Application Data for ST-FR322

Application of ST-FR322 in bromine flame retardant plastic compound

Table 1 PBT flame retardant formula

Number	1	2	3	4	5
PBT%	58	58	58	58	58
BEO%	12	12	12	12	12
Sb_2O_3%	3	2	1.5	1	0
ST-FR322	0	1	1.5	2	3
The others	5	5	5	5	5
GF%	30	30	30	30	30

Table 2 Flame retardant PBT sample test data

Test Item	Test Method	1	2	3	4	5	Unit
Tensile Strength	GB/T1040-1992	104	107	106	108	106	MPa
Elongation at Break	GB/T1040-1992	2.1	2.3	2.4	2.2	2.6	%
Bending Strength	GB/T9341-2000	137	136	139	140	139	MPa
Bending Modulus	GB/T9341-2000	7981	8106	7930	8008	8219	MPa
Notch Impact Strength	GB/T1843-1996	8.2	7.4	7.5	7.4	7.6	KJ/m^2
Heat Deflection Temperature	GB/T1634-2004	209	211	210	208	209	℃
Melt Index	GB/T3682-2000	27.3	31	32.5	34.1	37	g/10min
Flame Retardancy	UL-94	V-0	V-0	V-0	V-1	HB	/
Ash Content	GB/T9345-1988	30.3	30.5	30.8	31.2	31.8	%

Table 3 PA6 flame retardant formula

Number	21	22	23	24	25
PA6%	56	56	56	56	56
DBDPE%	18	18	18	18	18
Sb_2O_3%	6	4	3	2	0
ST-FR322	0	2	3	4	6
The others	5	5	5	5	5

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GF%	30	30	30	30	30

Table 4 Flame retardant PA6 sample test data

Test Item	Test Method	21	22	23	24	25	Unit
Tensile Strength	GB/T1040-1992	144	150	149	153	155	MPa
Elongation at Break	GB/T1040-1992	2.8	2.6	2.9	3.1	3.0	%
Bending Strength	GB/T9341-2000	183	195	191	197	196	MPa
Bending Modulus	GB/T9341-2000	7670	7809	7783	7841	7952	MPa
Notch Impact Strength	GB/T1843-1996	15.3	16.1	16.2	16.7	17.1	KJ/m^2
Heat Deflection Temperature	GB/T1634-2004	253	255	254	255	253	℃
Melt Index	GB/T3682-2000	/	/	/	/	/	g/10min
Flame Retardancy	UL-94	V-0	V-0	V-0	V-1	HB	/
Ash Content	GB/T9345-1988	25.6	24.8	25.3	24.9	25.5	%

Results and discussion:

According to the figures in Tables 1 and 3, combined with the test data in Tables 2 and 4, we can find that the addition of ST-FR322 in the flame retardant systems of PBT and PA6 leads to similar changes in results. The most obvious change is that the melt flow rate increases with the increase of ST-FR322 addition, while other mechanical properties remain basically unchanged, which is conducive to the forming and processing of the material. In addition, when replacing half of Sb_2O_3, the original flame retardant effect can be maintained, but ST-FR322 cannot completely replace Sb_2O_3 in bromine flame retardant systems.

ST-FR322 belongs to halogen free powder, which can better ensure the environmental requirements of the material than Sb_2O_3. The most important thing is that the price of ST-FR322 is significantly lower of that of Sb_2O_3, and the supply is not limited by metal mineral resources, which can greatly reduce the cost of flame retardant PBT and PA6, which is good to the market of flame retardant materials. In addition, adding ST-FR322 to flame retardant PA6 can significantly whiten the product, which is more positive to the appearance and coloring of the product.

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Table 5 ABS flame retardant formula

Number	6	7	8	9	10
ABS%	77	77	77	77	77
BTAC%	15	15	15	15	15
Sb_2O_3%	5	4	3	2	0
ST-FR322	0	1	2	3	4
The others	3	3	3	3	3

Table 6 Flame retardant ABS sample test data

Test Item	Test Method	6	7	8	9	10	Unit
Tensile Strength	GB/T1040-1992	39.3	41.0	40.7	40.8	41.5	MPa
Elongation at Break	GB/T1040-1992	18.6	21.3	20.3	23.8	21.6	%
Bending Strength	GB/T9341-2000	58	57	60	58	61	MPa
Bending Modulus	GB/T9341-2000	2491	2511	2485	2527	2508	MPa
Notch Impact Strength	GB/T1843-1996	12.1	12.4	12.2	12.6	11.6	KJ/m^2
Melt Index	GB/T3682-2000	3.1	4.2	4.8	5.9	6.5	g/10min
Flame Retardancy	UL-94	V-0	V-0	V-0	V-1	HB	/
Density	GB/T1033-1986	1.20	1.18	1.16	1.15	1.13	g/cm^3

The application results and discussion of ST-FR322 in flame retardant ABS compound:

According to the figures in Table 5 and the test data in Table 6, it can be seen that after adding ST-FR322 to the ABS flame retardant system, except for the increase in melt flow rate with the increase of its addition amount, the impact strength of the material slightly increases with the replacement of Sb_2O_3, while the specific gravity significantly decreases; When half or less of Sb_2O_3 is replaced in bromine flame retardant, the original flame retardant effect can still be maintained. Additionally, after replacing Sb_2O_3 with ST-FR322, the appearance of the extruded flame-retardant compound has become whiter, and the coloring power of the compound has also increased.

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Table 7 PP flame retardant formula

Number	11	12	13	14	15
PP%	60	60	60	60	60
DBDPE%	18	18	18	18	18
Sb_2O_3%	6	4	3	2.5	0
ST-FR322	0	2	3	3.5	6
The others	16	16	16	16	16

The application results and discussion of ST-FR322 in flame retardant PP compound:

According to the figures in Table 7, it is easy to find that after adding ST-FR322 to the flame retardant PP compound, just like flame retardant ABS, as Sb_2O_3 is gradually replaced, the melt flow rate and impact strength of the material increase with the increase of ST-FR322 addition, while the specific gravity significantly decreases; When one-third or less of Sb_2O_3 is replaced in the bromine flame retardant system, the original flame retardant effect can also be maintained. Similarly, after replacing Sb_2O_3 with ST-FR322, the appearance of the extruded flame-retardant modified product is whiter than before, and the surface gloss and coloring power have also improved to a certain extent. In addition, as ST-FR322 is an ultrafine powder, adding ST-FR322 to flame retardant modified PP products can have a certain nucleating effect, shorten the material's molding cycle, slightly increase the material's heat deflection temperature, and reduce the amount of special nucleating agent used in the modification process, further reducing costs.

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Table 8 HIPS flame retardant formula

Number	21	22	23	24	25
HIPS%	81.5	81	81	80.5	80.5
DBDPE%	13	13	13	13	13
Sb_2O_3%	4.5	3	2	1	0
ST-FR322	0	2	3	4.5	5.5
The others	1	1	1	1	1

Table 9 Flame retardant HIPS sample test data

Test Item	Test Method	21	22	23	24	25	Unit
Tensile Strength	GB/T1040-1992	24.3	25.1	24.8	25.1	25.3	MPa
Elongation at Break	GB/T1040-1992	49	61	52	60	69	%
Bending Strength	GB/T9341-2000	43	45	43	47	44	MPa
Bending Modulus	GB/T9341-2000	2180	2231	2209	2287	2313	MPa
Notch Impact Strength	GB/T1843-1996	11.8	12.3	12.4	12.7	12.6	KJ/m^2
Melt Index	GB/T3682-2000	8.8	9.3	9.4	9.7	9.6	g/10min
Flame Retardancy	UL-94	V-0	V-0	V-1	V-1	HB	/
Density	GB/T1033-1986	1.15	1.13	1.12	1.10	1.09	g/cm^3

Application results and discussion of ST-FR322 in flame retardant HIPS compound:

Based on the figures in Table 8 and the test data in Table 9, we can find that the addition of ST-FR322 to the HIPS flame retardant system has similar results as the addition of ST-FR322 to the ABS flame retardant system.

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Table 10 Application and formula of PVC for wires and cables

Material Name	A	B	C	D
PVC	100	100	100	100
DOP	35-40	35-40	35-40	45-50
Chlorinated Paraffin	14-18	14-18	14-18	14-18
Calcium Carbonate	30-50	30-50	30-50	30-60
Heat Stabilizer	3-5	3-5	3-5	3-5
Antimony Trioxide	1.5	2	2.5	1.5
ST-FR322	1.5	2	2.5	1.5
Oxygen Index	28-29	29.5-30.5	31.5-32.5	27-28

The application results and discussion of ST-FR322 in wires and cables (PVC):

ST-FR322, as a new type flame retardant synergist, can partially replace antimony trioxide in the brominated flame retardant system modification of plastics, as shown in Table 10. While reducing product costs, it can also significantly improve the material's processing performance and to some extent enhance the physical properties and strength of modified plastics. The demand for FR plastics compound is constantly increasing, and the continuous consumption of metal mineral resources needs to be reduced.

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