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Rayeneh Group

Designing Flame Retardant Plastic Compounds

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Company: Rayeneh Group (supplier & developer)

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Dear Reader;

Welcome to this our first edition of Rayeneh Group presentation for the ۸th international conference and exhibition on masterbatch and polymer compounds. Our aim is to explore the evolution of the Flame Retardants technologies and to report our best knowledge in this captivating and essential field of fire safety and flame retardants. From our perspective, flame retardants are comparable to a discrete fireman always present and close to you.

Thanks to Seyed Ali Motazedi and Zahra Yousefi for collecting and preparing this presentation.

Content

Flame Retardant Compound

Flame retardant systems are intended to inhibit or to stop the polymer combustion process through various mechanisms.

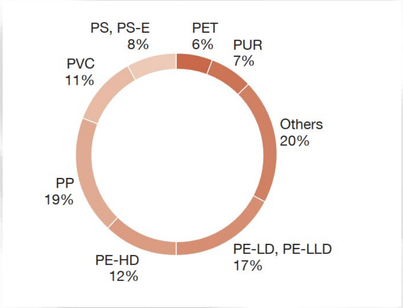

Figure1. Flame Retardants Market Size, by type

Industries which needs flame retardant materials

Today, flame retardants are typically used in :

- Wire and Cable
- Electrics and Electronics
- Home Appliances
- Building Constructions
- Automotive industries

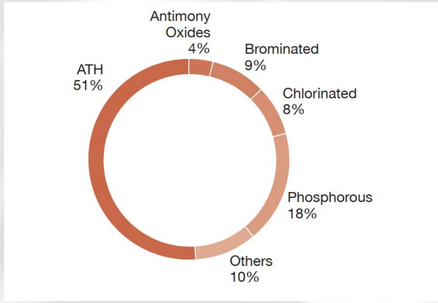

Figure2.The Global consumption of flame retardants in 2015

Mechanisms of Flame Retardant additives:

polymers are highly combustible Due to their chemical structure, made up mainly of carbon and hydrogen .

There are 3 various mechanisms of Flame Retardants:

Flame retardants can cause a layer of carbon (charring) on the polymer›s surface.

The flame retardant or its degradation products stop the radical mechanism of the combustion process. It takes place in the gas phase. The exothermic processes, which occur in the flame, are thus stopped. The system cools down and the supply of flammable gases is reduced and eventually completely suppressed.

The additives can form a shield with low thermal conductivity, through an external heat flux. This can reduce the heat transfer delta H۲ (from the heat source to the material). It then reduces the degradation rate of the polymer and decreases the «fuel flow» (pyrolysis gases from the degradation of the material). This feeds the flame

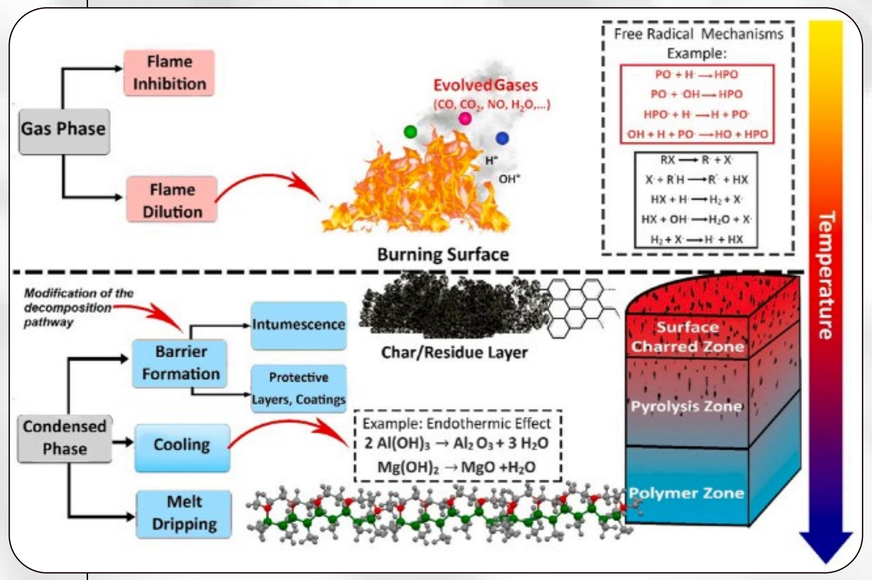

Figure3. Possible action mechanisms of flame retardants in the gas and condensed phases

LOI: (Limited Oxygen Index - iso 4589 , ASTM D2863)

There are several tests that help to assess flammability/fire performance behavior as a function of heat release, ignitability, flame spread,toxicity/corrosivity, smoke production, and fire resistance. Some of these tests are presented in Fig.3. and one of these tests is limited oxygen index.
The value of the LOI is defined as the minimal oxygen concentration [O2] in the oxygen/nitrogen mixture [O2/N2] that either maintains flame combustion of the material for 3 min or consumes a length of ٥ cm of the sample, with the sample placed in a vertical position (the top of the test sample is inflamed with a burner). On the other hand, the lower LOI, needs higher amount of the flame retardants.

Polymer	LOI (%)
PE	17.4
PP	17.4
PS	17.6 - 18.3
PC	22.5
PVC	45 - 49
PA 66	24

Table1. The amount of LOI for various Polymers

Flame Retardant, Which one?

Table ۲ presents the advantages and drawbacks of commonly used FR systems in different systems. New formulations are therefore needed that do not have these shortcomings and can be easily applied in products that successfully face the stricter regulations appearing in flame retardant sectors.

TYPE OF FLAME RETARDANT	ADVANTAGES	DISADVANTAGES
METAL HYDROXIDES	• NO ACIDIC GAS EMISSIONS • Effective smoke reduction • NON-TOXIC • LOW PRICE	• VERY HIGH LOADING NECESSARY • DECREASE MECHANICAL PROPERTIES • LIMITATION OF DEGRADATION TEMPERATURE DURING THE PROCESS
HALOGEN COMPOUNDS	• COMMONLY USED • EFFICIENT AT LOW LOADINGS • EASY TO PROCESS	• EMISSION OF SMOKE AND TOXIC GASES • LOW HEAT AND LIGHT STABILITY • CORROSIVE EMISSIONS
NITROGEN COMPOUNDS	• HALOGEN FREE • LIGHT STABILITY FUNCTION • LOWER CONSUMPTION RATE THAN HYDROXIDES	• EFFECTIVENESS LIMITED TO THIN SECTION IN PP
PHOSPHORUS COMPOUNDS	• FUNCTIONS WELL IN HIGH HEAT FLUX FIRE CONDITIONS • HIGH MECHANICAL PROPERTIES • LOWEST CONSUMPTION RATE	• MORE CO AND SMOKE GENERATION • UNDER ENVIRONMENTAL SCRUTINY
SILICON COMPOUNDS	• ENVIRONMENTALLY FRIENDLY • ANTI – DRIPPING PROPERTIES • GOOD PROCESSABILITY	• FEW STRUCTURES EFFECTIVE IN PP • HIGH COST

Table2 . The advantage and disadvantage of various Fame Retardants

Principles of Flame Retardant compound designing

To design and achieve optimal performance of a polymeric mixture consists of flame retardants, the following points should be considered:

- Reference Standard
  UL-94 Glow Wire – Needle Flame –IEC tests ,...
- Base Polymer
- Final Product Dimension
- Process
- Other Components
- Final Properties
- Other functional Additives:
  Anti dripping - Compatibilizers – Coretardant
- Final Prices

Some Flame Retardant compounds

Here, we introduce some products, the appropriate flame retardants, and their dosages for each polymer in Table 3.

Polymer	products	UL94 grade	Flame Retardant Additives	Dosage%
PE	Wire and cable	IEC tests	ATH, MDH,…	50-60
	Electrical Conduit	IEC tests	ATH, MDH, Nanoclay	30-40
	Home Appliance	V0-V2	Cl. Br.	<10
PP	Cover of capacitors	V0	Br , Cl , MDH, Si , Anti dripp	<15
	Home Appliance	V1	Br , Cl , MDH, Si	<10
	Automobile parts	V2	Cl. MDH	<10 <30
PS	GPPS, HIPS, EPS	V0	Br, ph	<5 <15
PA	electrical , Electronical parts , wire and cables	V0-V2	Br, N, Ph	5-15
PC, ABS	Electrical connectors , Electronical Parts , Electrical Boxes	V0-V2	Ph , Si	<10

Table3. appropriate Flame Retardant for each polymer

Rayeneh Group In this Bussiness:

Rayebeh Can Provide :

Importing the Flame Retardant Additives
Stocking some widely consumed Additives
Consulting about the market
Developing the formulations according to customer demands
Market Development for the Compounds

A knowledgment:

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Thanks for Your Attention

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