Polyphenylene Sulfide (PPS)

Market Study
Chemicals Practice

*Part of Engineering Plastics Strategy Report*
1. PPS MARKET EXECUTIVE SUMMARY

The Polyphenylene Sulphide (PPS) – Market Study – 2017 is written to provide clients with a historical perspective and an insightful future market outlook for global and regional PPS market for the period 2009-2025. This section (Introduction and Executive Summary) is intended to provide the client with an overview, findings and highlights of the PPS market study. In this short report we have covered strategic analysis and market dynamics from our current report that Prismane Consulting believes could have a significant impact on PPS market in the near future and in the long-term forecast. Additional analysis of all capacity, supply, demand, trade, prices, profitability, technology, and production costs, major applications and market analysis by country, market analysis by region, by applications and other related information can be found in the Polyphenylene Sulphide (PPS) Market Study - 2017

1.1. PPS INTRODUCTION

PPS made available commercially by Chevron Phillips in the early 70’s, is now an important category of engineering plastic. A characteristic polymer with exceptional chemical resistance and high-temperature stability can be used in a wide array of industrial applications. Be it automotive, electrical & electronics, industrial applications, filter media, coatings and other niche applications, PPS can be the preferred polymer due to its properties like chemical resistance and high-temperature stability and price when compared to the other high end engineering plastics. With different grades available in the market, majority of the commercially available PPS is compounded, with filler quantity lying between 30 to 60% depending upon the application.

While comparing PPS to its competitors, PEI and PEEK have better physical and chemical properties but are not as economic as PPS. PPS is also said to be the common man’s PEEK. Compared to PPS, polyether ether ketone (PEEK) from the polyether ketone family accounts for a very small market share in the high end-engineering plastics. The consumption of PEEK according to Prismane Consulting estimates was around 6,000 tons in 2015.

1.2. POLYPHENYLENE SULFIDE (PPS) END-USE DEMAND

The current PPS market share remains dominated by automotive sector, but emerging end uses like aerospace & defense and filter media applications will continue to experience strong growth.

The following figure shows the demand breakdown for PPS in 2016
2. MARKET OVERVIEW

Global Demand of PPS is estimated to be 83,651 tons in 2016, growing by around 7% since 2009. Prismane Consulting estimates the demand to reach 110,107 tons in 2020. The automotive industry remains a single largest driver for growth accounting for a total market share of around 41% and is expected to maintain its share in the short term forecast. Electrical & Electronics industry accounts for a share of around 20%. Third came the filter media applications with 16% share which is again expected to increase its market share to around 18% by 2020. This will be due to the continuous increase in demand for PPS fibres used to make filter bags which have been replacing the glass fiber based filter media in coal fired power plants and incinerators. Other key applications include aerospace & defense, industrial and metal replacement applications in construction & Infrastructure.

2.1. AUTOMOTIVE

Automotive remains the largest application for PPS with major use in the making of the under the hood complex materials. It is used in automobiles switches, connectors, sensors, fuse cases, lamp reflectors, light sockets, EV/HEV inverters, and IPM materials. In 2016, demand of PPS from the automotive sector was about 34,217 tons accounting for 41% of the global market. With automotive makers constantly optimizing their engine performance, reducing the automotive weight helps them achieve more efficiency and lower carbon footprints. The growing need for energy efficient automotives and their compliance to government regulations is likely to add to the growth of PPS in this sector. By 2020, automotive sectors share in the global demand is forecast to slightly decline to around 40% as other emerging applications increase their market share.
2.2. ELECTRICAL & ELECTRONICS

Electrical & Electronics sector is expected to be one of the strong demand drivers for PPS over the forecast period. PPS is being used in the making of the electronic components like circuit breakers, relay housing, connectors and bobbins and heat exchangers amongst others. Miniaturization of electronic devices has been one of the major growth factor, encouraging the use of plastics in the electrical & electronics industry. Further the need for energy efficient, quiet, and compact devices pushes manufacturers to innovate their products to meet the ever rising and demanding needs of its consumers. PPS readily meets the demands of the most rigorous lead-free solder processes when compared to other thermoplastics. In 2016, electrical & electronics sector accounted for 20% of the global market. By 2020, electrical & electronics share in the global demand is forecast to decline to around 19%.

2.3. AEROSPACE & DEFENSE

Aerospace and defense accounted for 10% of the global demand and is expected to increase to more than 11% by 2020. PPS has been finding major use into the aerospace industry as well. Be it for unloaded brackets or thermal acoustic blankets or for use in composites for fuselage or nose structures, PPS has well penetrated the aerospace industry. Around 50% of the MOC of aircraft’s primary structure including fuselage and wing are composites. Plastics help increasing the efficiency and performance of airframes, engines and structures, since they are light in weight and can be used to make complex parts. Excellent corrosion resistance, high temperature operability, ease of processability and weight reduction makes PPS a strong contender in the aeronautics industry. The use of PPS composites helps weight reduction of the aircraft by around 20%, helping attain more efficiency and without compromising on the safety. Recent reports also suggest that the new wide body aircraft revealed by the Boeing Inc. at the Paris Air Show 2017, the B797 is supposed to have an all composite fuselage. This implies that thermoplastic composites can play a vital role in the long term forecast for engineering plastics in the aeronautics industry.

Russia, China and Japan are also in the phase of developing their own single aisle twin-jets to reduce dependence on the order lagging Airbus and Boeing. Russian company Irkut Corporation, Japanese based, Mitsubishi Aircraft Corporation and China’s state owned COMAC have had successful test flights of their commercial aircrafts. Government initiative in India, especially the UDAN scheme, an initiative by the Indian government to make air travel economic and affordable with a moto to connect the rural parts of the country also offer humongous opportunities to the air travel industry.

It has been estimated that with the increasing disposable income and urbanisation, the air travel industry is at a rise which subsequently will require more aircrafts. With this there will arise a need for around 33,000 new aircrafts by 2035.
2.4. FILTER MEDIA
Filter media application accounts for 16% of the global PPS demand in 2016. The drive towards filter media application has largely been centred on China, where PPS consumption in this particular application is expected to grow at a CAGR of 10.4%. Filter media is estimated to raise up to 18% of the global PPS consumption by 2025 mostly driven by China’s demand for PPS fiber for filter bag manufacturing. PPS resins can be drawn into fibers which can be used in filter media. PPS based filters are commonly used filtration fabrics for pulse jet & low pressure - high volume applications. Major filter media applications include coal boilers at coal thermal power stations and dust chamber filters in incinerators. PPS based filter media have the capability to eliminate 99.9% of dust and have a service life of three years reducing maintenance and downtime. Smog has been a major issue in most of the countries which house coal based power plants. With stringent regulations in-effect to limit the dust discharge into the atmosphere, countries like China have been adopting these regulations to have a much better and pure atmosphere avoiding respiratory problems of its population in most of the region and provinces.

2.5. INDUSTRIAL
Industrial applications include coating, oil field equipment, machine and appliance parts, pumps, valves and pipe fittings. Since the PPS market accounts for a very small share in the global engineering plastics market, there is a wide scope for further developing new application of PPS. Companies involved in the supply-chain of PPS have constantly being investing in research & development, to develop grades that can be economical and suitable for different applications. Though PPS has many metal replacement properties, the polymer is expected to register higher growth rates in the long term forecast. Consumption of PPS for industrial applications is estimated to reach around 7.4% of the global demand in 2016 and will remain around that share by 2020, mostly driven by China’s demand.

2.6. OTHERS
Other end-uses which represented the sixth largest output for PPS in 2016 include various unexplored metal replacement applications. It accounted for a 6.6% market share of the total demand in 2016. This will be driven by Asia-Pacific region. PPS can be drawn into films for electronics and also be used into the construction industry. With increasing globalisation, various countries have been using plastics and composites in construction of bridges and road as well. This can be a fast growing application for engineering plastic like PPS.
3. CAPACITY AND PROJECTS ANALYSIS

With global capacity concentrated in the U.S. and Japan, producers are now eying the potential PPS demand in China by setting up compounding plants in the country. Companies are setting up compounding facilities for meeting the demand and ease of trade. The global capacity of PPS resins according to Prismane Consulting estimates stands at 152,600 tons in 2016 which should reach 200,000 tons by 2020 with scheduled expansions by Toray and NHU. Toray has planned expansions and will have a combined capacity of 38,000 tons, 19,000 tons each at its manufacturing site in Japan and South Korea. NHU, which currently manufactures 5,000 tons, will have a capacity to produce 30,000 tons by 2020, with expansions scheduled in 2017-2018. Initz Corporation, a joint venture between Teijin Limited and SK Chemicals currently has a capacity to produce 12,000 tons of PPS which can further be increased to 20,000 tons per annum in future. Fortron Industries, a JV between Kureha Corporation & Celanese Corporation and Solvay SA have PPS resin manufacturing plants in the U.S.

FIGURE 2. NEW CAPACITY ADDITIONS

Source: Prismane estimates

The manufacturing process designed by SK Chemicals, produces chlorine free PPS. China Lumena New Materials had claimed to be the largest PPS manufacturing company, but the company had been exposed to overstating its financials which led to its delisting on the Hong Kong Stock Exchange. The company, according to Chinese media sources has stopped operations. This claim is yet to be verified by Prismane Consulting.
4. MARKET DYNAMICS

4.1. GLOBAL

PPS demand has been severely affected since second half of 2008 due to the global economic recession and credit crisis. In 2009-2010 most regions saw gains in the demand with the market showing a growth of around 7% at global level. The developing markets, such as Asia, have turned out to be much more resilient than North American or European markets.

In 2016, Global consumption of PPS reached 83,651 tons and exceeded a value of $1 billion. World production capacity in 2016 was about 152,600 tons per year. World PPS capacity utilization was around 70%. Global PPS demand is expected to grow between 2016 and 2025 with demand from China accounting for an increasing proportion. PPS like other engineering applications continues to out-strip global GDP growth rates, and this is largely due to emerging end-use applications such as aerospace and defense and filter media applications. Other end-use applications also showed growths above the global GDP.

FIGURE 3. MARKET SHARE, BY CAPACITY (2016 VS 2020)

Source: Prismane estimates

Overall Prismane Consulting believes nameplate capacity will increase to approximately 200,000 tons by 2020 with Japan accounting for 33% and China around 31% of the global capacity.

Prismane Consulting notes that operating rates had reached around 65% by 2007 but sharply declined in 2008/2009, the result of a surge in capacity additions combined with low demand growth. The outlook until 2020 is for a gradual recovery in operating rates. Over the period 2017 to 2020, around 43,000 tons of new capacity is planned. Which would add almost 22% to the existing capacity base. Set against our demand for the same period is over 110,107 tons. Should all the planned capacity additions go ahead our analysis suggest that operating rates will continue recovering through 2025 and could reach around 75% - 80% in that year.
Prismane Consulting’s forecast for the global Supply/demand outlook for PPS is presented in the following figure.

**FIGURE 4. PPS CAPACITY, CONSUMPTION, AND OPERATING RATE (2014 – 2020)**

4.2. REGIONAL/ COUNTRY ANALYSIS

With the current situation of the plastics industry and further development of newer application areas, the demand for plastics should well double in the coming 15 to 20 years.

In 2016, global demand for PPS reached a level of about 83,651 tons and is expected to reach 110,107 tons by 2020 averaging around 7% per year on a volume basis. Asia-Pacific is anticipated to witness the highest growth of 8.2% till 2020 while the same for North America is expected to be around 4.5%. The European region is expected to witness a growth in the range of 5.7% while the Rest of World will grow around 6% between 2017 and 2020.
Amongst all the applications, aerospace & defense will register the highest growth of around 9.5% followed by filter media applications at 9%. Automotives and electronics account for more than 60% of the total consumption of PPS, both the applications are expected to grow at a CAGR of 5.5% to 6.5% from 2017 to 2020. Industrial applications account for only 5% of the total demand but we estimate that to be growing faster than automotive and electronics.

### 4.2.1. JAPAN

Japan is the world’s largest producer of PPS and in 2016, Japan produced around 50% of the world supply of PPS, of which a significant share of 58% was produced by DIC Corporation and Toray industries. Japan has increasingly added capacities specializing in engineering plastics including PPS. From 25,000 tons in 2005 to 40,000 tons in 2010; Japan’s capacity is estimated to be 65,000 tons in 2017. Japan’s capacity utilization for PPS has been around 65% to 75%. Japan maintains a trade surplus in most engineering plastics—a surplus that is particularly strong for PPS. Japanese PPS consumption is expected to grow at an average annual rate of 4.2% between 2016 and 2020.

### 4.2.2. CHINA

China consumed 38% of the world volume of PPS in 2016. China capacity utilisation for PPS has been in the range of 50 to 60%.

China is a net importer of PPS and is expected to remain a net importer in the long-term forecast. Though the Japanese players have a huge command in the PPS market, these companies are now entering the fast growing Chinese markets with setting up of compounding plants in the country. China has the second largest installed capacity and has scheduled expansions in the long term forecast. China is a major growth indicator for PPS in filter media application with a number of coal fired thermal power plants with a total capacity 65GW scheduled to come up in the country.
4.2.3. US

The United States is a net exporter of PPS and accounts for around 17% of the global demand. From 2014 to 2020, U.S. annual consumption of PPS is expected to grow at an average annual rate of about 4.3%. The change in governance under President Donald Trump, who aims to make the US a manufacturing hub, offers great potential for engineering plastics, especially for the automotive & transportation industry.

4.2.4. SOUTH KOREA

The total South Korea PPS demand was estimated around 3,000 tons in 2016 and is expected to grow at an annual average rate of 7.9 per cent in the forecast period. Companies currently producing PPS in South Korea are Initz Corporation (JV between SK Chemicals and Teijin Limited) and Toray Industries and their total combined capacity is 20,600 tons. The consumption of PPS in South Korea accounted for about 4% of world PPS consumption. The country has been a net exporter in the past and is likely to continue this trend in the long term forecast.

4.2.5. EUROPE

Europe accounts for 15 per cent of the global demand. Germany, France and Italy account for almost 71% of the total consumption in the region. Germany accounts for 6% of the global demand and around 40% of the total European demand. France is the second largest country in terms of PPS consumption in 2016 in the continent. Prismane Consulting doesn’t expect any major change in consumption pattern at country level in the European region till 2020. During 2009-2016, PPS consumption in Europe grew at an average rate of 5.7% per year.

There are no PPS resin capacities in Europe making the region continue to depend on import from other countries. Most of the supplies to Europe are from Japan, South Korea and Unites States. Germany, France and Italy and the region as a whole is expected to remain a net importer in the forecast period.
4.3. GLOBAL TRADE

Japan and the US will remain the main global supplier along with South Korea, and China, increasing their market share in the long term.

FIGURE 6. GLOBAL NET TRADE FLOW

Source: Prismane estimates

5. KEY TRENDS AFFECTING THE PPS INDUSTRY

Some of the following are key trends affecting the PPS industry:

5.1. TIMELY AVAILABILITY OF RAW MATERIALS, ENVIRONMENTAL AND SAFETY CONCERNS

Para-dichlorobenzene is the major raw material for the production of PPS. Para-Dichlorobenzene (p-DCB) is a chlorinated aromatic monomer produced by reacting chlorine with benzene. Chlorinated solvents have various environmental concerns responsible for groundwater and soil contamination. PCBs and dioxin can also cause cancer and other human health hazards. The US based Standard Chlorine Chemical Company, Inc.’s Kearny, New Jersey site has been listed as a Superfund site for which the EPA expects the spending of USD 11 Million for cleanup.

Considering the economic and ecological aspects, companies have been finding economical ways to modify existing plants and shift product slates. Maximum para-dichlorobenzene selectivity can be achieved using the right catalyst, while also finding acceptable commercial outlets for by-products. Shutdowns of various chlorinated solvent plants in the US and Europe has been one of the, major reasons for delays in lead time of PPS. This has led manufacturers to build integrated plants which produce p-dichlorobenzene, sodium hydrosulfate which are the raw materials for PPS resin.
5.2. ECONOMIC CONDITIONS (GENERAL ECONOMIC FACTORS SUCH AS GDP AND INFLATION)

Demand for most markets for engineering plastics like PPS are greatly influenced by general economic conditions. As a result, demand for PPS largely follows the patterns of the leading world economies and end-user sectors. Demand for PPS is directly linked to activity in the end-user industries like automotive and construction industries.

Other trends include:

- Competition and industry structure
- High cost of Production and Pricing in comparison to Basic polymers and other engineering plastics
- Weak Japanese consumer market for electronic and electrical products
- Transfer of manufacturing to Southeast Asia, especially for electronic and automotive industries
- Shifting of the PPS compounding players from Japan to China

5.3. DRIVERS & BUSINESS OPPORTUNITIES

Along with the transport industry, PPS is also being used in various industrial applications including pump casings, oil field equipment, machine and appliance parts, valves and pipe fittings.

5.3.1. GROWTH IN ELECTRIC AND HYBRID VEHICLES MARKET

Electric vehicles have been a major area of development in the transport industry since the last decade. With the only restraining factor of battery costs, EVs and HEV’s have been gaining importance and increasing their market share at a descent pace. Airbus Industries in collaboration with Siemens are looking into the feasibility of electrification in aviation. The companies aspire to develop various hybrid/electric propulsion systems by 2020.

The top guns present in the automotive industry including the likes of Toyota, Tesla, BMW, Volkswagen, and Mercedes, Volvo, Ford, Mitsubishi, General Motors and Renault-Nissan, all have successfully developed and are further optimizing their own hybrid and electric models for improved performance and efficiency.

India, which is one of the most lucrative and fast developing country, has set a goal of completely replacing gasoline automotives by 2030. Initiatives like lowering taxes and interest rates for loans on electric vehicles, capping sales of conventional cars, are some of the factors luring consumers focus towards electric vehicles. China also is expected to house manufacturing plants for electric and hybrid vehicles. The recent announcements by Volvo to set-up an EV manufacturing plant in China also highlights the shift in trend towards hybrid and electric vehicles in the largest automotive market-China.
5.3.2. FILTER MEDIA APPLICATIONS

Coal-fired power plants represented around 65% of total power generation in China in 2016 and also account for around 50% of the global coal fired plants capacity. It is estimated that China will add around 65GW of new coal-fired units between January 2016 and January 2017 to meet its growing energy need. The country has set up policies to increase its energy efficiency across its economy. Countries like China and India have also been adopting stringent regulations to limit the dust discharge into the atmosphere. This will prove to be beneficial for engineering plastics like PPS, which has excellent thermal and chemical resistance and are used for manufacturing filter-bags.

5.3.3. DEVELOPMENT OF NEWER GRADES

Engineering Plastics are preferred over metals due to their light weight, chemical resistance and ease of processing capabilities. Injection moulding makes it easier to make complex parts compared to casting. Ease and freedom of design with great performance makes PPS a material of choice for various end-use applications. The grade and filler material of a particular engineering plastic depends on the area of application. Companies have been developing newer and stronger grades for various end-uses. Majority of the research and development is based to provide materials with ease of processing and more efficient manufacturing. PPS has already entered into the automotive, aerospace, industrial and filter media industry. Industries such as medical devices / healthcare, food & beverages where there has been increasing use of plastics are the major areas to be explored for PPS. These industries account for a small share in the global market and companies have been investigating the feasibility for the use of PPS in various other untapped areas.

5.4. RESTRAINTS & CHALLENGES

5.4.1. PRODUCTION CONCENTRATED ONLY IN SPECIFIC COUNTRIES

PPS is a high performance engineering thermoplastic which can be used into a wide array of applications. It accounts for a very small share in the global engineering plastics consumption. Resin manufacturers are only concentrated in four countries including Japan, USA, China and South Korea. Resin manufacturers have their own compounding facilities and or have collaborations with third party compounders for compounding PPS. Procuring PPS resins by imports, compounding and then are put into use makes the value chain long.

5.4.2. ECO-FRIENDLY PPS

PPS is a high end engineering plastic, but requires technological expertise to manufacture. The technology through which the polymer is being manufactured produces NaCl as by-product and this makes it difficult for continuous production of PPS, which requires washing and drying of neat polymer. Traces of chlorine in PPS based electrical components may lead to environment concerns which may not comply with the regulations put into effect for electronics waste management.
6. ABOUT PRISMANE CONSULTING

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The Chemicals & Energy Practice also offers its clients market studies, strategy and business opportunity assessment reports related to refining, Chemicals, Petrochemicals, Plastic & Polymers, Coatings, Materials, Power & Utilities and other energy sources and products. For more information, please visit us at www.prismaneconsulting.com

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- Engineering Plastics (In-depth Strategic & Business Opportunity Assessment Study)
- PEEK Market Study
- Polycarbonates Market Study

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