Global Trends in PVC Resin Applications and Additives Usage

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Important Notices

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Corporate Profile

Townsend Solutions was founded to provide market research, analysis, strategic consulting and advisory services to the petrochemical industry.

We are a culturally diverse team of handpicked petrochemical professionals. Our team is representative of over 20 different countries, allowing us a very broad global footprint, and unique understanding of local markets.
Megatrends are long-term transformational processes on a global scale, with a broad scope and dramatic impact.
Global Megatrends

Forecasted Changes Through or As Of 2050

- 3 billion people
- 70% population living in cities
- 21.5% middle class
- 21.5% population over age 60
- +30% food needed
- +100% road transportation
- +10 years average life expectancy
- +45% primary energy needed
- +50% water needed

Source: Townsend Solutions

Global Megatrends
Changing Demographics

Advances in medicine and healthier lifestyle choices are enabling people to live for longer while remaining active. In 2000, 810 million people were aged 60 or over. In 2050 that number will rise to 2 billion... that’s almost 22% of the world population.

In less than a decade, people 65 and over will start to outnumber children 5 and under for the first time in human history. This increase in the numbers of retired people will fuel developments and demand for goods and services linked to older people. This is a tremendous opportunity for healthcare markets in particular, where traditional growth has come largely from material substitution.

In addition to rising incomes in rapid-growth markets, the seniors of tomorrow are more physically, professionally and economically engaged.
Changing Demographics: Age

According to the U.S. Census Bureau, global population of people 65 and older will surpass children 5 and under for the first time in human history.

The U.S. Department of Health and Human Services states that the elderly population rate will continue to grow and will reach 17% by 2050 from the current 8.5%.

65 and Over Population:
- Almost a third in Japan
- Over 21% in Germany and Italy
- France and UK are almost 20%
- U.S.A. is about 15%

- This current and emerging demographic will significantly effect
  - Healthcare sector
  - Disposable income share spending

Source: United Nations
Changing Demographics: Middle Class

According to the World Economic Forum:
- Half of India’s population is now considered middle class.
- But most of them spend only $4-6/day
- Another estimate pegs 27m urban workers making over $11,000 a year, just 2% of the population.
- Salaries have been stagnant for years.

Africa’s growing middle class?

Nigeria’s economy, huge in oil exportation, is also starting to focus on construction, film, services, transport, and retail to support it’s growing middle class bracket.
Urbanization (shift from rural to urban areas)

For the first time in history more than half the world’s population resides in cities. The world’s urban population now stands at roughly 3.9 billion people, and this number is expected to reach almost 6.5 billion by 2050.

The trend towards urbanization is accelerating quickly, with the majority occurring in developing regions. Cities are looking at effective infrastructure investment and sound planning to be competitive and resilient. At the same time, entrepreneurship is rising, driving the need for more supportive and complex ecosystems.

Urbanization has profound implications for a wide range of issues including food, water, and energy consumption.

Key Plastics Markets Impacted

• Agriculture (film, geomembrane, etc.)
• Building & Construction (pipe, windows, flooring, siding, etc.)
• Electrical & Electronic (power transmission, cabling, etc.)

PVC
PVC Resin
### PVC Consumption by Country/Region

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<thead>
<tr>
<th>Region</th>
<th>2016 (kt)</th>
<th>2017 (kt)</th>
<th>Growth 2017/2016 (%)</th>
<th>2022 (kt)</th>
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- China: 18,240.9 kt
- North America: 5,816.5 kt
- Asia Pacific: 4,599.7 kt
- Western Europe: 4,047.5 kt
- India: 3,372.7 kt
- Middle East: 2,844.2 kt
- Central & South America: 1,945.2 kt
- Central & Eastern Europe: 1,762.1 kt
- Africa: 1,214.0 kt
- Japan: 1,030.7 kt
### PVC Consumption Growth by Country/Region

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PVC Consumption by Main Applications

- **Rigid Profiles**
  - Window frames
  - Ceiling lining
  - Floor skirtings
  - Doors
  - House Sidings
  - Gutters

- **Flexible Profiles**
  - Hoses & Tubing
  - Fiber

**Unit: kt**

- **Pipe/Conduit**: 13,852.9 (31%)
- **Other Extrusion**: 4,394.9 (10%)
- **Film**: 5,018.7 (11%)
- **Spread Coating**: 10,032.1 (22%)
- **Injection Molding**: 217.7 (1%)
- **Wire & Cable**: 217.7 (1%)
- **Other Non-extrusion**: 217.7 (1%)
- **Fiber**: 1,473.9 (3%)
- **Sheet**: 3,321.0 (7%)
- **Blow Molding**: 1,177.1 (3%)
- **Rotomolding**: 990.1 (2%)

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Trends & Drivers — Asia Pacific

- Thailand has substantial auto and appliance manufacturing, which is boosting demand for W&C.
- Indonesia is the 2\textsuperscript{nd} largest manufacturer of automobiles in ASEAN. Growth is expected to be strong.
- Japanese investment in automobile production in Vietnam is set to drive demand for PVC.
- Automobile production is set to rise sharply in the Philippines due to investment by Japanese OEMs.
- Malaysia and Singapore are major manufacturers of medical tubing (one of the fastest growing sectors for PVC). Several foreign medical tubing manufacturers have production facilities in Thailand and Vietnam.
- Investment in PVC glove manufacturing plants in Vietnam is driving demand. However, PVC disposable gloves have been replaced by HDPE and NBR in Korea, and dip molding of PVC gloves has stagnated.
- Vietnam is a leading manufacturer of W&C (Wire & Cable) that uses PVC. Investment from Taiwan, Japan and Korea has boosted out significantly in recent years.
- Vietnam has attracted notable investment in PVC power cord production for appliances.
- Pipe and W&C demand was strong in Korea in the lead-up to the PyeongChang Winter Olympics.
- Tarpaulin demand is stagnant in Korea due to the offshore transfer of tarpaulin manufacturing plants, which will continue in the future.
Trends & Drivers — Asia Pacific

• In mid-2017, the first PVC window profile extrusion line started production in Australia.

• In-place PVC formwork for pouring concrete is a fast-growing application for PVC profiles in Australia. The formwork has a structural function in the final structure.

• Increased construction of high density residential blocks in urban areas in Australia is driving demand for water supply pipes, as well as drain, sewer and vent pipes. However, PVC faces competition from HDPE and other types of pipes and the upside is believed to be limited.

• There has been significant investment in 2017 in pipe extrusion capacity in Myanmar and Cambodia. Cambodia, however, is still reliant on imports of finished pipe from Thailand.

• Growth in infrastructure investment is also driving growth in pipe production in Vietnam.

• The significant demand for PVC flooring in Korean homes is due to Korea's unique heating system, which is called “ondol.”
PVC Additives

- Plasticizers
- Heat Stabilizers
- Lubricants
- Impact Modifiers
Plasticizer Consumption by Country/Region

Global consumption 2017: 7,982.0 kt

- China: 3,456.2 kt
- Asia Pacific: 1,204.6 kt
- Europe: 1,098.7 kt
- North America: 900.6 kt
- Middle East: 535.7 kt
- Central & South America: 341.7 kt
- India: 300.2 kt
- Africa: 144.3 kt

Unit: kt
Plasticizer Consumption by Type

Global consumption 2017: 7,982.0 kt

- Phthalate: 6,481.3 kt (81%)
- Epoxy: 470.9 kt (6%)
- Other: 391.1 kt (5%)
- Aliphatic: 351.2 kt (4%)
- Trimellitate: 215.5 kt (3%)
- Polymeric: 71.8 kt (1%)

Unit: kt
Key Plasticizer suppliers (2017 market share, tonnes)
Plasticizer Trends & Drivers

• Driven initially by Europe, concern regarding the perceived health risks of phthalates. In recent years, regulations have restricted some phthalates and thus alternatives have begun to be used.

• DIMP, is seen as a replacement for DOP, and although not restricted under REACH, it is restricted in the EU from items intended to be mouthed by children.

• DOTP (di-octyl terephthalate) is a terephthalate plasticizer. Eastman classifies DOTP as a non-phthalate (i.e., not derived from phthalic acid as are all ortho-phthalates. Applications in PVC are in flooring, toys, upholstery, wire & cable jacketing and various others.

• BASF’s DINCH (di-isononyl cyclohexane dicarboxylate) is also a non-phthalate plasticizer making steady progress in the market.

• DPHP, also from BASF, is a newer phthalate plasticizer, being touted as a replacement for DOP, DIMP, DIDP, and linear phthalates. Strong growth is anticipated.

• Diisoheptyl phthalate, sold by ExxonMobil Chemical under the JAYFLEX 77 brand, competes with DOP and BBP (n-butyl benzyl phthalate) in PVC flooring and is also used coating and dipping applications.

• PETV (pentaerythritol tetravalerate) from Perstorp is a non-phthalate plasticizer that reportedly outperforms DOTP and DINCH on several fronts

• Despite the availability of non-phthalate and “safe” phthalate plasticizers, some quarters are still pushing for PVC’s replacement with resins such as TPU and PE, especially in medical applications.
Heat Stabilizer Consumption by Country/Region

Global consumption 2017: 1,126.2kt

- China: 502.6 kt
- Asia Pacific: 175.8 kt
- Europe: 162.9 kt
- North America: 81.0 kt
- India: 55.3 kt
- Middle East: 52.0 kt
- Africa: 48.8 kt
- Central & South America: 47.9 kt

Unit: kt
Heat Stabilizer Consumption by Type

Global consumption 2017: 1,126.2kt

- Mixed Metal: 519.3kt (46%)
- Lead: 325.3kt (29%)
- Other: 141.1kt (13%)
- Tin: 140.5kt (12%)

Unit: kt
Key Heat Stabilizer suppliers (2017 market share, tonnes)
Heat Stabilizer Trends & Drivers

- REACH regulations have changed the heat-stabilizer landscape by phasing out lead use in Europe and restricting tin, thus driving use of mixed-metal stabilizers and organic stabilizers.

- In Europe, lead has been replaced in wire & cable with Ca/Zn stabilizers.

- Lead stabilizers remain widely used in wire & cable and rigid pipe applications in non-regulated regions such as India, unless the products are for export. Most other areas have shifted to Ca/Zn.

- In North America lead stabilizers have limited use for high-performance power cables.

- Japan is moving away from the use of lead stabilizers in PVC pipe; replaced by Ca-Zn powder systems.

- Developments in tin stabilizers, widely used in the US, include reduced tin content and cost, lower odor, and improved weatherability for siding and window profiles, particularly in dark colors.

- There has also been a general global shift away from dibutyl tin oxide to dioctyltin oxide and methyl tin driven by REACH.

- Another trend is toward heat stabilizers with lower levels of VOCs by reducing or eliminating solvent carriers in liquid heat stabilizers.
Lubricant Consumption by Region

Global consumption 2017: 1,216.8 kt

- North America: 349.7 kt
- Asia Pacific: 284.6 kt
- Europe: 242.8 kt
- China: 154.4 kt
- Middle East: 64.3 kt
- Africa: 55.1 kt
- India: 42.1 kt
- Central & South America: 23.8 kt

Unit: kt
Lubricant Consumption by Type

Global consumption 2017: 1,216.8 kt

- Paraffin/ Mineral Oils: 416.3 kt (34%)
- Metallic Stearates: 344.3 kt (28%)
- Petroleum/ Polyolefin Waxes: 207.6 kt (17%)
- Fatty Amides: 129.3 kt (11%)
- Esters/ Acids/ Alcohols: 99.7 kt (8%)
- Silicons/ Fluoro/ Others: 19.7 kt (2%)

Unit: kt
Key Lubricant suppliers (2017 market share, tonnes)
Lubricant Trends & Drivers

• Southeast Asian palm oil is becoming a key raw material for the lubricant market for stearates, fatty amides, esters and alcohols. Animal-based ingredients are generally being shunned, particularly for medical and food-related applications.

• Cost reduction is a key issue with lubricants. Efforts to reduce loading levels or switch to lower cost alternatives, such as PE waxes instead of ethylene bis-stearamide (EBS), will continue.

• The use of one-pack systems, which are blends lubricants, heat stabilizers and impact modifiers, or blends of just lubricants, is the new norm.

• The use of lubricants together with other additives requires careful selection and can result in synergistic effects.

• Wood plastic composites based on PVC represent a growth market for lubricants, particularly in Asia, as manufacturers strive to improve final product quality.

• In the medical field, there is a push towards reducing or eliminating any extractable chemicals, including use of fewer lubricants.

• Recently, Fischer-Tropsch waxes have emerged from China with suspect quality

• They are also trying to oxidize these FT waxes, something only Honeywell has been successful in doing to date with its PE waxes (oxidation delivers better metal release)
Impact Modifier Consumption by Country/Region

Global consumption 2017: 1,249.7 kt

- China: 404.7 kt
- Asia Pacific: 289.5 kt
- Europe: 192.2 kt
- North America: 170.3 kt
- Middle East: 62.7 kt
- India: 59.0 kt
- Africa: 40.1 kt
- Central & South America: 31.3 kt

Unit: kt
Impact Modifier Consumption by Type

Global consumption 2017: 1,249.7 kt

- CPE: 359.5 kt (29%)
- ABS/ MBS: 308.4 kt (25%)
- Acrylic: 299.6 kt (24%)
- Processing Aids: 241.2 kt (19%)
- EPDM/ EPR: 41.0 kt (3%)

Unit: kt
Key Impact Modifier suppliers (2017 market share, tonnes)
Impact Modifier Trends & Drivers

- CPE Impact modifier prices have decreased significantly because of slower economic growth and low-cost imports from Chinese producers, as well as shale gas effect driving PE prices down.

- This has resulted in plant closures and some Western suppliers outsourcing production to China, and/or focusing on higher end products like MBS and Acrylics for non-PVC applications.

- Chinese CPE suppliers are working to improve CPE quality and performance. Hebei Jingxin Chemical’s acid phase CPE production process, for example, reportedly yields CPE with superior elongation properties (up to a 90% improvement).

- Ultra High Molecular Weight acrylic PVC processing aids have emerged in the past 5 years (e.g., Rike UHMW, Kane Ace PA650, Arkema Plastistrength 580 and 566) for cellular PVC (lower density)...

- ...while low molecular weight acrylic processing aids such as Kane Ace PA121 and PA131 enhance metal release (less sticking), and Kane Ace PA211 reduces fish eye formation in films.

- Other new processing aids improve efficiency for processors or require lower loadings, including better compatibility with Ca/Zn heat stabilizer one-pack systems.

- A recently developed impact modifier from Arkema features anti-plate out properties.
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