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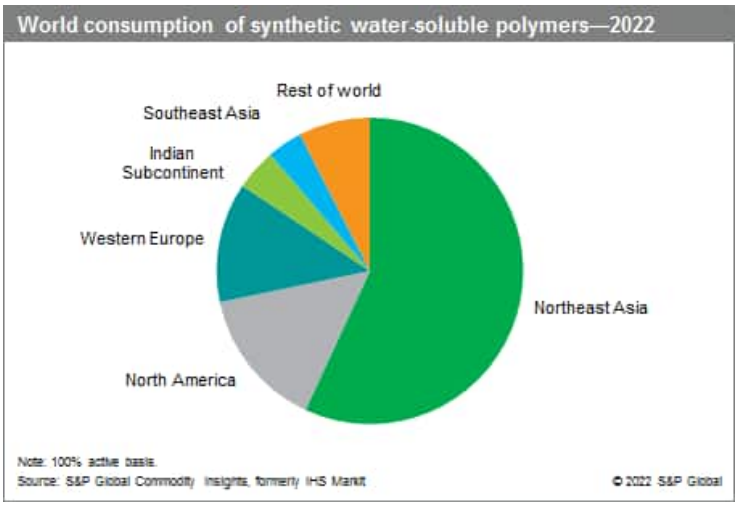
Water-Soluble Polymers, Synthetic

Chemical Economics Handbook

Published August 2022

Synthetic water-soluble polymers are organic materials that dissolve, disperse, or swell in water and thus modify the physical properties of the resulting aqueous system. These macromolecules act as dispersants, suspending agents, thickeners, stabilizers, coagulants, flocculants, film-formers, binders, humectants, and lubricants in aqueous media. In addition, some water-soluble polymers serve as starting materials for other products.

The following pie chart shows world consumption of synthetic water-soluble polymers in 2022:



Northeast Asia—mainland China, Japan, South Korea, and Taiwan—was the leading global consumer of synthetic water-soluble polymers, followed by North America and Western Europe. With regard to consumption growth, the Indian Subcontinent is the fastest-growing market, followed by Northeast Asia and Southeast Asia and Oceania. Consumption in North America and Western Europe is predicted to grow at a slower pace because of the maturity of large traditional applications such as water treatment, paper production, detergents, and textile processing.

Synthetic water-soluble polymers are employed in a wide range of applications. No single end use dominates the consumption of water-soluble polymers as a class; major applications vary from polymer to polymer. Large volume industrial applications include municipal and industrial water treatment, paper manufacture, mineral processing, oil and gas production, textile processing, detergents, adhesives, surface coatings, and construction materials. Synthetic water-soluble polymers also find application in consumer goods such as personal care products, cosmetics, and pharmaceuticals.

Growth in the consumption of synthetic water-soluble polymers is generally aligned with regional growth expectations for the relevant end-use industries. At a more granular level, demand for synthetic water-soluble polymers is affected by performance relative to competing materials and product trends within specific end uses.

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Alkyl Acetates

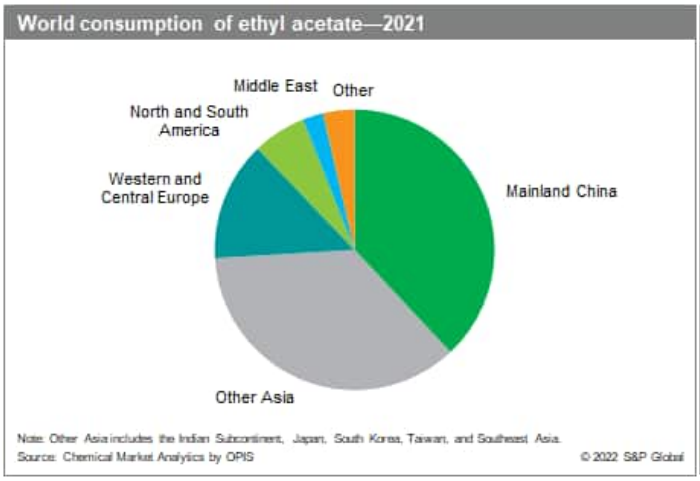
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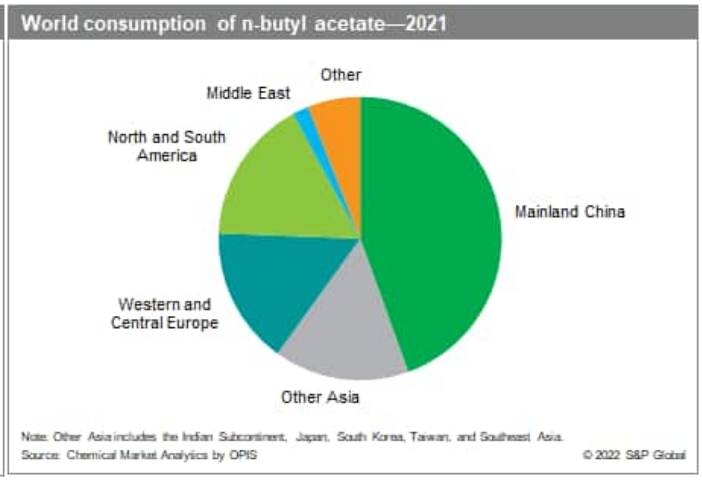
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The C_1-C_4 alkyl acetates discussed in this report include methyl acetate, ethyl acetate, n-propyl acetate, isopropyl acetate, n-butyl acetate, isobutyl acetate, and sec-butyl acetate. Ethyl and n-butyl acetates are the major markets for C_1-C_4 alkyl acetates, accounting for more than 83% of the total world consumption for C_1-C_4 alkyl acetates in 2021.

Growth in demand for C_1-C_4 alkyl acetates varies by acetate and region. Surface coatings and printing inks account for most of the global C_1-C_4 alkyl acetates consumption; the exception is methyl acetate, which is used almost exclusively as a chemical intermediate in the manufacture of acetic anhydride.

The following pie charts show world consumption of ethyl and n-butyl acetates:





Demand in most downstream markets for C_1-C_4 alkyl acetates is greatly influenced by general economic conditions. The consumption of C_1-C_4 alkyl acetates in surface coatings depends heavily on construction/remodeling activity, automotive production and refinish activity, and original equipment manufacture (OEM). The demand for C_1-C_4 alkyl acetates in inks tends to be more recession-resistant, as most rotogravure and flexographic inks are used in publications and food, and beverage packaging. Surface coating applications will continue to drive demand for alkyl acetates; this market accounted for around 40% of the global consumption in 2021. Growing demand centers such as India and mainland China will continue to drive global production.

sec-Butyl acetate is a relatively new end use for acetic acid. Mainland China accounts for almost all of the nameplate capacity for this product in 2021. sec-Butyl acetate is used mainly for coatings, pesticides, and gasoline blending in mainland China, where it is a growing market in China and most production is consumed domestically

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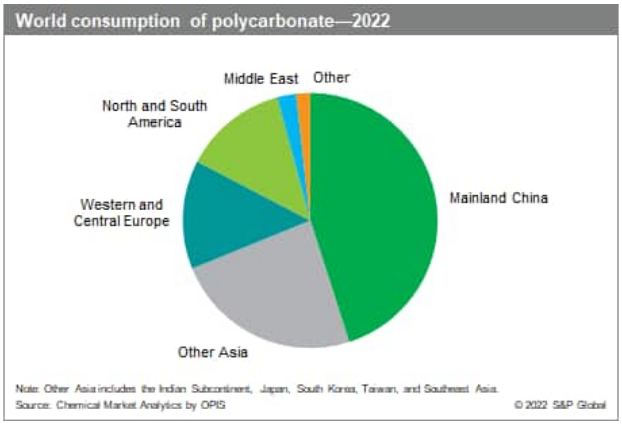
Polycarbonate Resins

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Polycarbonate (PC) is a lightweight, high-performance resin that possesses a unique balance of toughness, dimensional stability, optical clarity, high heat resistance, and excellent electrical resistance. These attributes allow polycarbonate to be used in a wide variety of common products including digital media, electronic equipment, vehicles, construction, greenhouses, exterior lighting fixtures, sports safety equipment, and medical devices. End uses such as automotive lighting, taillight assemblies, and electronics and electrical components take advantage of the impact resistance and high-heat properties provided by polycarbonate. With its outstanding toughness and transparency, polycarbonate can meet specifications for glazing in the construction (stadium roofs, firearm-resistant windows, etc.), transportation, and automotive industries. Polycarbonate's use in the production of optical discs is based on its excellent dimensional stability and optical properties. Polycarbonate is also a lighter, safer alternative to glass in optical applications, such as corrective lenses.

In 2022, total polycarbonate consumption is more than 5 million metric tons and is forecast to grow strongly over the next five years. Global polycarbonate capacity is approximately 7.2 million metric tons in 2022, and substantial additional capacity is forecast to come onstream in the next five years in mainland China. Covestro and SABIC Plastics are the two largest polycarbonate producers worldwide and together contribute nearly 40% of global capacity. The following pie chart shows world consumption of polycarbonate resins:



The electronics/electrical sector is now the current leading market for polycarbonate resins. Polycarbonate consumption in the electronics/electrical market is widely influenced by consumer demand for communication and entertainment devices, including mobile phones, tablets, personal computers, laptops, flat-screen televisions, cameras, network equipment, and printers. As the "stay at home" and "school from home" policies became the new norm during COVID-19, electronics/electrical demand rose with many people buying new electronics for their at-home offices. During the forecast period, brand owners will focus on the developing markets where there is demand from the large group of emerging middle-class consumers, such as mainland China, India, Southeast Asia, and Brazil. Devices that will help overcome poor infrastructure in the developing world, such as mobile phones, will see the most dramatic growth. The electronic/electrics sector will be the fastest-growing application during the forecast period.

Global polycarbonate demand is also driven by the sheet/film, appliances/housewares, and automotive industries; together, these markets account for almost half of global polycarbonate consumption in 2022. Demand in the sheet/film sector was highly influenced by the installation of protective shields in many businesses, in response to COVID-19. End uses in this automotive segment include lighting systems, headlamp lenses, reflectors, housings and mountings, exterior panels, wheel covers, and bumpers.

Prior to 2011, optical media was the largest consumer of polycarbonate resins. Worldwide demand for these end uses, including audio CDs, CD-ROMs, CD-Rs (recordable CDs), CD-RWs (rewritable CDs), MDs (minidiscs), MO (magneto-optical discs), and DVDs (digital versatile discs) exploded in the late 1990s. Later, demand for DVDs evolved to replace CD-Rs, followed by demand for Blu-ray disks replacing DVDs in more recent years. However, the continual shift to digital and cloud storage technology has led to a steady decline in consumption of polycarbonate resins for optical media. This declining trend is expected to continue during 2022–27. This will be only segment not to see demand growth over the next five years.

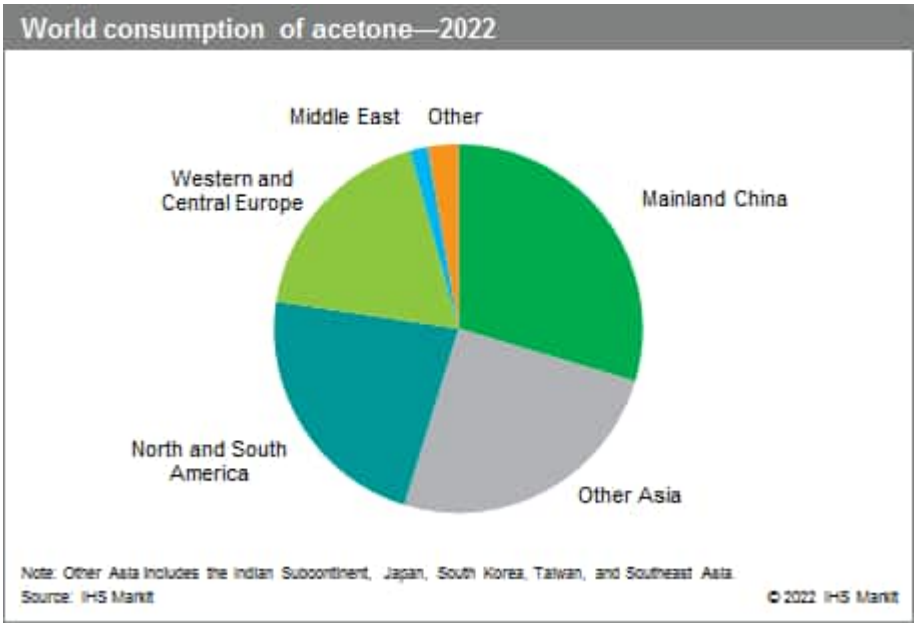
Acetone

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Acetone supply tends to be in excess globally. For roughly every two units of phenol produced, one unit of acetone is produced. While bisphenol A has been one of the better-performing derivatives, it consumes a higher phenol ratio at three parts to phenol to one part acetone. In turn, strong bisphenol A demand will lead to a longer acetone market. Secondly, methyl methacrylate (MMA) is another important acetone derivative and MMA technologies have been shifting. As capacity is built to meet increasing demand, some of the new capacity is based on nonacetone routes, such as units that can consume ethylene and methanol. Both of these feedstocks can be produced at very low cost, if natural gas is available at the low prices seen previously in the Middle East and now in the United States.

The following pie chart shows world consumption of acetone:



The global acetone industry is mainly driven by the solvents chain, the MMA sector, and BPA derivatives. The solvents chain is acetone's largest market and is estimated to consume 29% of global acetone demand in 2022. The main end-use markets for direct solvent are the manufacture of pharmaceuticals, including vitamins (vitamin C) and antibiotics (cephalosporins); glass-reinforced plastics (GRP); rubber chemicals; cosmetics (primarily nail polish remover); and spinning solvent for cellulose acetate fibers. For the most part, distributors handle solvent uses for acetone. In cosmetics, acetone used as a nail polish remover continues to compete with ethyl acetate. The solvents sector is often the last place acetone ends up, moving there only if it cannot be sold into the other higher-valued applications. Over the next five years, demand for solvent applications is expected to grow at an average rate of 3.9% per year.

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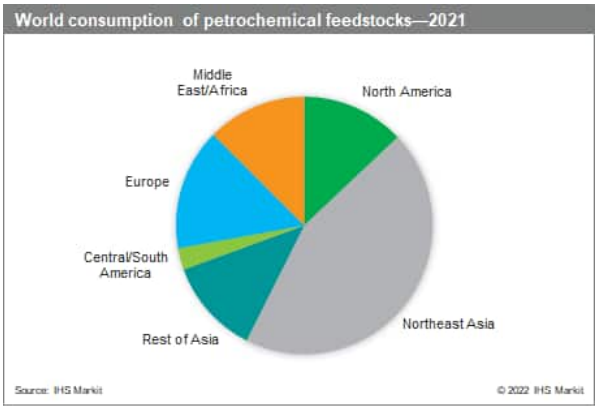
Petrochemical Feedstocks

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Fossil fuels (coal, crude oil or petroleum, natural gas liquids, and natural gas) are the primary sources of basic petrochemicals, but only about 9–10% of global fossil fuel production is ultimately used as a petrochemical feedstock; their primary usage remains the production of energy. As such, petrochemical feedstock supply and pricing are heavily influenced by fluctuations in world energy markets. The petrochemical industry typically produces a range of small-sized molecules by subjecting a selected feedstock to a set of chemical reactions. The produced molecules are part of the organic chemistry spectrum as they contain carbon atoms; the sole exception is ammonia, which is produced from natural gas but does not contain any carbon.

This report presents an overview of the world petrochemical feedstock demand situation for natural gas, natural gas liquids (NGLs), petroleum liquid feedstocks (naphtha and gas oil), and coal. NGLs include ethane, propane, butanes, and pentanes plus (C5+), also known as natural gasoline. The choice of feedstock(s) used by a petrochemical unit is a key determinant for the overall economics of production and is, therefore, critical; raw material cost is a major component in the overall cost of production of petrochemical producers. The following pie chart presents world consumption of petrochemical feedstocks:



Each region has developed its own feedstock specificities depending on the resource and technology available and the characteristics of the domestic markets and environmental standards of the region. In 2021, naphtha remained the largest-volume petrochemical feedstock used globally, followed by natural gas, coal, and ethane. The largest consumers of petrochemical feedstocks are Northeast Asia (largely mainland China), North America (mostly the United States), the Middle East, the CIS and Baltic States, and Western Europe.

Over the past decade, the use of ethane has gained momentum because of the development of new light-fed steam cracking capacity in the Middle East and North America (shale boom). The use of coal for the production of chemicals has also increased over the last decade, driven by the rapid development of the coal chemical industry in mainland China, which has capitalized on its abundant coal reserves to reduce its external dependency on both energy and chemical feedstocks. While the world's new requirements for fuels is gradually slowing, new technologies are being developed to redesign the overall refinery product slate. New pollution control measures are also modifying mainland China's coal-to-chemicals strategy. The report analyzes regional trends and changes currently affecting the wider petrochemical industry, including the impact of the COVID-19 pandemic and the risks related to the recent Russia-Ukraine conflict.