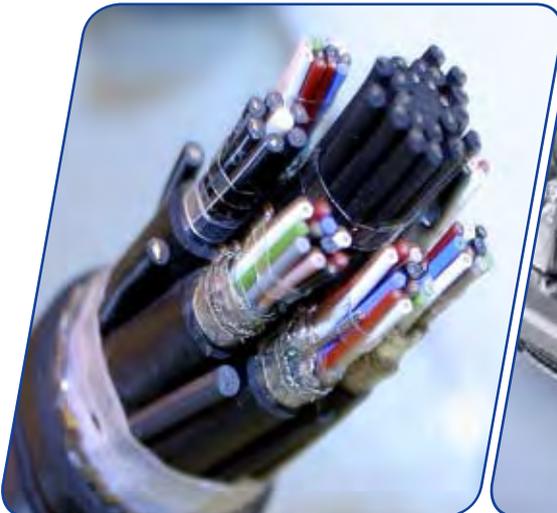


Market Study: Flame Retardants (4th ed.)



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- **Gain new customers**
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- **Improve your understanding of your competitors**
Who exactly are your competitors - and what are their strengths and weaknesses
- **Obtain a more detailed picture of your segment**
Learn which time is the best for entering or leaving a market
- **Have a look at the future**
Find out if new investments and technologies are worthwhile and how to gain access to future markets. We also show possible market scenarios
- **Recognize opportunities and risks**
Identify opportunities and risks on your target markets in time

This study is useful for:

- Manufacturers and distributors of aluminum trihydroxide (ATH), brominated compounds, chlorinated compounds, organophosphorus, antimony compounds (ATO), and other flame retardants
- Manufacturers of construction material, electrics & electronics, cables, vehicles, and many more
- Associations and institutes
- Executive board, technology and production, strategic planning, R&D, market research, marketing, sales, and procurement

In this brochure you will find the following information:

- An introduction on page 3
- A summary of the table of contents on page 4
- Following this, there are example pages from the study
- Please use the form on the last page to easily order your copy or a free reading sample!

Flame retardants act in chemical and physical ways by interrupting the burning process in different phases, i.e. during heating, thermal degradation, combustion, or spread of flames. Worldwide, about 2.15 million tonnes of flame retardants are used per year to protect plastic products, electronic devices, construction material, and textiles. For the fourth time now, Ceresana has analyzed the global market for these lifesaving products. These include brominated and chlorinated flame retardants, as well as ATH, organophosphorus, ATO, and other types. The present study provides both figures of demand and revenues for the overall market as well as demand volume for the particular types of flame retardants and their applications.

From a global perspective, the construction industry and the electrics & electronics industry (E&E) are the most important sales markets for flame retardants: Almost 53% of global demand volume originated in these two segments. Flame retardants are used for insulating foams made of expandable polystyrene (EPS) and polyurethane in large quantities but also, for example, for construction material made of rubber, in adhesives, as well as in paints and varnishes. In the segment E&E, they are used for single components such as circuit boards, computer casings, as well as household and telecommunication devices. They are utilized in technical plastics such as ABS, polyamide, epoxy, and polycarbonate. The third

largest single market for flame retardants is the application cables and wires followed by products for the transportation industry. At rates of 2.8% p.a. and 2.6% p.a., the segments transportation and E&E account for above-average growth.

With a market share of 37%, ATH is the most commonly used type of flame retardants worldwide, followed by brominated compounds. The most important application areas for brominated flame retardants are electrics & electronics and foams. Brominated flame retardants are very effective but also controversial. Due to legal provisions, there are significant regional differences. For example, demand for brominated compounds accounts for 6.7% and 12% respectively in Western Europe and North America which is only a fragment of total demand - however, in Asia their market share amounts to 28%. Brominated and chlorinated flame retardants will presumably account for the lowest growth worldwide in the upcoming eight years. On the other hand, flame retardants based on organophosphorus as well as substitute products for halogenated flame retardants in the segment insulation material and E&E will grow at above-average rates.

The Study in Brief:

Chapter 1 provides a presentation and analysis of the global market for flame retardants – including forecasts up to 2023: Demand for and revenues

generated with flame retardants are provided for each world region.

Chapter 2 analyzes the 16 most important countries and their flame retardants revenues and demand in detail. Demand is split by single applications and product types. Additionally, all important manufacturers of flame retardants are listed according to countries.

Chapter 3 offers a substantiated analysis of the application areas for flame retardants: construction materials, electrics & electronics, cables, transport industry, and others.

Chapter 4 examines demand for individual types of flame retardants: aluminum trihydroxide (ATH), brominated compounds, chlorinated compounds, organophosphorus, antimony compounds (ATO), and other flame retardants. Demand is clearly arranged for each of the 16 countries analyzed in chapter 2 and all world regions.

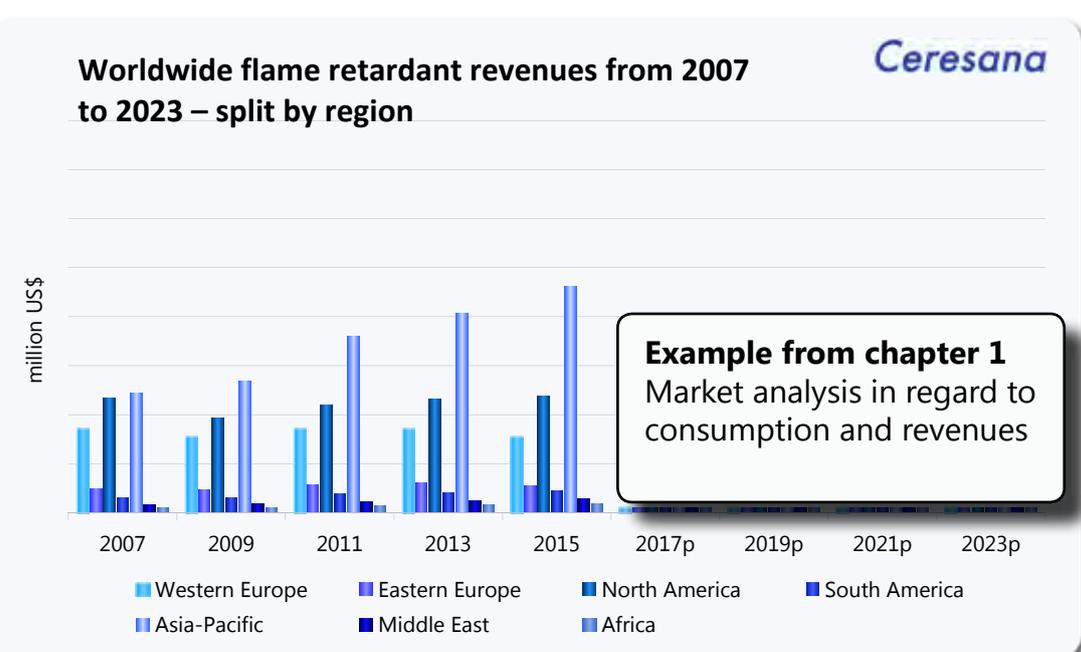
Chapter 5 provides profiles of the largest manufacturers, clearly arranged according to contact details, turnover, profit, product range, production sites, profile summary, and products. Detailed profiles are given for 97 producers, such as Akzo Nobel N.V., Albemarle Corp., Aluminum Corporation of China Limited (CHALCO), BASF SE, Chemtura Corp., Clariant International Ltd., Huber Engineered Materials, Rio Tinto Group, The Dow Chemical Company, and Tosoh Corp.

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 - 1.1.2 Revenues
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 - India (6)
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 - Taiwan (2)
- 5.5 Middle East
 - Israel (2)
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1.3 Eastern Europe

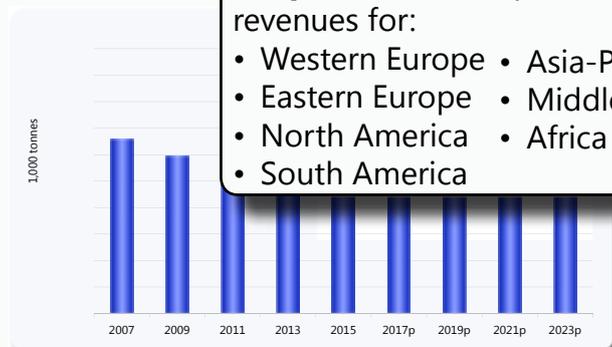
Demand for flame retardants in Eastern Europe rose by, on average, X% p.a. during the past eight years and amounted to X tonnes in 2015.

We forecast East European demand for flame retardants to continue to increase to approx. X tonnes in 2023. The East European share of global consumption will stagnate due to these average growth rates; in 2023, world market share will be roughly X%.

Revenues generated with flame retardants in Eastern Europe amounted to EUR X million in 2015. For 2023, we forecast

Chapter 1: Consumption and revenues for:

- Western Europe
- Eastern Europe
- North America
- South America
- Asia-Pacific
- Middle East
- Africa

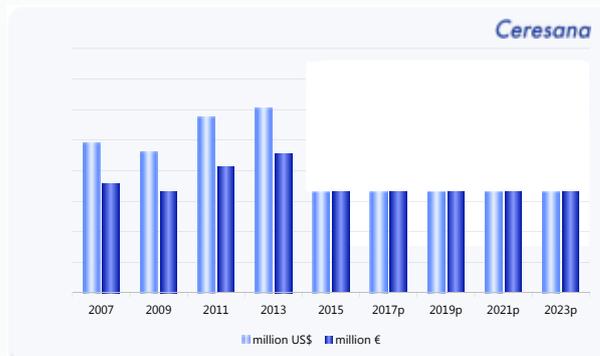


Graph: Demand for flame retardants in Eastern Europe from 2007 to 2023

In 2015, Russia was the largest consumer of flame retardants in Eastern Europe. Turkey ranked second, followed by Poland. The remaining East European countries (Ukraine, Czechia, Romania, Hungary, Greece, Belarus, Slovakia, Bulgaria, Croatia, Slovenia, Serbia, Lithuania) reached an aggregated market share of roughly X% in 2015. We forecast Russia to increase its market share until 2023. We do not expect any significant changes of market shares held by Poland and Turkey.

in 1,000 tonnes	2007	2009	2011	2013	2015	2017p	2019p	2021p	2023p	2015 - 2023
Poland	X	X	X	X	X	X	X	X	X	X% p.a.
Russia	X	X	X	X	X	X	X	X	X	X% p.a.
Turkey	X	X	X	X	X	X	X	X	X	X% p.a.
Others	X	X	X	X	X	X	X	X	X	X% p.a.
Total	X	X% p.a.								

Table: Demand for flame retardants in Eastern Europe from 2007 to 2023 – split by major countries



Graph: Revenues generated with flame retardants in Eastern Europe from 2007 to 2023, in million USD and million EUR

2.5.3 Japan

In 2015, about X tonnes of flame retardants were utilized. This translates into an average decline of X% p.a. between 2007 and 2015. For the 2015 to 2023 period we forecast positive growth rates of, on average, X% per year. Market volume will amount to approx. X tonnes in 2023.

Japanese revenues of flame retardants amounted to USD X million in 2015. Japan's share of total revenues of the region Asia-Pacific therefore rose to about X% in 2015. We forecast a market value of approx. USD X million to be reached in 2023. Compared to 2015, this constitutes a growth rate of X% per year, which falls short of the regional average.

in 1,000 tonnes	2007	2009	2011	2013	2015	2017p	2019p	2021p	2023p	2015 - 2023
Construction materials	X	X	X	X	X	X	X	X	X	X% p.a.
Electrics & electronics	X	X	X	X	X	X	X	X	X	X% p.a.
Wires & cables	X	X	X	X	X	X	X	X	X	X% p.a.
Transport industry	X	X	X	X	X	X	X	X	X	X% p.a.
Others	X	X	X	X	X	X	X	X	X	X% p.a.
Total	X	X% p.a.								

Table: Demand for flame retardants in Japan from 2007 bis 2023 – split by application

The most important application area for flame retardants in 2015 was the application electrics & electronics which utilized X tonnes followed by the segment construction material. With the exception of the segment other applications, which will see demand fall by X% until 2023, we forecast positive growth rates for all other applications. In 2015, Japan processed X tonnes of ATH. Organophosphorus flame retardants ranked second at a considerable distance followed by brominated compounds. In the period from 2015 to 2023, ATH and organophosphorus flame retardants will increase their demand most significantly by X% p.a. respectively.

in 1,000 tonnes	2007	2009	2011	2013	2015	2017p	2019p	2021p	2023p	2015 - 2023
ATH	X	X	X	X	X	X	X	X	X	X% p.a.
Brominated compounds	X	X	X	X	X	X	X	X	X	X% p.a.
Chlorinated compounds	X	X	X	X	X	X	X	X	X	X% p.a.
Organophosphorus	X	X	X	X	X	X	X	X	X	X% p.a.
ATO	X	X	X	X	X	X	X	X	X	X% p.a.
Others	X	X	X	X	X	X	X	X	X	X% p.a.
Total	X	X% p.a.								

Table: Demand for flame retardants in Japan from 2007 to 2023 - split by types of flame retardants



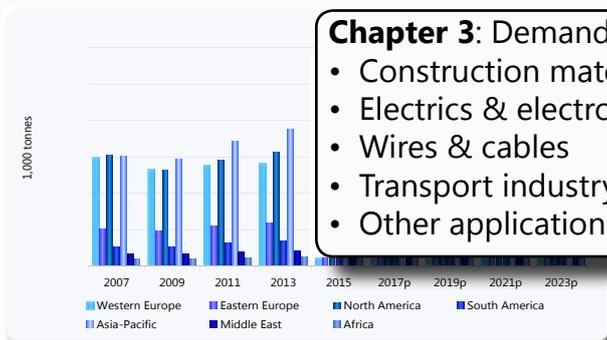
Graph: Demand for flame retardants in Japan from 2007 to 2023

Chapter 2: Market data at a global level and of 16 countries:

- Demand
- Revenues
- Demand split by applications
- Demand split by products

3.1.1 Applications - Construction Material

In 2015, about X tonnes of flame retardants were used worldwide for construction materials. Thus, demand in this application area rose at an average rate of X% p.a. since 2007. Given an expected X% p.a. increase, global demand for flame retardants used in the construction materials segment will amount to approx. X tonnes in 2023.



Chapter 3: Demand split by applications:

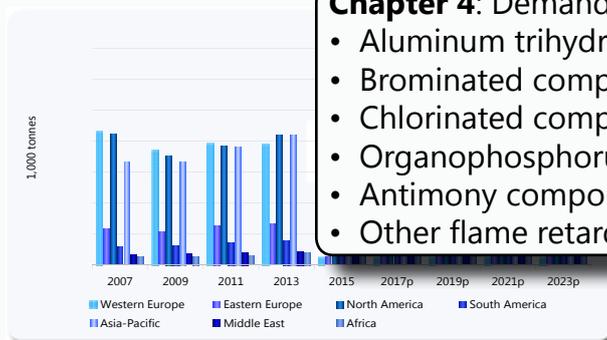
- Construction materials
- Electrics & electronics
- Wires & cables
- Transport industry
- Other applications

Graph: Worldwide demand for flame retardants in construction material from 2007 to 2023 – split by region

Flame retardants are used in numerous plastic products, e.g. in insulating foams made of expandable polystyrene (EPS), extruded polystyrene (XPS), polyvinyl chloride (PVC), or polyurethane (PUR). Moreover, flame retardants are used in construction materials made of rubber and in adhesives, paints, and coatings. Flame-protected paints that provide a protective layer can be applied on different construction materials made of plastics, wood, metal, and concrete. They are primarily used in buildings where stringent safety requirements have to be met. These include skyscrapers, large condominiums, public buildings like hospitals, and airports.

4.1.1 Products - Aluminum Trihydroxide (ATH)

Over the past eight years, global demand for ATH rose by an average of X% per year. Out of the X million tonnes of ATH used worldwide in 2015, about X tonnes were used in Asia-Pacific. Thus, this region enjoyed a considerable lead over North America and Western Europe. The highest relative increase at rates of X% p.a. from 2015 to 2023 is expected for the Middle East. Consumption volume in this segment is likely to rise to X tonnes. The least dynamic development at rates of X% p.a. and X% p.a., we anticipate for Africa and Western Europe, which will return onto the growth path nevertheless. All in all, we forecast a demand of X tonnes in 2023 for the ATH market. Accordingly, demand will rise by X% p.a. between 2015 and 2023.



Chapter 4: Demand split by products:

- Aluminum trihydroxide (ATH)
- Brominated compounds
- Chlorinated compounds
- Organophosphorus
- Antimony compounds
- Other flame retardants

Graph: Global demand for ATH from 2007 to 2023 – split by region

ATH is a white crystalline solid, which is manufactured from over-saturated sodium aluminate solution. ATH is used in the pharmaceutical industry, as a chemical intermediate, as a filler in plastics, rubber, cosmetics, and paper, as a glass additive, and in ceramics. Additionally, ATH is used as a non-smoke emitting, low toxicity halogen free flame retardant used for plastics, paints, adhesives, sealants, and rubber.

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Financial Key Data (in million EUR)

Year	Net Income	Total Revenues
2015	6.7	151.3
2014	5.5	143.3
2013	2.6	132.9
2012	2.1	129.2

General Information About the Company

2014 sales divided by business segments

Segment	Percentage
Functional Fillers	31%
Technical Ceramics	69%

2015 sales divided by regions

Region	Percentage
Europe (w/o Germany)	11%
Germany	48%
USA	28%
Rest of the World	13%

Chapter 5: Data and facts on 97 producers, clearly arranged by:

- Financial key data
- Production sites
- Profile summary
- Product details

Production Sites The company's production sites are located in:

- Schwandorf, Germany
- Kelheim, Germany
- Corpus Christi, TX, USA

Profile Summary Nabaltec was established through acquiring the aluminum oxide production at the Nabwerk from VAW Aluminium AG in Schwandorf, Germany. In 2004, the joint venture Nashtec was founded in Corpus Christi, USA, together with Sherwin Alumina, a US-American aluminum oxide manufacturer. Through the business divisions "Functional Fillers" and "Technical Ceramics", the company engages in design, manufacture and distribution of specialty products based on aluminum trihydrate (ATH) and aluminum oxide as well as other materials. The "Functional Fillers" business division includes the segments flame retardants, additives and environmental technologies. "Technical Ceramics" is divided into ceramic raw materials and ceramic bodies. In December 2011, the company established a strategical cooperation with Sumitomo in the segment aluminum trihydrate and in 2013, the company entered an Office-in-Office agreement with German Industry & Commerce Greater China, Shanghai. The foundation of the subsidiary Nabaltec Asia Pacific K.K. in the first quarter of 2016 set the platform for a stronger relationship with the local customers. At the end of 2015, Nabaltec employed 444 people. In 2016, the annual production capacity amounts to approx. 250,000 tonnes, of which 70% will be exported. Nabaltec is planning on expanding the production capacity at its site in the USA. The company has been listed on the Frankfurt Stock Exchange since 2006. The quality management system of all production sites is ISO 9001 certified and the environmental management system of the sites in Germany is certified according to ISO 14001 standards. Furthermore, the company is OHSAS 18001 certified.

Specific Information about Flame Retardants
 Through its market segment ...
 tribution of halogen-free flame

Chapter 5: Detailed profiles of the most important manufacturers, such as Akzo Nobel, Albemarle, BASF, CHALCO, Chemtura, Clariant, Huber, Rio Tinto, Dow, and Tosoh.

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