temperature factors;

(2) This kind of coating can make the wall of the energy-saving building have the characteristics of high strength and waterproof;

(3) This kind of coating can make the wall of the high-rise building has a certain "elasticity", such as imitating human human skin one

(4) The sealing of this kind of coating and one-way water seepage protection function is very strong, thus providing a "safe place" for the majority of high-rise residents.

3. THE APPLICATION STATUS OF GREEN COATING

Pollution-free, pollution-free, safe and other as green environmental protection paint label, instead of the traditional paint has been a development trend. The research focus of green coating is mainly related to the "greening" of chemical reaction, raw materials, catalysts, solvents and products. Green,

high performance and strong function are the goal and direction of green coating to develop at present. At present, the experts and scholars of the most studied green environment-friendly coatings can be roughly divided into: water-based coating, powder coating, high solid content coating, radiation curing coating, etc.

3.1. Water-Based Coating

As a new type of coating, its dispersion medium is water, solid and can be called water-based coating. The coating is some of the material evenly dispersed in water. Fundamentally completely eliminate the hidden danger caused by solvent volatilization. It has a wide source of raw materials, easy to absorb and purify and reduce the air pollution. The coating coated in a specific way on the surface of the base paper formed coating film good adaptability, and has non-toxic, no chemical stimulation, non-combustible and other characteristics, is the main development and application direction of "green coating". At present, the common are the following:

3.1.1. Waterborne Epoxy Resin Coating

The paint uses water as a dispersant. It not only has the characteristics of chemical resistance and strong attachment, but also has the advantages of low pollution, low smell and low price. Therefore, it is quickly and widely used and developed to all walks of life, such as: can be used in automotive related coatings, but also can be used in medical equipment, electrical equipment, etc.

3.1.2. Waterborne Polyurethane Coating

Zheng Surong et al. conducted a systematic study on its advantages[5]The coating is a binary colloidal system formed by polyurethane dissolved in water. Because of its environmental protection, non-toxic, safe and reliable, easy to operate and many other advantages, has been widely practical application, especially in the field of industrial equipment and civil facilities for protection and interior decoration application is particularly common.

3.1.3. Water-Based Light-Curing Coating

UV light curing coating, with the advantages of fast overall curing, in the deployment of a variety of solvent-free products do not need external heating, reduce the air pollution, save a lot of energy, is conducive to environmental protection. Automation can also be achieved during curing operations.

3.1.4. Waterborne Acrylic Resin Coating

Li Wen'an et al. made a detailed study on it[6]The coating is a coating of low pollution or even no pollution. Its raw material is water borne acrylic resin, water borne acrylic resin VOC content is low, its advantages are no pollution, non-toxic, no stimulation, low price. It is widely used in roads, Bridges, pipes, building walls and factories.

The performance of water-based coating materials is generally recognized worldwide, especially in the inorganic zinc-rich coating applied in the anti-corrosion process. It can be seen that the water-based coating is a promising green coating.

3.2. Powder coating

Powder coating is mainly composed of solid resin, pigment, filler and additives, etc. After heating under certain conditions, it is changed into a molten state melting, and then the coating, before drying film flow, then organic matter coking, and finally formed after curing. The dispersion medium of the powder coating is the air. At the same time, it has no solvent pollution, 100% synthetic membrane, low energy consumption. It will be widely applied to powder coating in the pipeline and shipbuilding industry. It has two main types: thermoplastic powder coatings and thermosetting powder coatings.

3.2.1. Thermoplastic Powder Coating

Thermoplastic resin, pigment, filler stabilizer and plasticizer are the main components of thermoplastic powder coating, polyethylene, polyvinyl chloride, polypropylene, polyester, chlorinated polyether, fluorine resin and other major varieties.

3.2.2. Thermosetting Powder Coating

It is made up of thermosetting resin, curing agent, pigments, auxiliaries and fillers. Including epoxy, polyester, epoxy-polyester, polyurethane, acrylic acid and other major varieties.

The leveling of thermoplastic powder coating is poor, mainly due to the resin for the high polymerization, and thermosetting powder coating is the prepolymer with low polymerization, its curing can form mesh crosslinked macromolecules, compared with thermoplasticity will have better decoration, so the development of thermosetting powder coating is faster. At present, it is widely used in industrial production and large-scale production and application of enterprises.

3.3. Coatings With High Solid Content

Under the premise of using traditional coating manufacturing methods and production process, the content of organic solvents harmful to human body and the environment is reduced as far as possible, and the content of solid components is increased to get our high solid content coating. It was originally developed by the United States in the 1980s. In traditional coatings, the content of solid components is usually between 30% and 50%, while in high solid content coatings, the content of solid components accounts for 65% to 85%, while the content of organic solvents harmful to human body is as low as 30% to 40%, effectively reducing THE emission of VOC. Completely in line with the green development, but will not make the coating product packaging construction and packaging coating film film has been reduced, greatly reduce the solvent in the coating industry product processing production and the use of solvent, so as to reduce the pollution to the environment. It is widely used in the car paint, and the decorative painting is also widely promoted in the industry. However, because the viscosity of high solid content coating will increase with the increase of solid component, affecting the use of high solid content coating in the daily process, so it can effectively and reasonably solve the problem between the viscosity of high solid component and the coating in daily use, so as to improve the use effect of solid content coating. Although from the effect, it is not the degree of traditional solvent coating, but for our human beings and the ecological environment of the whole earth, the development of green coating is inevitable.

3.4 Radiation-Cured Coating

Radiation curing coating synthesis first need to use polymer radiation (such as electromagnetic wave) energy, make the resin in the photosensitizer, vinyl film substance and active thinner is triggered, and then make free radical or cation polymerization, after formed mainly by ultraviolet curing and electric r beam curing of two kinds of two different types of coating[7]. It is usually based on a low relative molecular mass polymer (oligomer) mixed with a reactive monomer, and is generally used only in a solvent-free environment, allowing it to be instantly solidified quickly in the presence of UV radiation. But these instantaneous curing, solvent-free features can also have some problems. For example, for coatings that cannot be completely sterilized, low permeability, low adhesion and low weather resistance under a specific substrate; in addition, for those difficult coatings with UV (UV), for example, some coatings with a specific color or low transparency is difficult curing. Ultraviolet or visible light curing (except for electron ray curing) generally requires the initiator catalytic curing reaction.

4. PRODUCTION AND DEVELOPMENT OF GREEN COATINGS

4.1. Production of Green Coatings

As a kind of coating used for saving resources and using energy, no pollution to the natural environment, beneficial to protect the normal living environment, its design and development and production process is mainly based on the improvement of green, product performance and functional quality.

The research of these products is for our health and ecological environment. We should focus on the following five areas:

(1) Reduce the use of various natural resources

(2) Try to use low energy consumption industrial production process, clean industrial production management technology, as far as possible to reduce the average discharge of industrial waste gas, waste residue and industrial waste water.

(3) No longer use formaldehyde, halides, solvents or other aromatic hydrocarbons as raw materials or packaging for such products; and do not directly use lead, cadmium, chromium, and nickel and their metal compounds and additives.

(4) to strictly control the amount of VOC contained in the paint, the paint is strictly prohibited to use any chemical solvent causing damage to the human experience, reduce the harm of such products to us.

(5) According to the use of the product can be recycled or secondary recycling and comprehensive utilization, without any environmental health pollution of industrial waste, etc. With the progress of the society, we not only strengthen the protection awareness of ourselves and ecology, but also for the consumption of indoor safety energy-saving coating series products and demand is increasing. The development of green environmental protection coatings will gradually become an important way for coating product production enterprises to seek survival and sustainable development.

4.2. Production and Development of Green Coatings

In addition to strictly controlling the content of VOC in the coating according to the market demand, each kind of coating produced must be the minimum environmental pollution at the same time will not have an impact on human beings, to put the healthy, green and sustainable development in the first place. Therefore, green pollution-free methods should be used to produce green paint, making packaging is to take materials that can be recycled. In the process of producing green environmental protection coatings, in addition to strictly ensure the quality requirements of its production process, but also must adapt to the operation and management concept of the enterprise, correctly realize that there is a close connection between the sustainable development of research and development and production, so that its scientific and technological innovation ability is greatly improved.

5. THE DEVELOPMENT TREND OF GREEN COATINGS

Coating as the supporting basic engineering raw materials of national economy, with the development of The Times, space, ocean, environment, energy, information and other kinds of high and new progress, are in urgent demand and call for the coating industry to have the corresponding development future. This will undoubtedly bring a lot of new development opportunities, we must seize the opportunity to research and develop a new category of high-tech coating industry, on the one hand, fully meet the demand of domestic construction, on the other hand, actively participate in foreign market competition, continuous efforts, to coating industry based on the world today.

Therefore, for timely and accurate grasp of the overall development trend of the coating industry and market trend is the top priority.

At present, the development of coatings in the world is moving forward in the direction of safe and pollution-free. Due to the lessons given by nature in recent years, people deeply realize that to treat nature well and protect the environment is to treat themselves well. Countries for environmental protection regulations are more and more comprehensive, the average emissions of VOC, the use of harmful chemical solvents, solid waste and pigments containing lead, chromium and other harmful heavy metal emission content has made strict regulations, efforts to design, development, production and promotion of green paint become the manufacturer of the future efforts. In particular, the above mentioned green coatings are widely known in the field of large buildings and civil automobile coating. According to the investigation and research of the development of green environmental protection coatings in recent years, the data show that all kinds of environmental problems and economic losses caused by a large number of coatings containing toxic substances are very serious every year. Therefore, the necessity of green paint is obvious. Green coating is the main direction of the research and development of the coating industry, it has played an important role in the national economic construction and people's life, at the same time, industrial coating also gradually changed into powder coating, water-based coating. Therefore, the green paint research and development industry gradually to the water, powder, no solvent, high solids and radiation curing and other non-toxic, harmless, green and safe road forward.

6. PROSPECT OF GREEN COATINGS

Green coating has a broad sustainable development potential in the world, and has almost no harmful impact on the whole human health and natural living environment[8]. The use performance of green environmental protection coating is superior, the scope of use is also relatively extensive, not only can greatly improve our daily life and the environment we live in, at the same time can greatly enhance the economic development strength of coating production enterprises. Therefore, its application is worth full promotion and wide application[9].

At present, the function of green coating is based on energy saving and low pollution. With the development of The Times, the newly developed green coating will be more and more, not only to strengthen the functional characteristics of the coating, but also to refine the specific functions, so that the performance of different regions is different. In addition, the method of using the coating is more simple, convenient construction. The ultimate goal of green paint is to be healthy and pollution-free. With the further improvement of human understanding, green paint in the future development on the road in the current green on the basis of further, continue to take the road of green development, in the production, processing and manufacturing paint of each link more strict control, to achieve a complete "green".

REFERENCES

[1] Adriatic River. Present Situation and development trend of green coatings [J]. Business Herald, 2011(14): 100-101.

[2] Wang Yuanyuan, Chen Jingyi, Wang Pengzhu, Wang Jihu, Wen Shaoguo. Research progress of environmental friendly coatings [J]. Shandong chemical, 2015, 44(01): 58-61.

[3] Jiang Wenrong. Research progress in green coatings [J]. Guangdong chemical, 2009, 36(05): 68-69 + 90.

[4] Guo Jun. Environmentally friendly applications of green paint [J]. Northern environment, 2013, 25(05): 52-53.

[5] Cheng So-wing, Wang Wei-an, Yang Shi-jun. Research and development progress of environmental friendly coatings [J]. Guangzhou Chemical, 2006(02): 63-64 + 69.

[6] Li Wen'an, Suen King-hin. Research progress of green coatings [J]. Chemistry and bonding, 2007(05): 361-364.

[7] Talk about Jin Feng. Discussion on the new development of coatings industry-green environmental protection coatings [J]. Chemical Management, 2016(32): 298-299.

[8] Xu bin. Progress in green functional coatings [J]. Hebei chemical, 2010, 33(06): 46 -47.

[9] Jiang Yahui, Zhao Wenzeng. Present Situation and development trend of green coatings [J]. Information Construction, 2016(05)