

Analysis of Development Trend of Flame Retardants Patents/Technologies

Jongtaik Lee*

*Korea Institute of Science and Technology Information, Korea

E-mail : jtlee@kisti.re.kr

1. Introduction

Various studies for safe products and buildings from disasters have been performed. One of them is concerned with harmless non-combustible products/technologies and related technology development and investments have been actively conducted. This paper will present the developing flow and trend of patents/technologies regarding flame retarding materials and suggest future direction of necessary R&D contents by Korean domestic enterprises.

There are three types of flame retardants: addition form, reaction form, and inorganic form. Addition form is used for mixing in a mechanical or physical way with base polymer resin to show flame retarding characteristics. Reaction form is for chemical bonding with high molecular resins to make flame retarding element bonded to base resins, or itself is a flame retarding high molecular resins. Retardant aid such as antimony oxide or aluminum oxide to support and help the effect of flame retardants is classified as inorganic form.



Figure 1. Example of Flame Retardant¹ (with halogenated flame retardant)

Addition form of flame retardants is sorted into halogen system, phosphorus system, and nitrogen system according to retarding elements.

2. Technology Trend

Recently, researches of environment-friendly halogenated flame retardants are the most common topics, followed by phosphorus or other inorganic products. This trend is not irrelevant to social needs or market competitive power. Below is about recent technology trend of each flame retardant system.

[Table 1] Technology Trend of Flame Retardant Systems²

Halogen System	Phosphorus System	Nitrogen System
reduction of physical properties, such as shock or heat, decreasing	anti-heat and retarding effect by oligomer-typed phosphate ester	paper/wood flame retarding by guanidine compound
increasing rheological properties, mold corrosion, adhesion or deterioration	increasing anti-volatility, anti-hydrolysis by bisphenol A bis(diphenylphosphate) or di-2,6-silylphosphate)	N-P containing Antimon phosphate(or sulfate) in a molecule
synergy with halogen and metal oxide	surface treatment by aluminum hydroxide, magnesium hydroxide, zinc hydroxide or titanium hydroxide)	retarding system with amide compound and pentaerythritol
new halogenated compound:TBBA, oligomer, trimethylphenyl phosphate	micro-capsulation of phosphate compound or silan compound	
low fume-emitting by Cu ₂ O, MoO ₃ , FeOOH, boronated salt		
effect of intumescent silicate powder		

¹ <http://blog.daum.net/russiaculture>

² Nishijawa Research Center, Japan, 2012

3. Patent Trend³

A considerable number of patents were applied in 1989 and 1993, and more than 100 patents (average) have been annually applied since 1997, when the applied patent number was peaked. The number of patents applied is approximately 2.5 times than '80s. Five major applicants are Cheil Industries (merged to Samsung SDI), Asahi Chem, General Electrics, Japan St Nt Hetic Rubber Co., and Kolon.

Below is the global number of patents applied from 1974 to 2013.

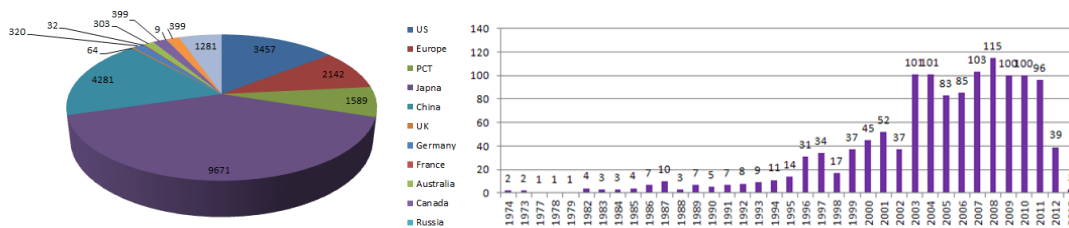


Figure 1. Patent Number of Global Areas(left) and Korea over years(right)

The number of patents in Korea had started increasing from 1988, and increased dramatically from 1995. Patents of original technologies had been the main contents up to 1991 and applied technologies were the main after 1996. Annual average number of patents applied in Korea is about a hundred. On the contrary, US shows about 12 to 15 patents on the average with a constant level. Japan had started increasing from 1980's and still shows very active patent activities, unlike US.

Addition form out of three types of flame retardants occupies 89% of applied patents in the world regarding flame retardants, and reaction forms 6%, inorganic forms 5%. Applied patents in Korea regarding addition form occupies 94% and Cheil Industries has applied the most patents and the next companies are Kolon and LGChem. These three major companies occupies more than half of the patents in Korea. In the US, GE holds a prominent position with 15% for addition form and 25% for reaction form.

In Korea, the majority out of halogen, phosphorus, and nitrogen system is halogen system. And the next system is phosphorus one due to the trend of non-halogenated system without maleficence. However, the patents of phosphorus system are mainly for application technology such as composition rather than original technology or additive manufacturing. Nitrogen system has been studied to figure out color problems of halogen system and give a solution as a flame retarding coating material. Recent studies involve phosphorus-nitrogen mixed system rather than nitrogen single system.

Recent trend of flame retardant research includes safety and balancing with the environment as well as outstanding physical properties and machinability. The main issue for implementing them would be reasonable cost, regulation of flame retardants, and social circumstances.

4. References

- [1] The Freedonia Group, "World Market of Flame Retardant", 2013
- [2] Nishijawa Hitoshi, "Recent topics in Flame Retarding Technology of Polymer", Science and Engineering, 72(4), 137, 1998.
- [3] Jang, B. N., and Choi, J. H., "Research Trend of Flame Retardants and Retarding Resin", The Polymer Society of Korea, 2012.
- [4] www.cischem.com, Chemical Report, 74, May 1997.

³ Analyzes on www.kipris.or.kr (2013. July. 7) with keywords of flame and retardant.