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Big Data in The Preparation and Application of Phosphorus and Nitrogen Synergistic Flame-Retardant Polyester Polyols: Based on IoT Monitoring

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Abstract:In this paper, the Internet of Things monitoring based on big data uses N, N-bis (2-hydroxyethyl)aminomethylene diethyl phosphate (FRC-6), adipic acid, hexylene glycol, etc. as raw materials, designing and synthesizing one A new type of phosphorus-nitrogen synergistic polyester polyol (JZP), the structure of JZP was characterized by nuclear magnetic resonance and infrared spectroscopy, and it was used as a soft-segment chain extender. Propionic acid reacted with toluene diisocyanate (TDI) to prepare a flame-retardant waterborne polyurethane (TPU) coating material. The structure and performance of TPU have been tested. The test results show that as the content of JZP increases, the average particle size of the TPU emulsion increases, the viscosity decreases, and the water resistance increases. The novel ideas of the IoT monitoring is applied for the computer assisted analysis.

Keywords: Big Data, Nitrogen Synergistic, Flame-Retardant Polyester Polyols, Iot Monitoring

1. INTRODUCTION

Epoxy resin (Epoxy Resin, EP) refers to a molecular structure containing two or two W epoxy groups, the main molecular chain W can be aliphatic, aromatic or alicyclic high molecular oligomer W. Simple epoxy resin can take various forms such as liquid, viscous, and solid. Generally, it does not have good mechanical properties. Only when it reacts with the material containing active ammonia to produce insoluble and non-meltable thermosetting high molecular polymer can its application value be reflected [1-6].

Therefore, the curing agent plays an important role in the application of epoxy resin. Under normal circumstances, what we call epoxy resin actually refers to the resin or its cured products of the curing agent W and various additives. This term will sometimes be used in the afternoon of this article. There are many types of epoxy resins, and there are endless new varieties, and the classification methods are also diverse. According to the physical state of the resin, it can be divided into solid epoxy resin and liquid epoxy resin; according to the number of functional groups, it can be divided into bifunctional epoxy resin and multifunctional epoxy resin; according to the chemical structure of the molecule, it can be divided into Aliphatic epoxy resin, cycloaliphatic epoxy resin, glycidyl acid epoxy resin, butyric acid epoxy resin, glycidyl vinegar epoxy resin, glycidylamine epoxy resin and mixed epoxy resin; according to purpose , Divided into ordinary epoxy resin and special epoxy resin and so on. The process of the epoxy group in the epoxy resin and the curing agent containing active ammonia undergoes the ring-opening addition polymerization reaction of the epoxy group is called the curing process. During this curing process, no small molecular substances are generated, only high molecular polymers with a three-dimensional network structure are generated. In this kind of high molecular polymer molecular structure, there are a large number of reference groups and basic bonds. They can form intramolecular ammonia bonds to make the high molecular chain segments closely arranged [7-14].

The combustion mechanism of combustibles is very complicated. Generally, combustibles will burn only when they come into contact with air at a certain temperature and are ignited under the action of flame retardants. The combustion mechanism can be simply summarized as: thermal degradation of polymer materials will occur during heating and combustion. During this process, large pieces of polymer materials will degrade into small particles. These small particles will volatilize into the air and mix with oxygen. When it rises to a certain level, these small particles will burn again, and the heat released by this process will also promote further thermal degradation of the polymer material, thereby producing more combustible particles. To realize the informationization of enterprise energy consumption monitoring, it can automatically complete the data statistics of enterprise energy consumption, and at the same time, it can also carry out real-time monitoring of energy consumption equipment to improve the office efficiency of the enterprise. By monitoring and analyzing the real-time energy consumption of various energy-consuming equipment in the enterprise, problems can be found in time, preventing a large amount of energy loss, and reducing the energy consumption of the enterprise [15-21].

Through the integration of energy consumption and environmental monitoring and the use of expert system principles, it provides enterprises with reasonable strategies for reducing energy consumption and achieves the purpose of energy saving and emission reduction. According to the deployment and application of actual projects, the advantages of the Internet of Things and its application prospects have been fully demonstrated, and it also provides a certain reference value for the research of other Internet of Things systems. Therefore, after curing, epoxy resin has the advantages of low shrinkage, high mechanical strength, excellent electrical insulation, and good chemical stability. It is widely used in electronic and electrical materials, coatings, adhesives, composite materials, building materials, Many fields such as national defense construction. The most common inorganic phosphorus flame retardants are red

phosphorus and micro-column red phosphorus. Red phosphorus is an inorganic polymer with high flame retardant activity. It is usually used as a highly active flame retardant. Good flame retardant effect. Because red phosphorus easily absorbs moisture in the air, it combines with water in the air to produce toxic phosphine, so it needs to be treated during use. The so-called coating is to cover the surface of red phosphorus with one or several layers of protective film. This treatment not only prevents the red phosphorus particles from contacting oxygen and water in the air, but also reduces the probability of red phosphorus being ignited by external impact and heating [22-24].

2. THE PROPOSED METHODOLOGY

2.1 The Phosphorus and Nitrogen Synergistic Flame Retardant Polyester Polyol

Tetrabromophthalic anhydride, industrial products, Shanghai Technical College of Chemical Industry; polyethylene glycol 400#, industrial products, imported from Russia; 1,2-propanediol, industrial products, Jinxi Refining and Chemical Plant; di-n-butylamine, chemically pure, Tianjin Kemeo Company; p-toluenesulfonic acid, chemically pure, Beijing Xizhong Chemical Plant; tetrabutyl titanate, chemically pure, Tianjin No. 1 Chemical Reagent Factory; nitrogen, industrial products, commercially available. In a four-necked reaction flask equipped with an electric heating mantle, a temperature controller, a stirrer, a reflux tower and a nitrogen introduction tube, polyethylene glycol was added, and the stirring, heating and nitrogen gas were started.

When the temperature of the material rises to about 100～130℃, add di-n-butylamine catalyst, then add tetrabromophthalic anhydride into the reaction flask in batches, and react at a constant temperature at a reaction temperature of (110±5)℃ for 1～1.5. h. When the acid value measured by sampling is less than 75mgKOH/g, add the weighed propylene glycol, heat up to about (200±5) ℃, react at a constant temperature for about 4 hours, and take a sample to measure the acid value of the material. If the acid value of the material is less than 20mgKOH/g, turn off the nitrogen and use a vacuum pump to remove the water generated during the reaction; if the acid value is greater than 20mgKOH/g, continue the reaction for a period of time and then take a sample to measure the acid value until the acid value is less than 20mgKOH After /g, start to evacuate dehydration. When the acid value is below 2.0mgKOH/g, the temperature will be lowered to below 100℃, and the material will be turned off and discharged. The acid value and hydroxyl value measured again when cooled to room temperature are the product technical indicators. In a four-necked reaction flask equipped with an electric heating mantle, a temperature controller, a stirrer, a reflux tower and a nitrogen introduction tube, polyethylene glycol was added, and the stirring, heating and nitrogen gas were started. When the temperature of the material rises to about 100～130℃, add di-n-butylamine catalyst.

2.2 The Big Data Model

The definition of big data has not yet been unified, but the core connotation is largely the same. The "Outline of Action to Promote the Development of Big Data" points out: Big data is a data collection with large capacity, multiple types, fast access speed, and high application value. It is rapidly developing into a large number of data with scattered sources and diverse formats Perform collection, storage, and correlation analysis to discover new knowledge, create new value, and enhance new capabilities of a new generation of information technology and service formats.

From the 3V characteristics of big data: the data's scale (Volume), structure diversity (Variety) and high speed (Velocity) gradually expanded to 6V characteristics, increasing the authenticity (veracity), variability (Variability) and value (value) (Gandomietal, 2015); As a collection center of environmental information resources, the cloud data center can provide storage and management services for various environmental protection service systems and various basic data collected by equipment in the intelligent service platform of the Internet of Things, and Through unified organization, sharing and use among multiple applications, expanding the utilization rate and scope of development and utilization of Internet of Things information resources. At the same time, as an information resource application service center, the cloud data center processes and comprehensively processes the aggregated information resources, constructs various application services, and provides reliable and efficient common technical support for the construction of application services. Meet the business needs of personnel at different levels and scope of responsibility. The ground monitoring data mainly comes from online monitoring systems for the ecological environment in various places. Due to the different development periods of the systems, the different technical means, and the diverse data formats, it is difficult to form information sharing between the systems.

2.3 The IoT Monitoring

The Internet of Things (IOT) was first proposed in 1999, and its purpose is to realize the interconnection and intercommunication between all things and to realize the intelligent interaction between things and things and between things and people. Using various modern communication network technologies, including wireless sensing technology, infrared detection technology, GPS (Global Positioning System), RFID (Radio Frequency Identification Technology), etc., real-time collection of any object or process that needs to be monitored, connected, and interacted, and collected its sound Various required information such as light, light, heat, electricity, mechanics, chemistry, biology, location, etc., through various network access methods, realize the ubiquitous link between things and things, and things and people, and realize the intelligence of things and processes Perceive, identify and manage.

The rapid development of the Internet of Things can bring new development opportunities to all walks of life and produce a huge industrial chain. According to the research report of professional departments, the future market scale of the Internet of Things can reach hundreds of billions, and it will be applied to many fields such as security monitoring, energy saving and emission reduction, and biomedicine. Alkyl phosphates are usually prepared by reacting fatty alcohols, alcohol ethers, alkyl phenols, etc. with phosphorylation reagents. There are many types of phosphorylation reagents. Common phosphorylation reagents include P2O5, POCl3, H3PO4 and nH3PO4, PCl3 and so on. Among them, it has high reaction activity as a phosphorylation reagent, and the esterification conversion rate is high during the reaction process, and the obtained product has high purity. However, phosphorus oxychloride and phosphorus trichloride themselves are highly corrosive and Toxic, and more toxic hydrogen chloride gas will be generated during the reaction, which not only requires high production equipment, but also brings hidden dangers to the safety of operators, and also

causes environmental pollution, which is not conducive to the implementation of the process. When phosphorus pentoxide is used as phosphorylation reagent, although the reaction activity is reduced compared with the former, no toxic substances are produced during the reaction process, and the process is relatively green. However, because the reaction process occurs gradually, the products are mostly mixtures, except Phosphoric acid monoester and phosphoric acid diester also contain a small amount of phosphoric acid triester, phosphoric acid dipolyester and so on. At the same time, phosphorus pentoxide is a powdery solid, and it is easy to absorb moisture and agglomerate, which makes the reaction uneven when it reacts with fatty alcohols, which in turn leads to local over-excitation of the reaction.

3. CONCLUSIONS

In this paper, the Internet of Things monitoring based on big data has successfully synthesized the phosphorus-containing polyester polyol JZP with a PN synergistic structure. The molecular structure of JZP was characterized by proton nuclear magnetic resonance spectroscopy and infrared spectroscopy. Then using JZP as the soft segment chain extender, a series of halogen-free flame-retardant waterborne polyurethane TPU emulsion coating materials were successfully synthesized. The particle size distribution test results show that the particle size distribution of the TPU emulsion is uniform, with an average particle size of about 60 nm, and the latex particles are evenly dispersed.

4. REFERENCES

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