

Technologies and expertise of ADEKA,

a comprehensive polymer additive maker, are used to make plastic products which are essential for our everyday life highly functional.

Development of Intumescent Flame Retardants The Adeka Group's New Challenge to Protect Human Life and Environment

Polymer additives which are essential for manufacturing plastic products in our everyday life are regarded as one of the Adeka Group's core business segments, together with the food business. With manufacturing and sales bases for polymer additives mainly in Europe, U.S., Asia, and the Middle East, the Group has strived to reinforce its global supply system centering on a domestic mother plant in Mie Prefecture. In June 2010, the polymer additives department was newly established, integrating related functions such as sales, planning, and R&D. The Adeka Group has a system in place to offer new products created with cutting-edge technologies worldwide at the same time, in cooperation with overseas bases.

Regenerating plastics with polymer additives

Plastic is called "synthetic resin" as it looks like natural resin such as rosin before formed. The world's first plastic "celluloid" was invented in U.S. in 1869. As celluloid is very flammable and fragile, we hardly see it these days.

Plastic like celluloid at that time cannot meet various market needs. It is useless, easily broken if dropped, and tarnishing and deteriorating with sunlight (ultraviolet light). Therefore, polymer additives add characteristics demanded by customers to plastic, for example durability, heat and flame resistance, as well as transparency, in order to make plastic more useful in everyday life.

In a way, chemical manufacturers providing such additives play a role of pharmacist in the resin industry. For example, in order to fulfill multiple needs such as durability, heat and flame resistance, and easiness to form,

many additives are blended to draw specific characteristics of plastics. Solid technologies, experience, and expertise which have been cultivated for long years are essential to prescribe special additives for each customer. The Adeka Group's existence value as a "comprehensive polymer additives maker" could be attributed to this point.

Major kinds and roles of polymer additives

Stabilizer	Preventing deterioration
Plasticizer	Providing plasticity
Antioxidant	Preventing deterioration due to heat and acid
Light stabilizer	Making optical energy such as ultraviolet harmless to prevent deterioration and tarnishing
Nucleating agents	Improving physicality of machinery, such as rigidity and heat distortion temperature. Promoting plastic forming cycle in the stage of manufacturing improving productivity
Clarifying agents	Increasing transparency
Heavy metal deactivators	Preventing deterioration due to catalysis of metal
Flame retardants	Providing flame resistance

History of development of flame retardants: Starting from fire at the Opera House

Study of flame retardants which make flammable things flame-resistant dated back to the era of Louis XIV (1678-1715) in France. At that time, while famous opera and ballet were in their heyday, the number of fires at closed buildings increased. As fires often occurred by curtains catching fire, fibers containing flame retardants became used as preventive measures. It is considered to have been known that flame retardants work on flammable things, air, and heat to inhibit burning since then.

The development of such non-flammable fibers drastically advanced with study by the U.S. Armed Force during the period of the World War II. At that time, a lot of pilots who escaped from a burning airplane were burned to death by flight suits catching fire while bailing out. Worried about loss of valuable combat personnel, the U.S. Armed Force developed epoch-making flame retardants for flight suits such as halogen compound as a result of prodigious studies.

After that, the R&D of various halogen flame retardants made from the compound advanced.

Deadly smoke and carbon monoxide poisoning

With the theme of saving a lot of precious lives from fire, the Adeka Group successfully developed non-halogen flame retardants to reduce generation of smoke and carbon monoxide, compared with halogen flame retardants.*

In recent years, as new needs for more effective air conditioning, security, and privacy protection including sound insulation, etc. have increased amid progress of urbanization in people's lives, more airtight living environment has been demanded.

At the same time, risks of losing lives have also increased. It was reported that more people died in suffocation and poisoning caused by smoke and carbon monoxide generated from burning building materials and household goods than in burn injury.

*In the 1990s, European environmental organization pointed out that dioxin is emitted from halogen flame retardants at low burning temperature. However, a certain research concluded as follows: 1) toxicity of dioxin itself is considered low; 2) even in a case of generation of dioxin, as it would be decomposed for short time, the possibility of environmental destruction is extremely low. In response to the indication, some European countries and U.S. have proactively shifted to non-halogen flame retardants. Ahead of competitors worldwide, the Adeka Group has worked on provision of non-halogen products to those countries, introducing cutting-edge technologies.

The Adeka Group's New Challenge to Protect Human Life and Environment

Development of intumescent flame retardants overcoming challenges*

*Reducing development of fire and generation of smoke and carbon monoxide

In order to overcome the challenge that the generation of excessive smoke and carbon monoxide kills more people, the Adeka Group developed ADK STAB FP-2000 series, intumescent flame retardants for polyolefin which is manufactured most among general-purpose plastics with studies over the years. Polyolefin known as resins such as polyethylene and polypropylene is used for various things in our everyday life, widely ranging from low-cost

to sophisticated versions through improvement in production technologies. While excellent in chemical resistance, mechanical characteristics, workability, and recyclability, polyolefin is disadvantageous in that it is very flammable, composed of only carbon and hydrogen. The Adeka Group believe that its technologies and expertise for flame retardants, etc. could make great contributions to making said material further useful.

System to suppress burning

The basic principle of flame resistance in intumescent flame retardants is the same as other flame retardants. If plastic containing intumescent flame retardants catches fire, foaming on the surface of resin forms a thick carbonized layer of foams like swollen bread. This layer increases effects to insulate heat and cut off gases that fuel the flame, inhibiting combustion of the plastic. As a result, the development of fire and the generation of smoke and carbon monoxide can be curbed (See the figure shown below). ADK STAB FP-2000 series, which is phosphorous compound, does not generate dioxin. A smaller amount of intumescent flame

retardant is more effective than halogen products. This feature is very important not only in terms of cost, but also because the large amount of flame retardant added impairs the effects of other polymer additives.

The intumescent flame retardant is used for cables of televisions and PCs, and peripheral electric components of automobiles, which may combust due to heat generation and overvoltage.

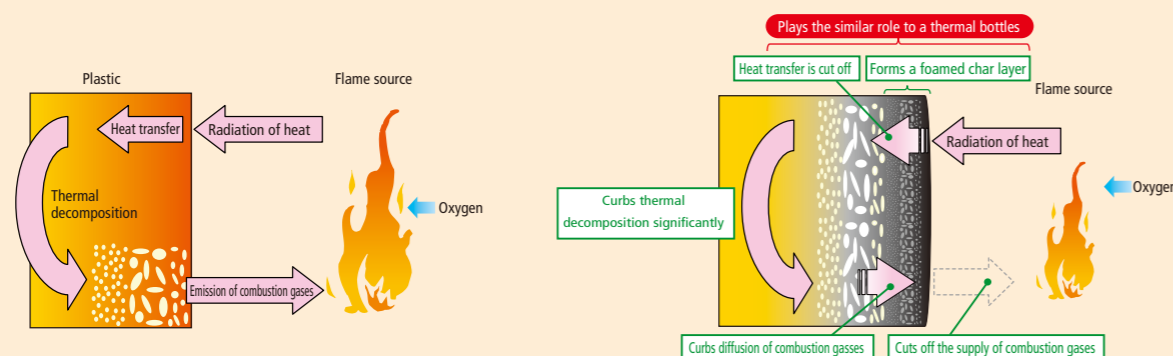
Pattern diagram of combustion cycle

Plastics without flame retardants

When heat is radiated, plastic decomposes and emits gases that fuel the flame source to continue the combustion cycle.

Plastics containing intumescent flame retardants

The plastic initially combusts, but this is immediately followed by carbonation and foaming, creating an intumescent layer that provides thermal insulation and acts as gas barrier to inhibit combustion and extinguish the flame.



Establishing a mass production system with Adeka Fine Chemical (Shanghai) Co., Ltd. as a core production base

In March 2011, a production plant for intumescent flame retardants was newly established in "Adeka Fine Chemical (Shanghai) Co., Ltd. in China, which would serve as a core production base. While establishing a production system to manufacture 5,000 tons per year, the Adeka Group is taking into account ambient environments, for example, by introducing a recycle system for water used for solvent. In the future, the market of intumescent flame retardants is expected to grow to the scale of 50,000 ~ 100,000 tons. As a leading company in this field, the Adeka Group intends to focus on diffusion of intumescent flame retardants

which are made of eco-friendly materials and would support security of our lives from the behind.



Production plant for flame retardants at Adeka Fine Chemical (Shanghai) Co., Ltd.

Topics on the polymer additives business

Completed a plant for one pack additives at ADEKA Al Ghurair Additives LLC, a new base of the polymer additives business in the Middle East

In March 2012, a plant for one pack additives was completed at the Adeka's first joint venture in the Middle East. One pack additives are easily-handled granules which consist of multiple polymer additives, such as antioxidants and light stabilizers, blended according to customer's needs. Mistakes in blending and scattering of powder are prevented by put the additives into a single package. The product is popular among many customers, as taking into account advantages in terms of production management and environmental aspects.



Completion ceremony at ADEKA AL GHURAIR ADDITIVES

New polymer additives developed uniquely by Adeka

Developing "ADK STAB NA-05," a nucleating agent for PET Making PET bottles thinner and lighter, and improving productivity

The Adeka Group developed a new nucleating agent for polyethylene terephthalate (PET), a material of PET bottles, etc. With a small amount added, ADK STAB NA-05 improves performance of PET products, by increasing stiffness and thermal stability, and curbing warpage. Furthermore, the nucleating agent is expected to contribute to resource saving and reduction in wastes by making PET products thinner and lighter.

Developing "ADK STAB LA-F70," a long-wavelength ultraviolet (UV) absorber

Excellent product to be applied in a wider range of areas

The Adeka Group developed an ultraviolet absorber which effectively cuts off long-wavelength ultraviolet (UV-A:320 ~ 400nm) to prevent organic substances from deteriorating with ultraviolet. With its high heat resistance meeting a requirement for processing over 300°C, the ultraviolet absorber is expected to be applied in a wider range of areas, such as optical films to be attached on monitor screens.