



Encapsulated APP series applied in Textile Coating

Eco-friendly halogen-free flame retardant

Product form: White powder



Version 1.4
2014-10

Content

- **Preniphor™ APP series and other APP on the market that we know**
- ✓ Testing methods and standards of flame retardant
- ✓ Physical properties comparison of different APP
- **Application of different APP in textile coating**
- ✓ Testing equipment and sample preparation
- ✓ Comparison of different APP used in textile coating
- ✓ Summary of different APP used in textile coating

Testing methods and standards of flame retardant

Items	Standard/method	Test equipment
pH value	25°C , 10% suspension	pH Meter
Water content	105°C/2h	Drying Oven
Water solubility	25°C , 10% suspension	High-speed mixer, Drying Oven
Particle size	ASTM E112-1996	Malvern Mastersize 2000
Viscosity	ASTM D445-06	Viscosity Checker
TGA	ASTM D3850-12	TA Q500
Polymerization Degree	³¹ P NMR	Bruker-400 NMR tester

Physical properties comparison of different APP

- **Basic data of different APP**
- **TGA curves of different APP**
- **Particle size distribution of different APP**
- **P³¹NMR spectrum of different APP**
- **Water resistance of different APP**

TDS data of different APP

Item code	P (%)	N (%)	pH	Viscosity (mPa·s)	Polymerization degree	Water content (%)	Solubility (%)	Particle size D ₅₀ (μm)
APP-C2	29~31	15~17	6.5~8.5	≤20	≥1000	≤0.5	≤0.04	~20
EPFR-APP262	~29	~16.5	5.5~7.5	≤20	≥1000	≤0.5	≤0.04	~10
EPFR-APP263	~29	~16.5	5.5~7.5	≤20	≥1000	≤0.5	≤0.04	~20
APP-J2	~30	--	4.0~7.0	≤5	≥1000	≤0.5	≤0.04	~18

Basic data of different APP

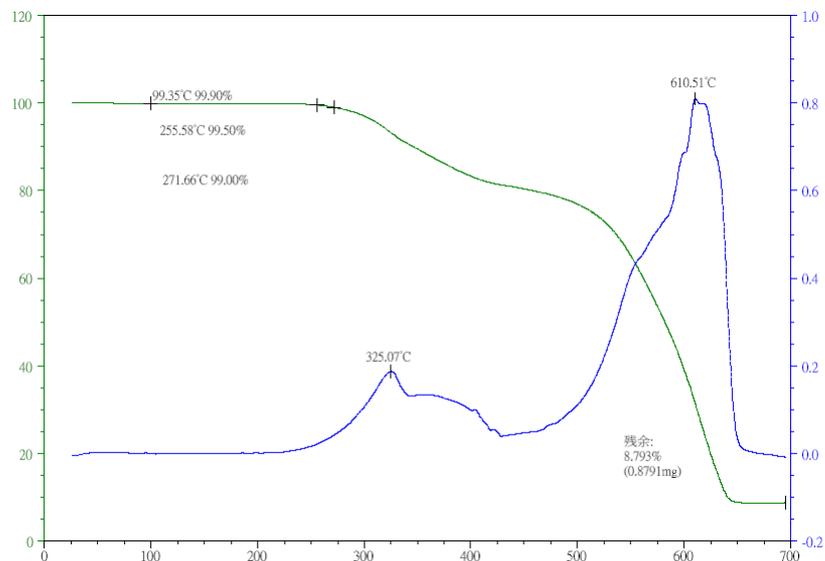
Item code	pH value	Viscosity (mPa•s)	Solubility(%)	Particle size(μm)	
				D ₅₀	D ₉₀
APP-C2	6.17	3600	0.0	15.46	27.73
EPFR-APP262	6.46	2800	0.0	11.50	20.72
EPFR-APP263	6.90	2700	0.02	20.62	36.94
APP-J2	6.08	2300	0.01	18.67	37.53

Basic data of different APP

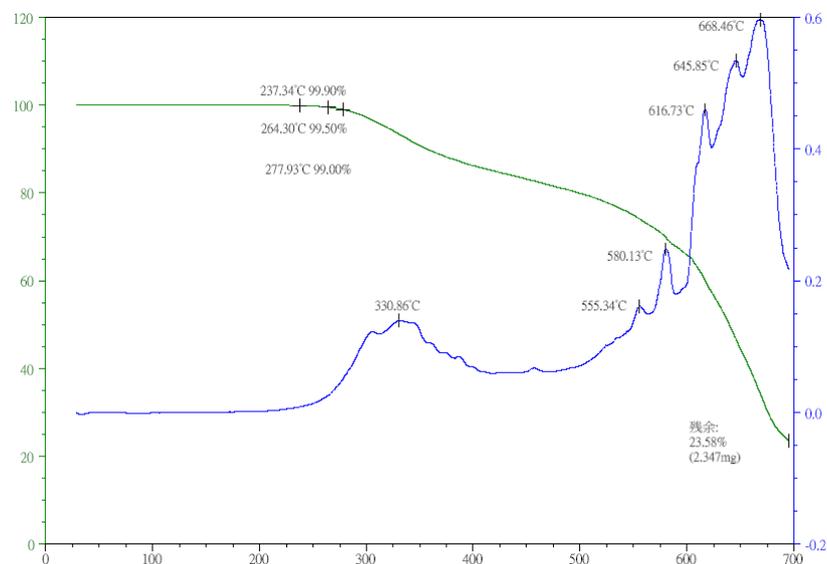
Item code	Polymerization degree	TGA (°C)				
		-0.1%	-0.5%	-1.0%	DTG1	DTG2
APP-C2	2500	90.35	255.58	271.66	325.07	610.51
EPFR-APP262	5000	237.34	264.30	277.93	330.86	668.46
EPFR-APP263	10000	238.68	263.19	276.00	324.85	629.18
APP-J2	1333	259.76	264.38	269.02	290.77	528.17

Basic data of different APP TGA curves

APP-C2

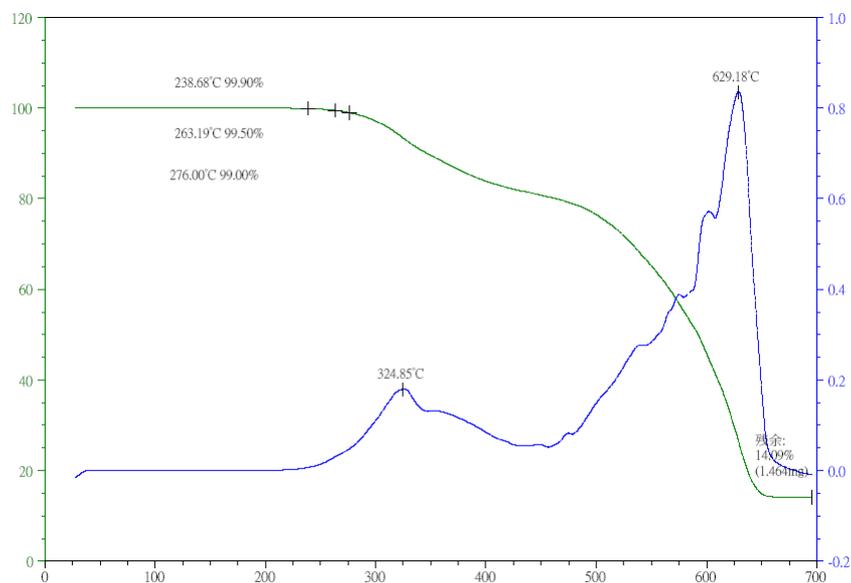


EPFR-APP262

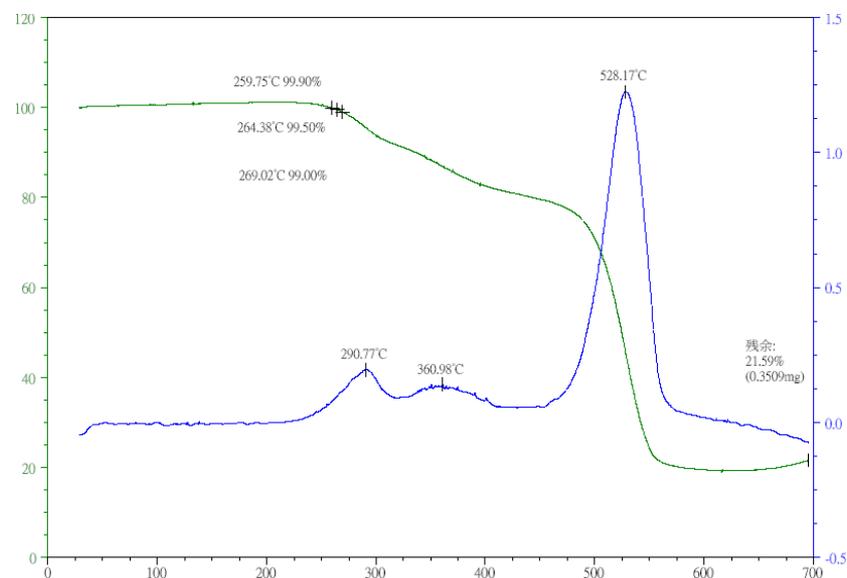


Basic data of different APP TGA curves

EPFR-APP263



APP-J2



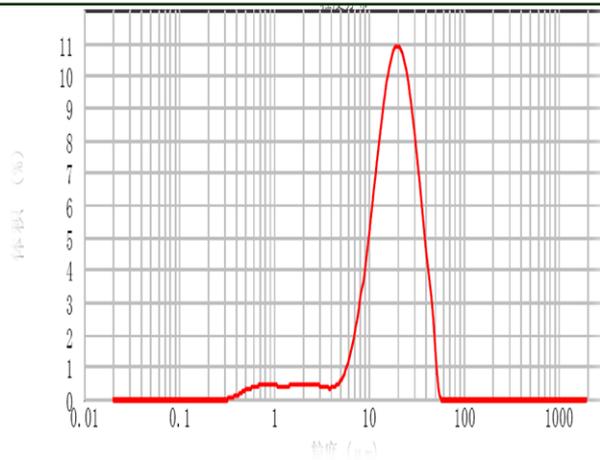
Basic data of different APP

Particle size distribution

APP-C2

Particle Size

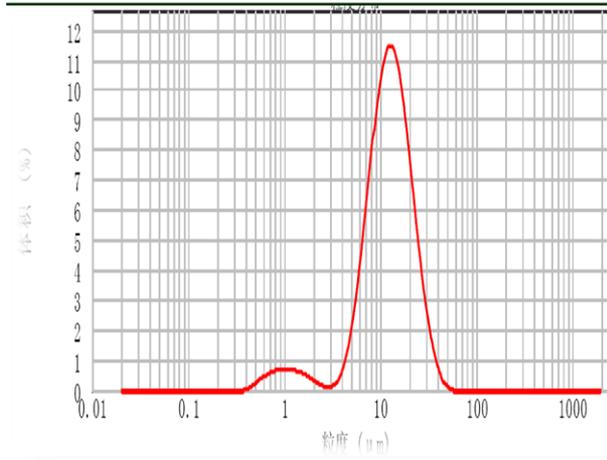
D ₁₀	5.65 μm	D ₅₀	15.46 μm
D ₉₀	27.73 μm	D ₉₈	33.32 μm



EPFR-APP262

Particle Size

D ₁₀	5.65 μm	D ₅₀	11.50 μm
D ₉₀	20.72.48 μm	D ₉₈	33.32 μm



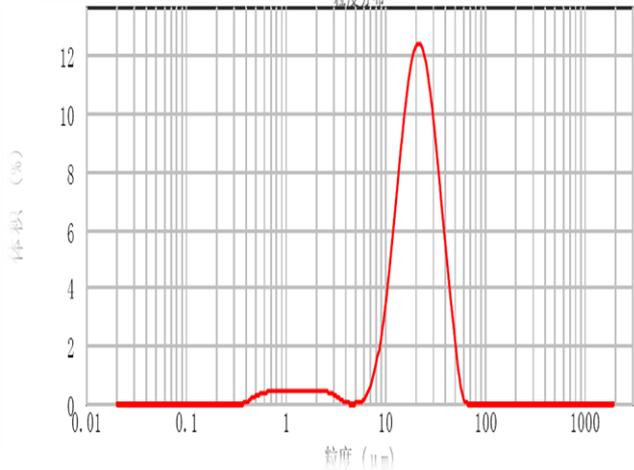
Basic data of different APP

Particle size distribution

EPFR-APP263

Particle Size

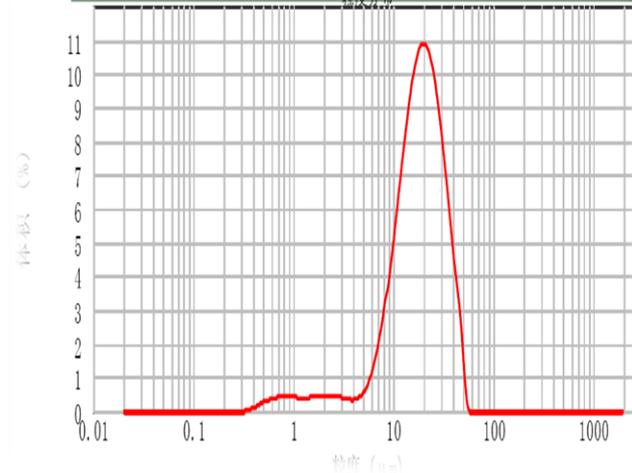
D ₁₀	10.26 μm	D ₅₀	20.62 μm
D ₉₀	36.94 μm	D ₉₈	47.85 μm



APP-J2

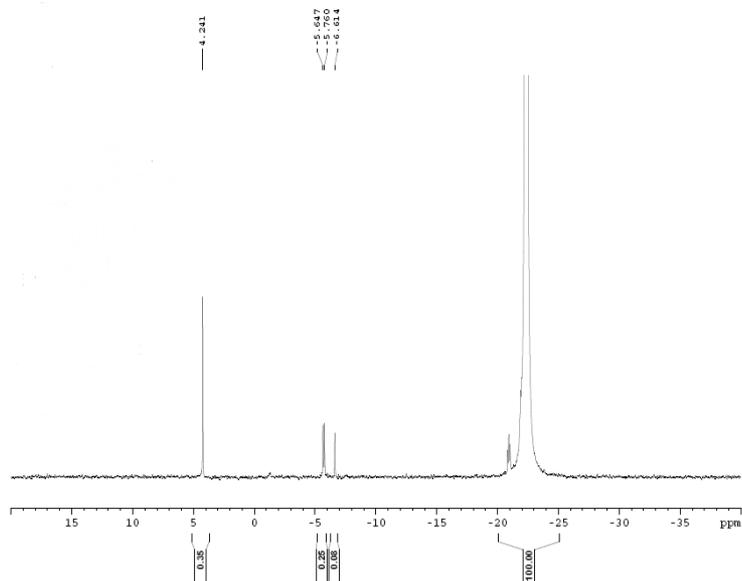
Particle Size

D ₁₀	7.64 μm	D ₅₀	18.67 μm
D ₉₀	37.53 μm	D ₉₈	45.35 μm

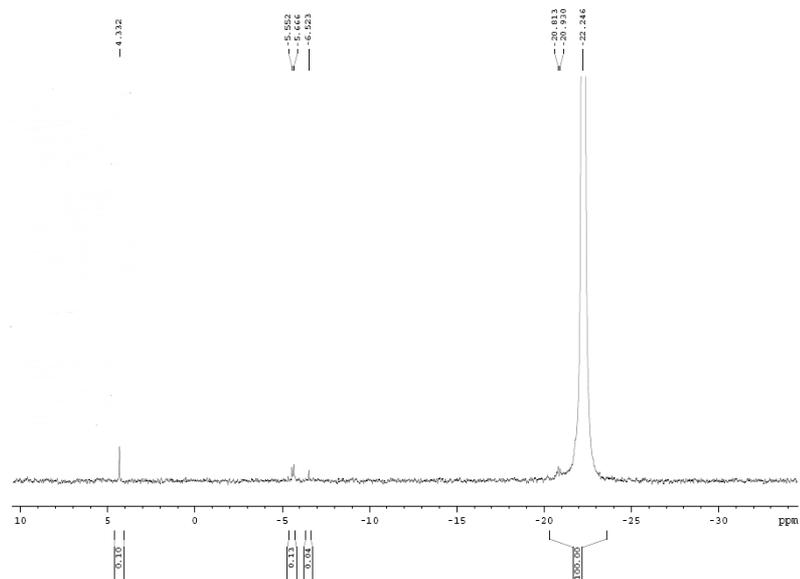


Basic data of different APP P³¹ NMR

APP-C2



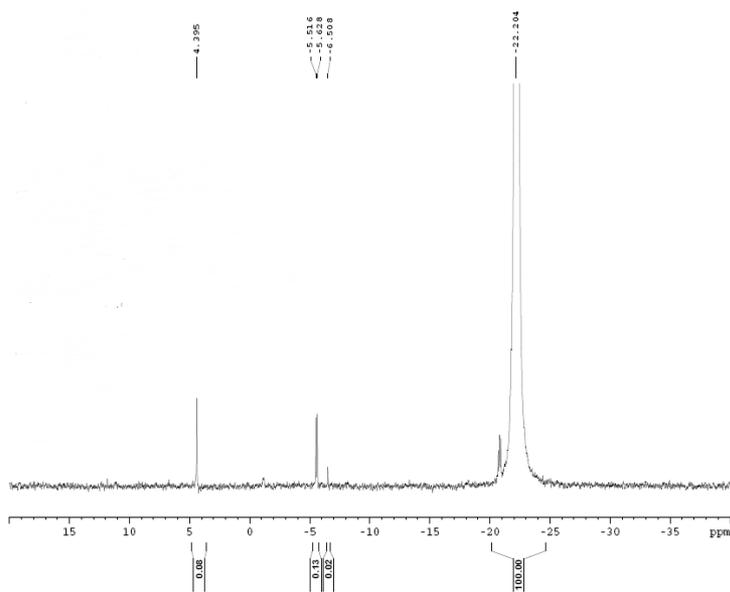
EPFR-APP262



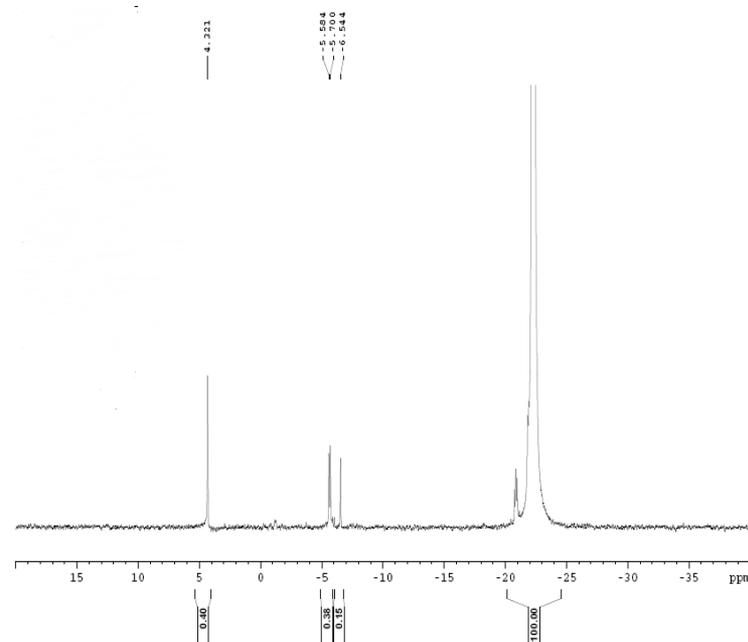
Basic data of different APP

P^{31} NMR

APP-263



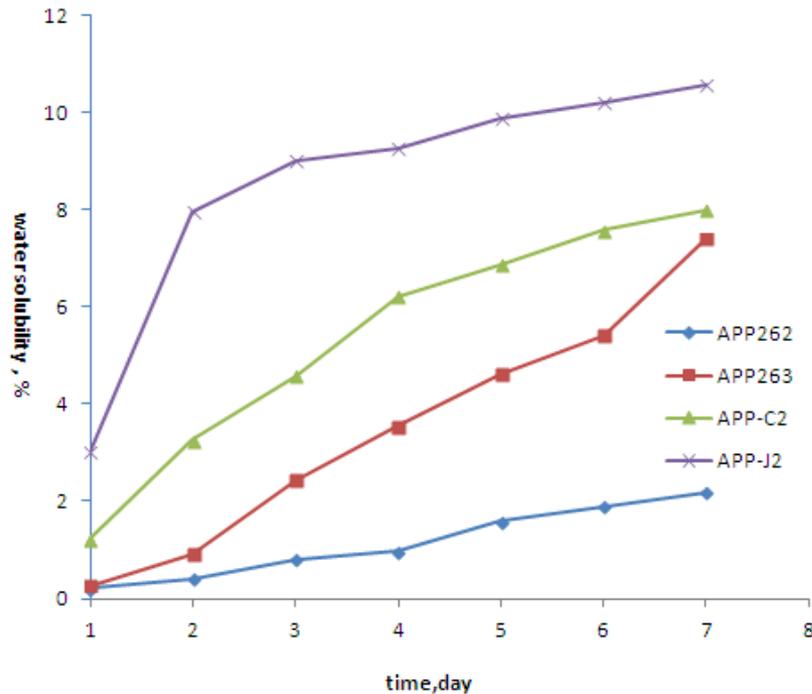
APP-J2



Basic data of different APP

Solubility at high temperature

Solubility test at 80°C



Test method: Make 10% saturated solution with 100g powder and 900ml water, then put it into 80°C thermostat water bath, take 50ml sample every 24h by dispersing solution evenly. We can get the water solubility after centrifugation, suction filtration, drying and weighing.

Application of different APP in textile coating

Application of different APP in textile coating

- **Recommended formula**
- **Test equipment and sample preparation**
- **Application property**
- **Flame retardancy**

Application of different APP in textile coating

Formula of textile coating used to evaluate different APP

Raw material	D2374 Water-based latex	APP
Weight (%)	60	40

D2374 water-based latex

Test Item	component	Solid content	pH value	Initial viscosity	Ionic type	T _g
Test data	Acrylate copolymer suspension	39.0-41.0%	6.0-8.0	<60mPa.s	Anion	-18°C

Testing equipment and sample preparation

Textile coating device



Textile vertical burning tester



Painting → Drying at 170°C → Painting another layer → Drying at 170°C

Test standards and test equipments

Test item	Test standards	Test equipment
Mass per unit area	ASTM D3776	Analysis balance
Glue amount	ASTM D3776	Analysis balance
pH value	AATCC 81	pH meter and water bath kettle
Water resistance	AATCC 22	Tension mounted water resistance tester
Flame retardancy	GB/T 5455	Fabric vertical burning tester
Water resistance under 45°C	BS 5651	Thermostatic water bath

Application of different APP in textile coating

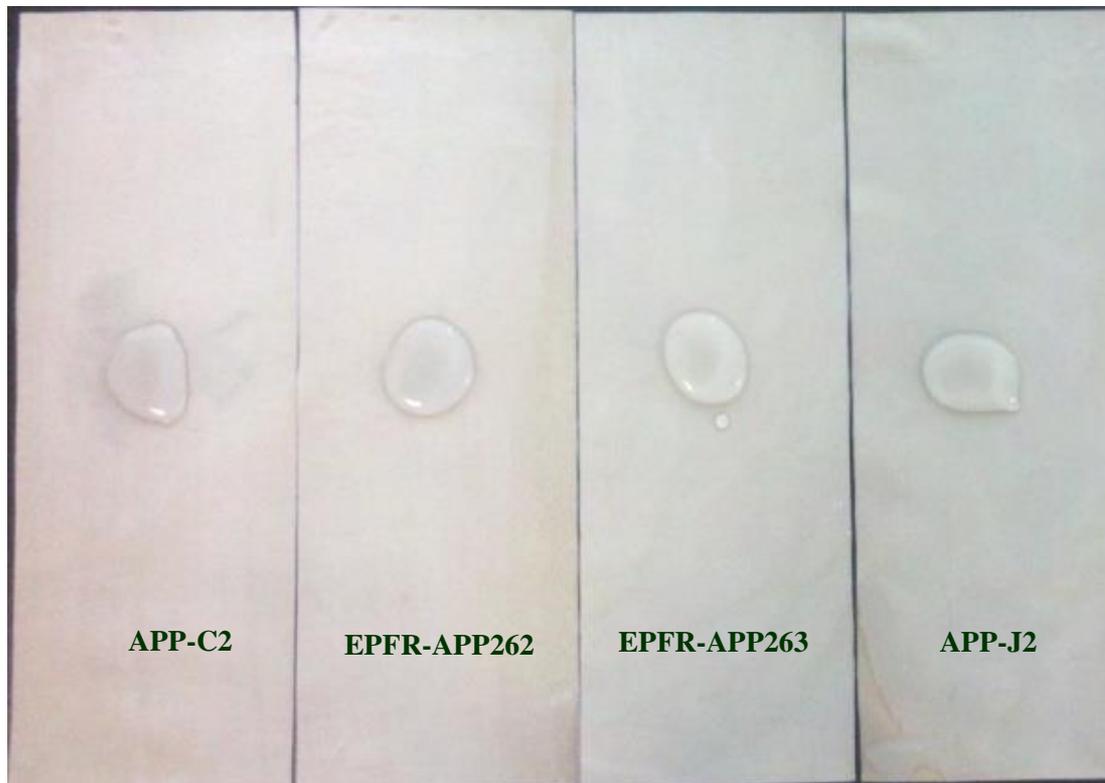
Application properties

Item code	Initial viscosity mPa.s	pH value after boiled 30mins	Water resistance (喷淋法)	Appearance	Hand feel
APP-C2	3600	6.05	50	No white spots, color close to textile itself	Soft
EPFR-APP262	2800	6.37	50	No white spots, color close to textile itself	Soft
EPFR-APP263	2700	6.11	50	No white spots, color close to textile itself	Soft
APP-J2	2300	5.51	50	No white spots, color close to textile itself	Soft

Application of different APP in textile coating

Precipitation tests using water drop

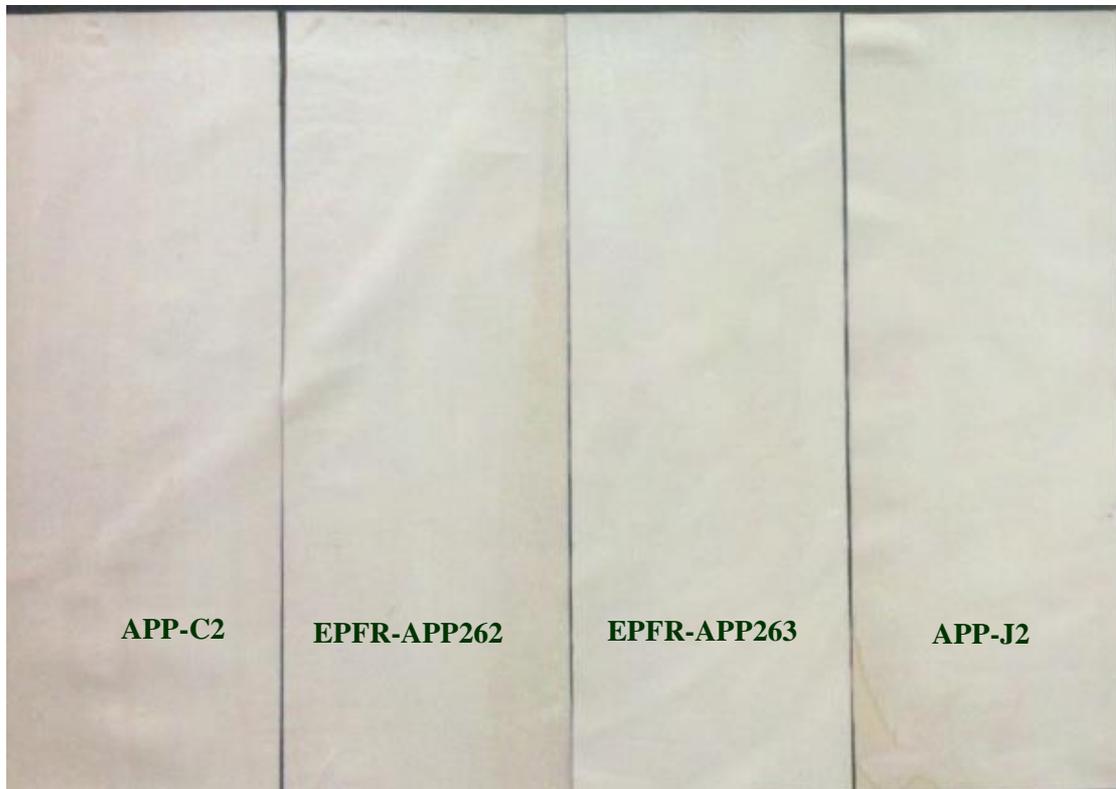
Water drop fall tests



Application of different APP in textile coating

Precipitation tests using water drop

After water dried



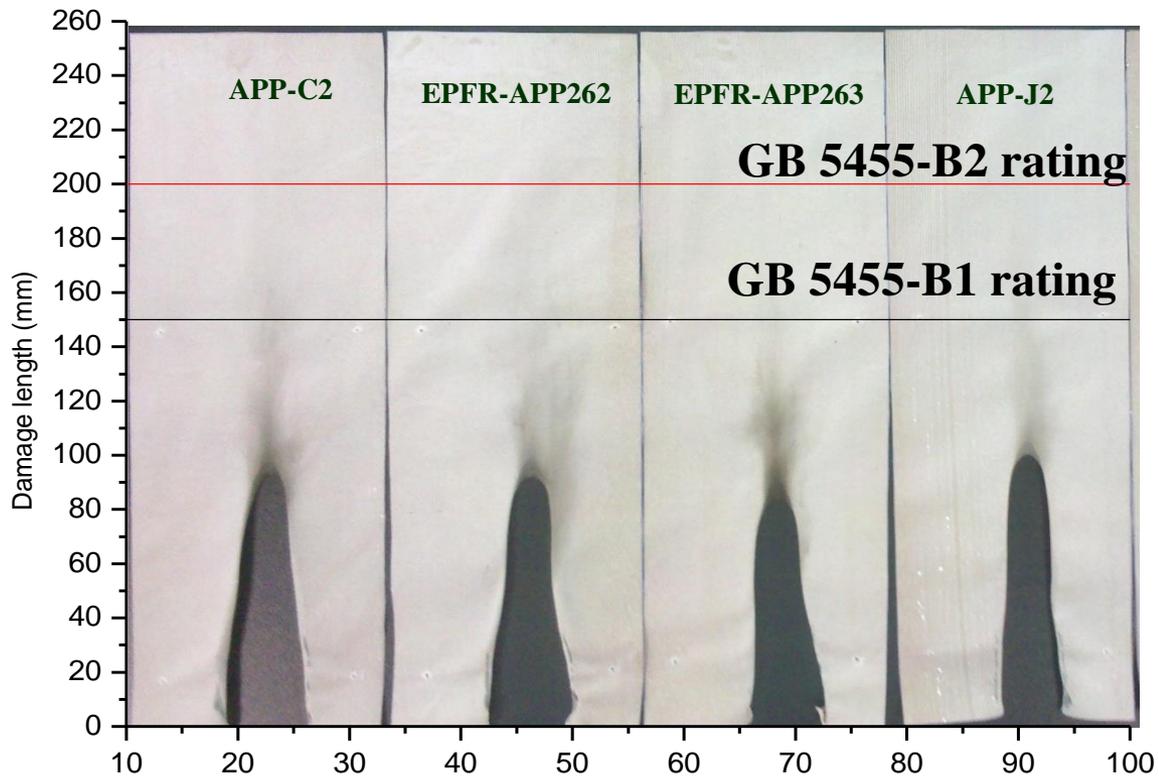
Application of different APP in textile coating

Comparison of flame retardancy

Item code	After flame time (s)	After glow time (s)	Damage length (mm)	Dripping	Glue amount (g/m ²)
APP-C2	0	0	98	√	120
EPFR-APP262	0	0	97	√	120
EPFR-APP263	0	0	96	√	120
APP-J2	0	0	102	√	120

Application of different APP in textile coating

Flame retardancy



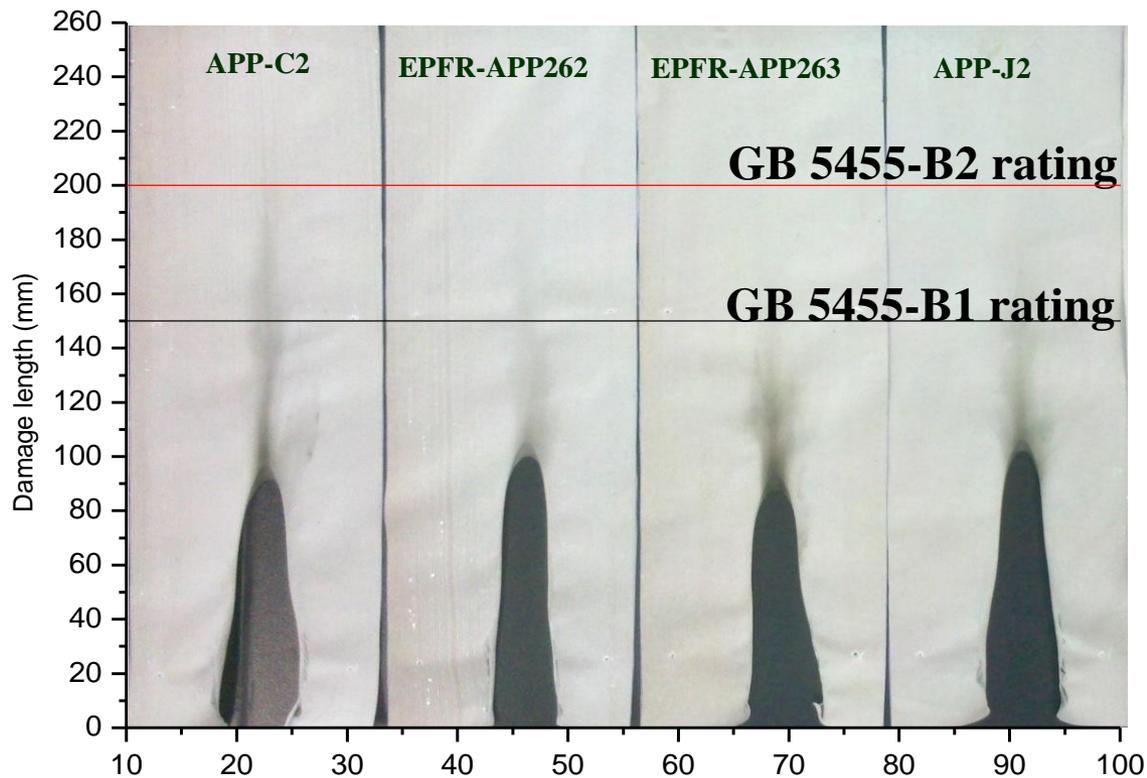
Application of different APP in textile coating

Flame retardancy comparison after 120mins immersed in 45°C water

Item code	After flame time (s)	After glow time (s)	Damage length (mm)	Dripping	Glue amount (g/m ²)	Weight loss ratio after water immersion/%
APP-C2	0	0	99	√	120	1.9%
EPFR-APP262	0	0	103	√	120	0.8%
EPFR-APP263	0	0	100	√	120	0.7%
APP-J2	0	0	104	√	120	2.6%

Application of different APP in textile coating

Flame retardancy comparison after 120mins immersed in 45°C water



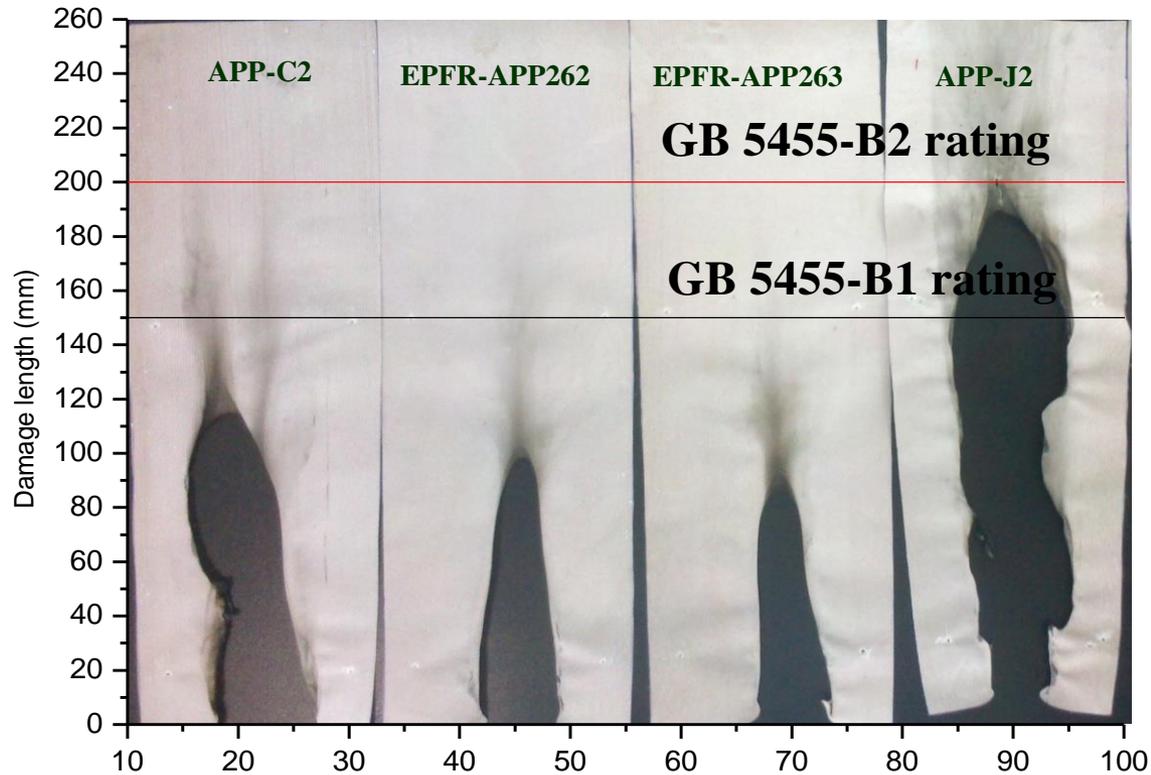
Application of different APP in textile coating

Flame retardancy comparison after 30mins immersed in 100°C water

Item code	After flame time (s)	After glow time (s)	Damage length (mm)	Dripping	Glue amount (g/m ²)	Weight loss ratio after water immersion/%
APP-C2	3.4	0	129	√	120	29.0%
EPFR-APP262	0	0	102	√	120	7.7%
EPFR-APP263	0	0	98	√	120	14.2%
APP-J2	15.3	0	201	√	120	33.4%

Application of different APP in textile coating

Flame retardancy comparison after 30mins immersed in 100°C water



Application of different APP in textile coating

Recommended formula

Raw material	D2374 Water-based latex	APP	MPP	MCA-10	phosphate	Water	Application
Formula 1	40	14	8	8	30	Appropriate	Heavy textile
Formula 2	50	14	8	8	20		
Formula 3	60	40	--	--	--		Light textile

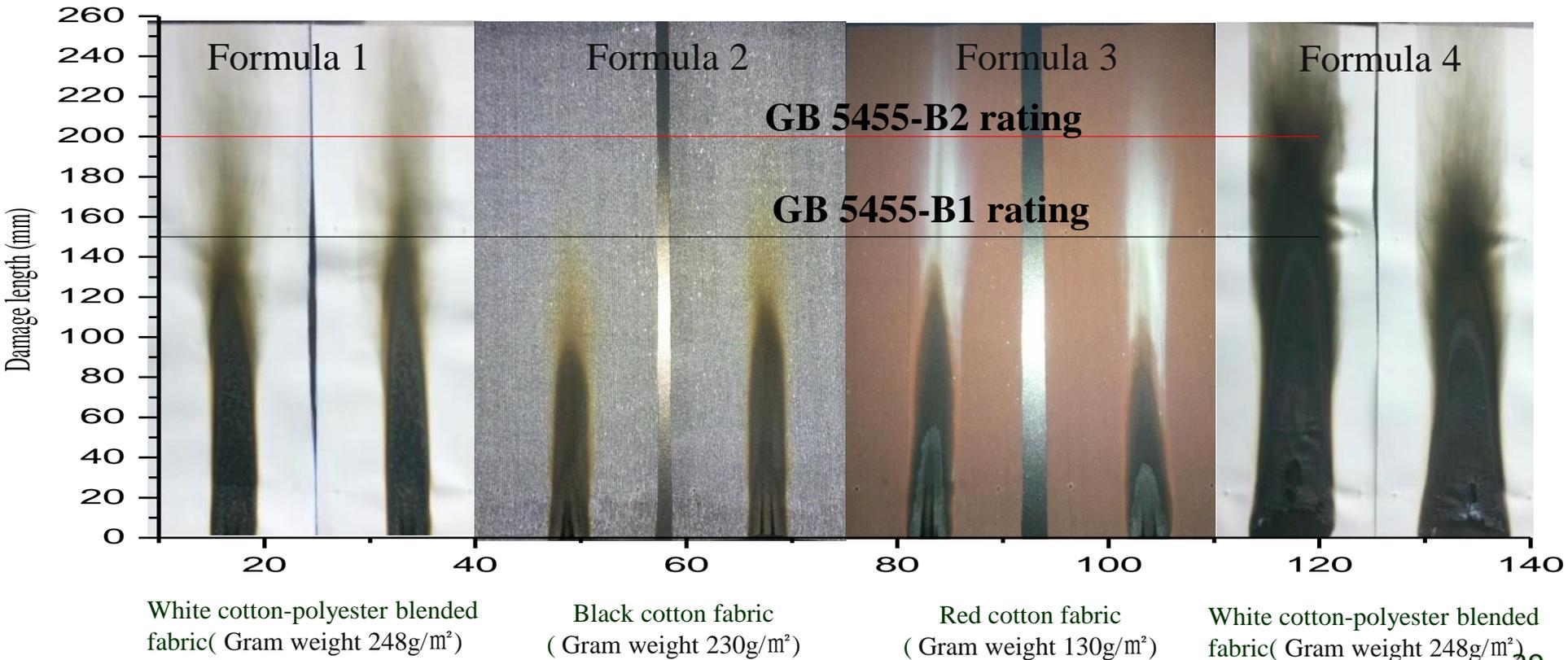
Bromine flame retardant as reference

Raw material	D2374	DBDPE	Antimony trioxide	Water	Application
Formula 4	40	40	20	Appropriate	----

Note: MCA-10→melamine cyanurate, MPP→melamine polyphosphate, phosphate→bis[(5-ethyl-2-methyl-2-oxido-1,3,2-dioxaphosphinan-5-yl)methyl] methylphosphonate

Application of different APP in textile coating

Application examples of recommended formula



Application of different APP in textile coating

Comprehensive comparison

Item code	Cost	Cost performance ratio	Water resistance	Compatability	Flammability	Batch stability
APP-C2	★	★★★	★★★★	★★★★★	★★★★★	★★★★★
EPFR-APP262	★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
EPFR-APP263	★★★	★★★★	★★★★	★★★★	★★★★★	★★★★★
APP-J2	★★	★★★★	★★★★	★★★	★★★	★★★★

Conclusion

Characteristics of EPFR-APP used in textile coating:

- ❖ **Excellent flame retardancy**
- ❖ **Low solubility in water**
- ❖ **Excellent dispersity and storage stability**
- ❖ **Good water resistance and resistance to precipitation**



Halogen free flame retardant specialist

PRESAfer



PRESAfer

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