

TOPIC: Working mechanism of different compounds in flame retardants

REF: TT/ June 2016/ WK 4

Flame Retardants:

Flame Retardants are additives (discrete molecules or polymers) or reactive compounds that can be added to or applied as a treatment to materials such as plastics, textiles, wood etc.

Basic working principle of flame retardants:

Flame retardants reduce the flammability of materials by either blocking the fire physically or by initiating a chemical reaction that stops the fire.

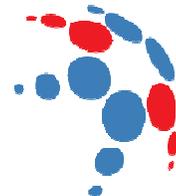
Types of flame retardants classified based on their chemical nature:

❖ Brominated Flame Retardants (BFRs):

- The effectiveness of Brominated flame retardants lie in their ability to release active Bromine atoms (called free radicals) into the gas phase as the material decomposes in the flame.
- These Bromine atoms effectively extinguish the fire through successive chemical reactions occurring in the flame, which results in a reduction of heat generation, subsequently retarding or even preventing the burning process.
- The addition of metallic compounds such as Zinc or Antimony Oxides enhance the efficiency of BFR's, by allowing the formation of transition species, also known as metal Oxohalides, which results in the deposit of a protective layer of metal oxides. e.g. Antimony Trioxide (Sb_2O_3)

❖ Phosphorous flame retardants:

- Phosphorus-containing flame retardants act efficiently in the solid phase of the burning material.
 - When heated, Phosphorus reacts to produce a polymeric form of Phosphoric Acid. This acid causes the material to char, forming a glassy layer, inhibiting the "pyrolysis" process (break down and release of flammable gases), which is necessary to feed flames.
 - By this mode of action the amount of fuel produced is significantly diminished, because char rather than combustible gas is formed.
 - Certain retardants contain a combination of Phosphorus, Chlorine, Bromine or Nitrogen, increasing their retarding properties. They are widely used in standard and engineering plastics, polyurethane foams, thermo sets, back coating and textiles.
-



❖ **Inorganic flame retardants:**

- The inorganic compounds used include metal oxides, hydroxides, borates, stannates (Aluminum and Magnesium Hydroxides, Antimony Oxides, Zinc Borate and Stannate), inorganic Phosphorus compounds (red Phosphorus and Ammonium Polyphosphate) and graphite.

Interference with the burning process through three main physical processes:

- 1) Release of inert gases such as water vapour, which dilute the fuel/oxygen mix thus preventing the exothermic radical reaction from taking place in the combustion zone.
- 2) Energy absorption through endothermic decomposition (reducing energy available for fire spread) thereby contributing to cooling and retardation of the pyrolysis process.
- 3) Production of a non-flammable and resistant layer on the surface of the material, (protective char layer) reduces the release of flammable gases and energy transfer to the polymer.

Have a great week ahead!

Technical Tuesdays is a knowledge sharing initiative by Resil Chemicals Private Limited
arc@resil.com | www.resil.com

