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Study on flame retardant ABS

Xiaonan Lin,Wenmin Feng,Liangzhu Xu

School of Materials Science and Engineering, Suining University of Technology, Sichuan, China

ABSTRACT

Flame-retardant ABS resin was prepared by adding flame retardant, toughening agent and dispersing silicone oil with acrylonitrile-butadiene-styrene resin (ABS, grade 0215 A) as raw material. The results showed that in the ABS resin, flame retardant with tetrabromobisphenol A and antimony trioxide as the composite system (the mass ratio of 2:1) was added. When the bromine content of the system was more than 10%, the flame retardant ABS meets the requirements of UL 94 V-0. The best toughening agent for flame retardant ABS resin is ABS graft powder. When the amount of flame retardant ABS is 9% ~ 19% (mass fraction) Strength of 150-200 J / m; in the same formula and operating conditions, brominated alkylene oxide as flame retardant prepared flame retardant ABS resin, the weather resistance is better than tetrabromobisphenol A as flame retardant The Composite expansion flame retardant and coated red phosphorus is an effective halogen-free flame retardant.

KEYWORDS: flame retardant ABS resin; toughener; dispersant; impact strength; brominated alkylene oxide

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Correspondence to: Liangzhu Xu, School of Materials Science and Engineering, Suining University of Technology, Sichuan, China. xlz19790726@yahoo.com

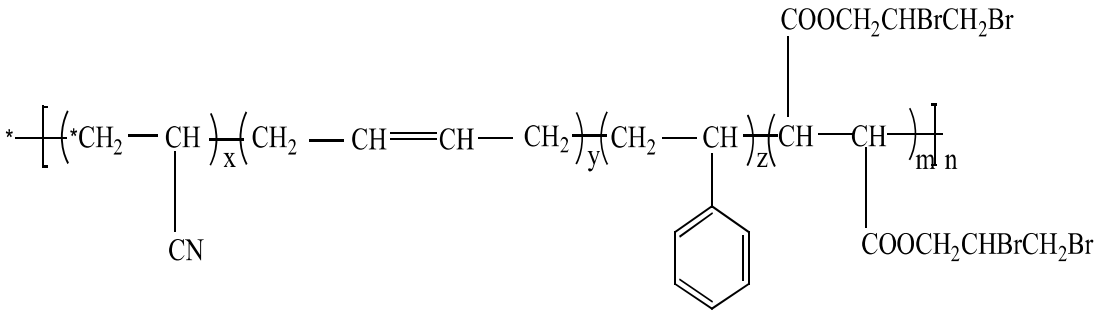
1. Literature Review

1.1. Significance of flame retardant ABS

ABS (Acrylonitrile Butadiene Styrene) resin is one of the five synthetic resins, composed of acrylonitrile, butadiene and styrene ternary copolymer, which can show the synergistic performance between the three components: acrylic clear components in the ABS performance characteristics of heat resistance, chemical resistance, rigidity, tensile strength, butadiene performance characteristics of the impact strength, the performance of styrene is the processing of liquidity, gloss. The combination of these three components, complementary advantages, so that ABS resin has excellent overall performance, good rigidity, high impact strength, heat resistance, low temperature resistance, chemical resistance, mechanical strength and electrical performance, good thermal stability And chemical stability, good mobility, easy processing, processing dimensional stability and good surface gloss, easy to paint, coloring, can also be sprayed metal, electroplating, welding and bonding and other secondary processing. ABS resin is the largest output, the most widely used polymer, it will PS, SAN, BS various properties organically unified, both tough, hard, just equal balance of excellent mechanical properties.

1.2. ABS flame retardant category

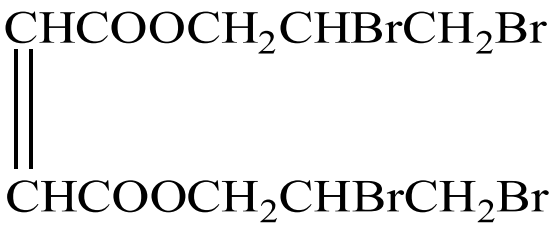
According to the use of ABS flame retardants, can be divided into additive flame retardant and reactive flame retardant two categories.



Flame retardant ABS structure

1.2.1 Reactive flame retardants

Such flame retardants have reactive groups and are copolymerized as one of the monomers in ABS resin synthesis. Once this flame retardant as part of the ABS molecular chain, it will no longer migrate, flame retardant lasting, and the physical and mechanical properties of the material and the impact of smaller electrical properties. ABS commonly used reactive flame retardant for the bis (2, 3-dibromopropyl) fumarate, the flame retardant FR-2, the formula is:



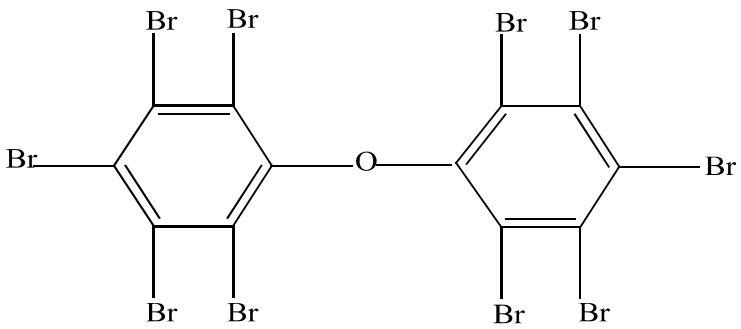
In the ABS synthesis by adding 15% of the goods as a fourth monomer copolymer, can produce the structure as shown in the flame retardant ABS resin, can be achieved from the fire [4]. In addition, the use of a reactive flame retardant, 2, 3-dibromopropyl methacrylate as a copolymerization component with styrene or a bromine-containing 10% ABS obtained by copolymerizing a bromine-containing monomer, has flame retardancy. The reactive flame retardant has little effect on the mechanical properties of ABS or ABS blends. Although the dosage is generally small, the price is high and the application is limited.

1.2.2 Additive flame retardants

The additive flame retardant is a kind of flame retardant which is widely used in the research of plastic flame retardant. It is used as a kind of filler to fill in resin and release flame retardant. The general use of flame retardant is large, significant impact on the mechanical properties of ABS, poor flame retardant durability. According to its chemical structure, it can be divided into organic additive flame retardant and inorganic additives flame retardant.

1.2.2.1 Organic flame retardants

ABS organic additive flame retardant mainly include alkyl diaryl phosphate, triphenyl phosphate, polychlorinated benzene, perchlorocyclopentane decane, decabromodiphenyl ether (DBDPO) and so on. Where DBDPO is of the formula:



Flame retardant mechanism is mainly mechanism (4), with bromine content of up to 83.4%, high flame resistance, ABS flame retardant is currently the most widely used organic aromatic bromide flame retardant. But this product is subject to ultraviolet light easy to change color, reduce the impact strength of materials and other shortcomings. At the same time, DBDPO in the combustion of dihydroquinoline and its use is limited, its proportion in the brominated flame retardant has been greatly reduced. ABS resin has been widely used TBA (butyl acetate)/epoxy resin oligomers instead of DBDPO. Chlorinated cyclopentane is a widely used another chlorine species, which is derived from the polymerization of hexachlorocyclopentadiene, chlorine content of up to 78.3%, high flame retardant properties, thermal stability and chemical stability Also good. Between ABS resin and antimony oxide will come with synergistic effect.

For the ABS resin, the commercial production has been used in the main flame retardant halogen, because the brominated flame retardant C-Br bond can be much smaller than the C-C1 bond, flame retardant effect is better, most of the use of Brominated flame retardants. Representative of the bromine series flame retardants include decabromodiphenyl ether (DBDPO), octabromodiphenyl ether (OBDPO), 1,2 bis (2,4,6-tribromophenoxy) ethane BTBPO), 1,2-bis (tetrabromo phthalimide) ethane (BTBPIE), tetrabromobisphenol A (TBBPA), decabromodiphenylethane (BPBPE), brominated epoxy resin (BER), polydibromostyrene (PBDS), and the like. Halogen flame retardant

The flame retardant effect is exhibited by terminating the free radical chain reaction mechanism. Although the halogen flame retardant alone has flame retardant properties, a flame retardant is not added alone to obtain a high performance flame retardant material. The general method is halogen is a synergistic system of flame retardants and phosphorus flame retardants, metal oxide flame retardant synergists and free radical initiators. In the halogen / phosphine flame retardant system, the halogen phase to play the role of gas phase flame retardant, phosphorus showed solid phase flame retardant effect, the two form a complete gas / solid phase flame retardant system. In the coordination with metal oxide flame retardant synergist, halogen / antimony flame retardant system is the most common application.

A. Pets (9) were treated with 1, 2-bis (2, 4, 6-tribromophenyl) ethane (BTBPE) as flame retardant, zinc stearate (ZHS)

And zinc stannate (ZS) as synergistic flame retardants, and chlorinated polyethylene was added to study the oxygen index of ABS. It was found that the oxygen index of ABS was 29.6 when the content of ZHS was 6%, BTBPE content was 20% and chlorinated polyethylene content was 5%. The addition of flame retardants will have a great impact on the other properties of ABS. Most importantly, impact strength, heat distortion temperature, melt flow index and UV stability have little effect on tensile strength and flexural strength. Richard Seddon [10] studied the effect of BTBPE, TBBPA and Sb2O3 on ABS performance. It was found that 20% bromine content was the key point for the decrease of the flow ability of the polymer. When the addition of 4% Sb2O3, the strength of the melt increased, when the particle is 0.1, the impact strength of ABS is improved. WEN YENCHIANG [11] with TBBPA and Sb2O3 complex, as ABS flame retardant, and adding titanate coupling agent LICA44 grafted styrene - maleic anhydride (SMA), the material oxygen index increased at the same time, ABS And the tensile strength and tensile strength of the grafted resin were also increased. Electron microscopy showed that the grafting agent had a good binding effect between the ABS resin and Sb2O3 and the two phases.

1.2.2.2 Inorganic flame retardants

ABS resin for inorganic flame retardants are mainly antimony trioxide (Sb2O3), zinc borate, barium metaborate, ammonium sulfate and so on. Sb2O3 is the most used one, its own no flame retardant role, the need for organic halide with the use, have a certain effect, it is often referred to as synergist. The synergies are as follows:

$$Sb_2O_3+6HCl \longrightarrow 2SbCl_3+3H_2O$$

$$Sb_2O_3+2HCl \longrightarrow 2SbOCl+h_2O$$

$$5SbOCl \xrightarrow{176\sim280℃} SbCl_3+Sb_4O_5Cl_2$$

$$3Sb_4O_5Cl_2 \xrightarrow{320\sim700℃} 2SbCl_3+5Sb_2O_3$$

Since SbC13 has a higher boiling point (223 ° C), it can adhere to the surface of the ABS resin and cut off the supply of oxygen. Brominated flame retardants and Sb203 also have similar synergistic effects. Zinc hydrate is a kind of flame retardant. Its flame retardant mechanism is mainly mechanism (2), which can be used as a substitute for Sb203. This product can still keep crystal water at 260 ℃, so it is suitable for high temperature processing. (NH4) 2SO4 pyrolysis mechanism is not yet fully determined. It is basically believed that: (NH4) 2SO4 decomposes at high temperature,

absorbs heat and reduces the ambient temperature; (NH4) 2SO4 pyrolysis produces a large proportion of sulfuric acid, forming a liquid coating on the surface of the material, To prevent the decomposition of combustible gas, while sulfuric acid decomposition products SO3 is a heavy gas, covering the surface of the flame area, can prevent the entry of oxygen; sulfuric acid is a strong dehydrating agent, can promote the high temperature dehydration of polymer materials, carbonization layer can not only To block the heat source, to prevent the role of heat diffusion, but also play a role in preventing the evaporation of flammable gases, so as to achieve flame retardant [12].

The amount of inorganic additive flame retardant is larger, and the coupling agent or other pretreatment before blending filling will get better mechanical properties.

Inorganic additive flame retardant with good thermal stability, low toxicity or non-toxic, does not produce corrosive gases, in the storage process

In the non-volatile, difficult to precipitate, a lasting flame retardant effect, and the source of raw materials rich, low prices, in dealing with a large number of flammable polymer materials, fire and low smoke, low toxicity, is still a simple But also a practical way. Inorganic flame retardants have high safety, both synergistic flame retardant, smoke suppression and reduced toxic gas function, in the added flame retardant has an important position. Sb2O3 alone has no flame retardant effect on ABS, but it has obvious improvement after flame retardant effect with halogen-containing flame retardant. It shows that there is a certain synergistic effect between halogen flame retardant and Sb2O3. Unprocessed Mg (OH) 2 has a strong polarity, poor compatibility with non-polar resin, the impact of the impact of the decline is clearly reflected, and the surface treatment of Mg (OH) 2 and ABS resin compatibility Sex has improved. Mu Xiuling [13] and other research found that bromine / antimony flame retardant ABS has a good flame retardant, high bromine flame retardant than the low bromine content of the flame retardant effect, the impact of the impact of the system small. In the flame retardant ABS resin containing bromine / antimony system by adding appropriate amount of magnesium hydroxide, can improve the impact strength of the system, and has a smoke effect. Adding CPE to toughen the system is to ensure that the flame retardant system has good processing performance. ABS resin with 8% ~ 12% bromine / antimony flame retardant, 0.5% ~ 0.8% magnesium hydroxide and 7% CPE flame retardant resin can be obtained excellent flame retardant resin, resin oxygen index can reach 31.2%. The relationship between flame retardancy, smoke suppression and other properties of ABS resin was studied and discussed. The experimental results show that Sb2O3 and DBDPO have good flame retardant synergistic effect. Al (OH) 3, MoO3 and Sb2O3 / DBDPO complex flame retardant system have better flame retardant and smoke suppression synergistic effect. Silane coupling agent has a good effect on Al (OH) 3 and MoO3 can effectively improve the processing performance and mechanical properties of the flame retardant system, and have no effect on the flame retardancy of the system. (OH) 2 on the surface of the silane coupling agent was nanorods dispersed in the ABS matrix. The addition of nano Mg (OH) 2 was improved at the same time as the increase of the ABS oxygen index. Reducing the smoke generated by ABS combustion, and the flow of composite material is better. Cui Yongyan [16] studied the new inorganic flame retardant ammonium sulfate in ABS flame retardant and smoke-free function. Ammonium sulfate in the ABS showed a prominent flame retardant and smoke suppression function, each additional 20, the system of oxygen index increased by an average of 2.4%, while in the same circumstances, Mg (OH) 2 increase rate of only 1.5% but the mechanical properties of the material a greater impact.

1.3. ABS flame retardant performance research status

As ABS and other resins (such as PVC, PC, etc.) can be prepared to achieve a comprehensive performance of high-performance alloy, so ABS is often used in the form of its blended alloy which with PVC blending research and application more. As PVC has self-extinguishing from the fire, it will have certain flame retardant effect. Practice has proved that ABS / PVC blends not only excellent flame resistance and impact properties, but also tensile properties, bending properties and hinge properties, chemical resistance and tear resistance than ABS has improved. The flame retardant properties of the blends are excellent, but there is no synergistic effect. As shown in Figure 1 [24]. In the blending process, in order to prevent a large number of added PVC heating decomposition, often add a small amount of Sb2O3, and accordingly reduce the amount of PVC.

Xia Ying [25] and so on using the experimental design method, the establishment of the blend composition and performance of the correlation between the mathematical model, the flame retardant ABS blends in the system of components and components of the interaction between the blends The impact of the performance. The results show that when the ratio of ABS / PVC is 70 / 30-30 / 70, the flame retardancy of the blend can reach FV-0 level, and the impact strength can be higher than that of general ABS resin and high impact ABS resin. Chen Guilan [26] and so on using DBDPO and Sb2O3 as a flame retardant and added to the ABS / PVC alloy, the results show that when the ratio of DBDPO and Sb2O3 2: 1 when there is a good flame retardant synergistic effect. With ABS resin by adding 8 copies of Sb2O3 and 16 copies of DBDPO, it can achieve flame retardant requirements but mechanical properties and processing performance deteriorated. Zhongming Qiang [27] compared the PVC, PVC / Sb2O3, DBDPO / Sb2O3 on the ABS plastic combustion performance, mechanical properties and processing performance of the law. The results show that

DBDPO / Sb2O3 composite flame retardant has the best effect on ABS flame retardant, followed by PVC / Sb2O3 system. PVC has good flame retardant effect only when the amount of addition is large.

2. Preparation and Performance Study of Flame Retardant

ABS is a universal type of thermoplastic material developed in the 1940s, it has good mechanical properties, chemical resistance, easy processing and so on. ABS resin has been widely used in home appliances, construction, automotive, office supplies and other industries. But ABS is extremely easy to burn, limiting its use in many areas. Therefore, the study of flame retardant ABS has been one of the hotspots and difficulties in the field of polymer flame retardant materials.

As early as the 1970s, the United States UL (Underwriter Laboratory), Australia's As-3195 and other companies have on the electrical shell flame retardant performance requirements. Now the domestic gradually began to attach importance to the electrical accessories shell flame retardant performance. At present, the performances of flame retardant ABS at home country and abroad only assess the UL94-96 as the standard [39].

In the preparation of flame retardant ABS resin, the need to add the mass fraction of 15% to 30% of the bromine - antimony composite flame retardant, the product flame retardant to UL 94 V - 0 level requirements. The addition of flame retardants reduces the physical and mechanical properties of the material, especially the addition of antimony trioxide, which will significantly reduce the impact strength of the material. Therefore, the key to obtaining high performance flame retardant ABS resin is to ensure the combustion performance At the same time, improve the physical and mechanical properties of materials.

2.1. Experimental part

2.1.1 Main raw materials

ABS resin (grade 0215 A) and ABS resin graft powder (grade PW 151), produced by China Petroleum Jilin Petrochemical Company with it synthetic resin plant production.

Styrene-acrylonitrile copolymer (SAN): grades SAN-T and SAN-L, the relative molecular mass of 8 × 104,10 × 104; at a temperature of 200 ℃, load of 5 kg under the conditions, The two melt flow index were 3.0,1.8 g / min; acrylonitrile content of the same, Jilin Petrochemical Company production.

Tetrabromobisphenol A: grades Fr 1524, manufactured by GreatLakes, USA.

Bromo alkylene oxide: grades BF 8200, produced by Israel ICL.

Antimony trioxide: grade PATOX-M, produced by Japan Jinghong Co., Ltd.

Chlorinated polyethylene (CPE): grade 2135, chlorine content of 35%, Weifang Yaxing company production.

The styrene-butadiene-styrene block copolymer (SBS) is commercially available.

Silicone oil: viscosity of 1Pa · s, Jilin Petrochemical Branch Research Institute developed.

Compound Expanded Flame Retardant (M-IFR): Key Laboratory of Degradation and Flame Retardant Polymer Materials, Sichuan University, College of Chemistry, Sichuan University

Coated red phosphorus (RP): Shanghai Asahi non-halogen smoke-retardant flame retardant Co., Ltd. production, 35% phenolic resin coated

2.1.2 Major instruments and equipment

PRISM PiLot Laboratory High Speed Mixer (PM15): Thermo Fisher Scientific (Shanghai) Co., Ltd.

SHJ-63 Twin Screw Extruder: Nanjing Jieen Te Electromechanical Co., Ltd

TYD128-A servo energy-saving injection molding machine: Beijing Hongyuan Lee Fang Plastic Machinery Co., Ltd.

AGS-5 KNG Universal Tensile Testing Machine: Shimadzu Corporation

UL 94 type combustion tester: Shimadzu Corporation

120 FWP-type melt flow index tester: Japan Yasuda company

CZF-1 vertical burning tester: Nanjing, China, the test standard ASTMD635

HC-2 type limit oxygen index instrument: Nanjing, China, the test standard ASTMD 2863)

2.1.3 Sample preparation

The flame retardant, toughener, dispersant silicone oil and 0215 A (or PW151 and SAN-T) were added to the 5L high-speed mixer for 3 minutes, extruded through a twin-screw extruder, Injection molding machine into a spline. Extrusion temperature: a section of 165 ℃, two sections of 170 ℃, three sections of 175 ℃, four sections of 180 ℃, five sections, six sections of 185 ℃, die 185 ℃. Injection temperature: a section of 170 ℃, two sections of 180 ℃, three sections of 180 ℃, nozzle 180 ℃. After drying Mg (OH) 2 in an oven at 50-60 ° C, it was added to a high-speed mixer and mixed thoroughly for 20 min.

2.1.4 Sample analysis

The physical and mechanical properties of the samples were measured on an AGS-5 KNG universal tensile tester using ASTM (American Society for Testing and Materials). Using the vertical combustion standard (UL-94), the burning performance of the sample was measured on a UL 94 type combustion tester with a sample size of 127.0 mm x 12.7 mm mm x 2.0 mm. The melt flow index of the sample was measured on a 120 FWP melt flow index tester using the ASTM D 1238 standard.

2.2. Results and discussion

2.2.1 Effect on flame retardancy

2.2.1.1 Bromine content

Bromine flame retardants are usually used in combination with antimony trioxide, the mass ratio of the two is 2: 1 [42]. The effects of different bromine content on the flame retardancy of the samples were investigated by adjusting the amount of flame retardants by adding tetrabromobisphenol A and antimony trioxide in this ratio to 0215 A (see Table 1).

Bromine content Fraction /%	Burning phenomenon	Impact strength / (J · m-1)
8	immortal	135
9	less than 10s, there are Mars falling	122
10	less than 10s	108
11	less than 10s	78
12	less than 10s	73
13	does not burn	68

It can be seen from Table 1 that when the bromine content is less than 10%, the combustion effect is stronger than that of flame retardant, and the flame retardancy of the sample cannot meet the requirement of UL 94 V-10. If the content is higher than 10%, the flame retardant is stronger than the combustion So that the burning material is extinguished, that is, the flame retardancy of the sample satisfies the requirements of UL 94 V-0. With the increase of the bromine content in the flame retardant, the impact strength of the sample is greatly reduced. Taking into account, with bromine content of 10% is appropriate.

2.2.1.2 Flame Retardant Type

The flame retardants were blended with 0215 A. Under the condition of bromine flame retardant and antimony trioxide mass ratio of 2: 1 and bromine content of 10%, the effects of different flame retardants on the samples Flame retardant properties. It can be seen from the experiment that the flame retardancy of the samples can meet the requirement of UL 94 V-0, and the impact strength is 108,82 J / m respectively after the addition of tetrabromobisphenol A and brominated alkylene oxide flame retardants. The main reason for the difference in impact strength is that the flame retardants have different bromine content (the theoretical content of bromine is 58% and 53% respectively). Therefore, the flame retardant ABS resin has the same content of bromine content, Tetrabromobisphenol A is less than the amount of brominated alkylene oxide, so that the former impact on the impact of the sample can be slightly less than the latter.

2.2.2 Toughening of flame retardant ABS resin

CPE, SBS and ABS resin has a certain compatibility, ABS resin is commonly used toughening agent [43-44].

2.2.2.1 Add dispersant

0215 A is a blend of PW 151 and SAN-T. In the experiment, it was found that the flame retardants and toughening agents were added with 0215 A and PW 151 and SAN-T according to the same formula, and the samples were blended

under the same operating condition strength higher than the former. This is mainly because: (1) the latter to avoid the PW 151 and SAN-T of the secondary extrusion, improve product performance; (2) powder and powdery flame retardant mixing easier, in the high-speed mixing stage, Mix more evenly.

In order to further improve the mixing effect between the powder, in the PW 151 and SAN-T, adding 0.2% of the liquid dispersant (silicone oil) to wet the surface of the powder, the results shown in Table 2.

Table 2 Effect of dispersant on physical and mechanical properties of the sample

Project	without silicone oil	add silicone oil
The impact strength/(j. m - 1)	152	165
The tensile strength/MPa	43. 2	43. 7
Bending strength/MPa	73. 4	72. 8
Melt flow index/(g · min -1)	5. 20	5. 32

Note: The project did not add silicone oil to silicone oil

Note: The flame retardant system is tetrabromobisphenol a complex antimony trioxide, the mass ratio of 21, bromine content of 10%.

As can be seen from Table 2, a small amount of dispersant increases the impact strength of the sample, but has little effect on other properties. By observing the high-speed mixed material after adding the dispersant, it can be seen that the mixing of the powders is more uniform.

2.2.3 Weather ability flame retardant ABS resin

The mechanical and mechanical properties and flame retardancy of flame retardant ABS resin prepared by tetrabromobisphenol A and antimony trioxide composite flame retardant can be balanced, but the weather resistance is poor. Brominated alkylene oxide with bromine mass fraction and tetrabromobisphenol an equivalent, the thermal stability is better than the latter, and in the preparation of weather-resistant flame retardant ABS resin at the temperature of decomposition.

The flame retardant ABS resin was prepared by using brominated alkylene oxide and tetrabromobisphenol A as flame retardants under the same formulation and operating conditions using PW-151 and SAN-T as raw materials. The dendritic (ASTM I) tensile specimens were irradiated under sunlight to analyze the weather resistance of different flame retardant ABS resins (see Table 3).

Table 3 Comparison of weather resistance of flame retardant ABS resin

Time/d	stretch strength/MPa	
	Tetrabromobisphenol A	Bromoepoxide
0	43. 7	42. 5
3	41. 0	41. 4
6	37. 8	40. 5
9	34. 7	38. 7
15	29. 2	36. 4
30	9. 7	23. 5

It can be seen from Table 3, under the action of sunlight, the use of brominated alkylene oxide flame retardant can slow down the aging rate, can effectively improve the weathering performance of flame retardant ABS resin.

ABS molecular chain due to the existence of unstable double bond, easy thermal oxygen aging and photo aging, and some halogen flame retardants of poor light stability, making the resistance of flame retardant ABS is not good, poor color stability, limiting the ABS in the Outdoor application.

2.2.4 Oxygen Index and Vertical Combustion Test [45]

Through a large number of formula experiments, it was found that ABS had the best condition when the mass ratio of complex expansion flame retardant (M-IFR) to coated red phosphorus (RP) was 8: 5 and the total added fraction was 26% of the flame retardant effect. Table 4 shows the results of the limit oxygen index (LOI) and vertical combustion (UL94) for ABS and flame retardant ABS (74% 5ABS / 16% M-IFR / 10% RP). From the table we can clearly see that, relative to pure ABS lower oxygen index and no level of vertical combustion, flame retardant ABS oxygen index and vertical combustion levels have been significantly improved, the oxygen index from the original l8 .5 increased to 24.5,

which is increased by 6 percentage points, while the vertical combustion level from the level to V-0 level. Oxygen index and vertical combustion results show that the composite expansion flame retardant and coated red phosphorus complex is ABS an effective halogen-free flame retardant.

Table 4 LOI and UL-94 test results

	LOI(%)	UL-94
ABS	18.5	NR
ABS/16%M-IFR/10%RP	24.5	V-O

2.3. Conclusions

The flame retardancy of the sample meets the requirements of UL 94 V-0 under the condition that the mass ratio of tetrabromobisphenol A and antimony trioxide is 2: 1 and the bromine content is more than 10%.

The best toughening agent for flame retardant ABS resins is PW 151. When the PW 151 with mass fraction of 9% ~ 19% was added in 0215 A, the impact strength of flame retardant ABS resin was 150 ~ 200 J / m.

With PW 151 and SAN-T as the raw materials, the dispersing agent silicone oil with the mass fraction of 0.2% was added. The impact strength of the flame retardant ABS resin was improved, but it did not affect the other properties.

The flame resistance of the ABS resin with brominated alkylene oxide as the flame retardant was better than that of the tetrabromobisphenol A as the flame retardant under the same formula and operating conditions with PW-151 and SAN-T as raw materials.

Composite expansion flame retardant and coated red phosphorus is an effective halogen-free halogen-free flame retardant.

3. Summary

Plastic as a synthetic polymer material, because it has good formability, film-forming, insulation and acid and alkali and low permeability, water permeability and easy to color, bright appearance and other characteristics, widely used in people's lives in all aspects. Plastic and most of the polymer material has a fatal flaw, easy to break down at high temperatures, burning, while in the combustion process also generates a lot of smoke and toxic and harmful gases, the ecological environment and people's health caused a huge the harm. At present, the development of domestic environmental protection flame retardant by more and more people concerned about. At the same time, people on the fire safety and flame retardant products are also increasingly demanding, halogen-free, low smoke, low toxicity of environmentally friendly flame retardant has become the pursuit of the goal.

Nearly 80% of the domestic modified plastic flames retardant for the halogen-containing flame retardants, of which PBDE and polybrominated biphenyls as the representative material. Brominated flame retardants are high in efficiency, have little effect, have little effect on the properties of the material, and the brominated flame retardants are affordable. Compared with other types of flame retardants, brominated flame retardants performance / price ratio is more superior, China's exports of electrical and electronic products in 70% to 80% are using such flame retardants. However, in recent years, some countries in the EU believe that brominated flame retardants burn poisonous carcinogenic polybrominated benzoin (PBDD) and polybrominated dibenzofurans (PBDF). The EU has introduced a ban on all electrical and electronic equipment sold in EU countries and cannot contain polybrominated biphenyls and polybrominated diphenyl ethers.

Although ABS is a general-purpose thermoplastic material developed in the 1940s, it has the advantages of good mechanical properties, chemical resistance and easy processing. ABS resin has been widely used in home appliances, construction, automotive, office supplies and other industries. The study of flame retardant ABS has been one of the hotspots and difficulties in the field of polymer flame retardant materials [46]. At present, for the ABS flame retardant research, still add bromine-based flame retardants and inorganic flame retardant-based. Brominated flame retardants because of its possible environmental problems, and some have been banned; and inorganic flame retardants, such as magnesium hydroxide, aluminum hydroxide, etc., the general amount must be added to more than 60% in order to play on the ABS Of the flame retardant effect, and such a high amount of added is bound to destroy the inherent ABS itself the performance. Therefore, the study of new halogen-free flame retardant system, for the ABS flame retardant research has a very important significance, is the trend of research.

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