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North America: Technology Developments and Market Opportunities Drive Industry Growth

A country report in the run-up to K 2019

The North American plastics industry, led by the United States, is posting good business results this year. Sales, revenue and growth indicators are pointing up for the foreseeable future. Among the factors driving growth are the digital revolution in controls and machine communication which yields significant advances in process and automation capabilities, as well as benefits in productivity, manufacturing economy and quality; new and evolving markets that generate demand for plastics applications; and a pro-business climate in the U.S. that under President Donald Trump is characterized by lower federal taxes, increased government spending and a relaxation of many onerous regulations since 2017. At "K 2019" 100 US and 18 Canadian enterprises will be represented while to the tune of 8,500 trade visitors will travel from North America to this, the international No. 1 trade show for plastics and rubber in Düsseldorf. Reason enough to take a closer look at the economic situation in North America and the local market conditions for the plastics industry, in particular, in the run-up to "K 2019".

Cautious Economic Optimism

Analysts report that U.S. gross domestic product (GDP) posted a 3% increase in 2018 from 2017 and should expand 2 to 3% in 2019, a range that represents healthy growth but is not considered high enough to trigger inflation, prohibitive interest rates or "irrational exuberance" among investors, lenders and consumers that could lead to an economic contraction.

Some experts, however, anticipate that 2019 GDP results will be at the low end of that scale. According to The Balance, an online publication, U.S. GDP growth will slow to 2.1% in 2019 and decline to 1.9% in 2020 and 1.8% in 2021. The reasons stem from a predictable reduction in demand for goods and services that follows the healthy growth of the past two years, and to the side effects of what the publication calls Trump's trade war, during which he imposed 10% tariffs on $200 billion (€224

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billion) worth of products from China, and levied tariffs against other countries.

The president also ordered tariffs on imported steel and aluminum and renegotiated a trade agreement with Canada and Mexico that will replace NAFTA, the 25-year-old North American Free Trade Agreement, with a treaty known as USMCA, or the U.S.-Mexico-Canada Agreement. The impact of the steel and aluminum tariffs has been generally good for the balance sheets of U.S. producers of the metals and costly to most end-users. The verdict is still out on how successful USMCA will be. Though it has been signed by the leaders of the U.S., Canada and Mexico, the treaty must be confirmed by the legislatures of each country before it takes effect. At stake is $1 trillion (€1.12 trillion) of annual trade between the neighbors.

Another concern created by the tariffs on China and other countries is their cost to U.S. consumers in the form of reduced product availability, higher domestic product prices due to less competition, the passing along of tariff penalties by importers and supply disruptions. The New York Federal Reserve Bank, for example, estimates that the China tariffs alone cost U.S. consumers at least $6.9 billion (€7.7 billion) of income from January through November 2018, and possibly as much as $12.3 billion (€13.7 billion), depending on how the numbers are interpreted.

"We find that the U.S. tariffs were almost completely passed through into U.S. domestic prices, so that the entire incidence of the tariffs fell on domestic consumers and exporters … with no impact so far on the prices received by foreign exporters," report the Fed economists. "We also find that U.S. producers responded to reduced import competition by raising their prices."

Despite these concerns, U.S. manufacturing is poised for growth. The MAPI Foundation (Manufacturers Alliance for Productivity and Innovation) forecast last year that U.S. manufacturing as a whole will grow by an average of 2.8% per year between 2018 and 2021; spending on capital equipment will increase by an average of 6.8% annually during that period; and exports will rise by 6% per year.

All of this is good news for plastics, which, based on one metric, employment figures from 2012 to 2017, outperforms the U.S. manufacturing industry. During that period plastics manufacturing employment grew by 1.6%, while total U.S. manufacturing employment rose 0.9%, according to figures developed by the Plastics Industry Association (PIA) and Probe Economics LLC.

In a report released late last year that covers results in 2017, PIA (formerly the Society of the Plastics Industry) states that plastics manufacturing generated 989,000 jobs in the U.S., a 2.4% increase from 2016, and 1.81 million jobs counting suppliers. The association's "2018 Size and Impact Report," an annual publication, puts the value of manufactured plastics shipments in 2017 at $432.3 billion (€484.1 billion), an increase of 6.9% from the year before. When suppliers are included, the value of shipments reached $590.6 billion (€661.4 billion), up 7% from 2016.

While it's likely that industry growth will slow somewhat in the next three years, demand for plastics products in the U.S. and the rest of North America, along with the evolution of major end-use markets, could be enough to cushion the impact of an economic slowdown for processors and suppliers. The relative stability, and in some cases depreciation, of the U.S. dollar compared with other major currencies will keep American-made products competitive at home and in export markets. The short-term outlook for the U.S. plastics industry and North America generally, is positive.

Enhancing Automation

The PIA report notes that the U.S. plastics industry is essentially at full employment. Anecdotal information from molders, extruders and other fabricators reveals that most are having a difficult time finding qualified workers. This situation is spurring efforts by product makers, compounders and others to further automate operations.

Many such initiatives are based on Industry 4.0 (I4) automation principles. I4 received a major boost from the German government in the past decade as a way of promoting digital manufacturing to improve productivity, product quality and, ultimately, competitiveness. In North America progressive processors are taking advantage of new and

powerful controls and software from such specialists as Siemens, IQMS/Dassault Systémes, Allen-Bradley, Omron, RJG and others, as well as from select equipment and robotics vendors, to create connected operations in which machines communicate seamlessly with each other and provide detailed operational data in real time.
The results allow product makers to extend quality control to ever-smaller batch sizes, even individual parts if necessary, and assure that production fully meets customer specifications.

Automation suppliers, meanwhile, are equipping robots with vision-inspection systems and other sensors to detect quality problems ranging from excess flash on parts to surface imperfections and short shots. This data can be used to manually or automatically adjust a processing machine or mold to eliminate quality problems.

I4 connectivity is also effective for predictive maintenance on machines, molds and tooling, and other equipment. By placing sensors at key points and monitoring them, processors detect when a component needs replacing, thereby eliminating the potential for unexpected and costly downtime, as well as off-spec production.

Such capabilities are increasingly available in software systems and machine controls. As such, they have the potential to create fully automated process plants—so-called lights-out manufacturing facilities—in which human operators are either eliminated or reduced to a handful of supervisory personnel.

The capital expense of installing I4 and similar automation may be daunting to end-users, but suppliers maintain that the return on investment can be as little as one year or less and the upside in productivity, quality, economy and competitiveness is worth the cost. As a result, U.S. adopters of digital technologies include medium and even smaller companies as well as large manufacturers. Much of the attraction of I4-level automation relates to the production involved, rather than company size. Medical, automotive and electronic parts, for example, have high quality thresholds, and advanced automation is the price of market entry.

Automation is not without its downside—at least to critics who claim it deprives humans of jobs and governments of tax revenue from displaced workers. Initiatives are periodically proposed to levy taxes on robots. The latest effort in the U.S. comes from Chicago, Illinois, where a city official wants an annual tax on each robot that is equivalent to one year's salary of every worker it replaces.

To date, no U.S. city or state has passed a law to tax robots. The European Union Parliament has rejected such a measure; and the only country in the world where a similar proposal has become law is South Korea. In this country, however, the government has removed business tax deductions for robots that take human jobs, not levied a tax on their use.

For now, however, mass replacement of humans by robots isn't likely. Robot makers say that when manufacturers install their equipment, they typically reassign affected workers to higher-value jobs. And with the industry at full employment in the U.S., companies do not want to lose workers.

The Road Ahead

New and evolving markets will account for a range of innovative applications in coming years. Two areas in particular that will generate important opportunities for North American plastics are electric vehicles and autonomous vehicles.

Electric vehicles (EVs) are common in North America, if underrepresented when compared with the number of cars and trucks powered by internal combustion engines. EVs, however, are more reliant on plastics to achieve the weight they need for optimum cruising range with a manageable battery size. Too much vehicle weight necessitates a disproportionately large battery (the ratio is geometric), which in turn requires an inordinate amount of interior space and consequent tradeoffs in vehicle design and passenger comfort.

Similarly, autonomous vehicles (AVs) will become major users of plastics and composites since they will be powered by electricity or, in some

cases, hydrogen, both of which will be weight-dependent for maximum range.

Every legacy automaker in the U.S. is developing AVs, as are global competitors with manufacturing plants in America such as Daimler, Volkswagen Group and BMW, as well as newcomers like Tesla and Waymo.

Auto OEMs expect to begin selling AVs with limited autonomy as soon as 2022, and with full autonomy no later than 2030. In addition to electric propulsion, AVs will be electronics-rich environments, with connections to personal communication devices like smartphones, the internet, and of course the high-tech sensors and lidar (light detection and ranging) systems that make autonomous operation possible. Aptiv (formerly Delphi Automotive Systems), a specialist in AV electronics, says that by 2020 a car with some autonomous capabilities will transfer 100,000 pieces of data each microsecond. The current data-transfer rate in AVs is 15,000 per microsecond.

These and other requirements mean that plastics and composites will play major roles in weight reduction, part consolidation, heat dissipation, high-tech lighting like OLEDs (organic light-emitting diodes), and flexible touchscreens for controls and morphable (shape-changing) instrument panels.

The transition to AVs seems unstoppable. While they may never entirely replace conventional gas- and diesel-powered vehicles, the auto industry is preparing for a major shift in unit sales and revenues. Consultant Roland Berger says OEMs will see their share of conventional car sales decline worldwide to 29.9% in 2030 from 34.7% in 2015, and their share of profits fall to 22.3% from 38.1% in the same period. AV fleets, in contrast, will capture 19.6% of global revenues in 2030 compared with 1.2% in 2025, and 40.3% of profits from 2.8% in the five-year timespan.

AVs won't be just for the road. A number of companies in the U.S. are working to develop autonomous urban air taxis that will ferry riders around congested cities as well as to and from airports.

Arguably the best known of these is Uber, the ubiquitous ride-sharing program, which formed Uber Elevate to make urban air taxis a reality. The company plans to open "skyports" in at least two cities, Los Angeles and Dallas, by 2020, with an eye toward full commercial service in 2023. Uber ground vehicles, autonomous or with drivers, will transport passengers to a skyport where they will board a small autonomous air taxi that is programmed to fly them where they want to go. The vertical-takeoff-and-landing (VTOL) vehicles will be electric and require lightweight polymer technologies to optimize flight range and battery power and to accommodate the electronics required for flight, air safety and passenger convenience. Uber is working with five aviation companies on designs for the air taxis.

One major aerospace manufacturer developing such a vehicle is Boeing, whose Aurora Flight Sciences division is one of the companies working on air taxi designs with Uber. Early this year Boeing flight-tested a VTOL prototype. How the concept of autonomous air taxis develops is anyone's guess at this point. However, enough corporations are investing significant sums of money in the idea and the technology that it could well be a commercial service in the next five or so years.

Rethinking Recycling

Recycling concerns seem to be cyclical in the U.S. The industry is currently in an "up" cycle, which is generating publicity among consumers and regulators. Most attention is on single-use plastic bags, with restrictions at local and state levels. California banned them entirely, and New York passed a similar law this year. In addition, some 350 U.S. cities and counties restrict or prohibit their use.

The restrictions are not likely to have much effect on recycling or the environment. This is because consumer recycling programs in general are not effective in the U.S.

Major resin suppliers are promoting local efforts to reclaim flexible waste, primarily packaging. These favor mono-material constructions, not mixed waste. While flexible food packaging is too valuable to restrict, efforts are underway to redesign packages for recycling.

Dow, for instance, has an all-polyethylene standup food pouch that facilitates recycling, as well as compatibilizer technology that allows PE packages with EVOH barrier layers to be recycled in the same stream. The company also has a solution for plastic bags: blend the scrap with Elvaloy, a reactive elastomeric terpolymer, for mixing with asphalt paving modifiers.

In February, the resin producer proved the concept by paving two private roads with a combined length of 0.5 miles (almost 1 km) at its plant in Freeport, Texas, using a blend of Elvaloy and 1,686 lb. (765 kg) of linear low-density polyethylene scrap, the equivalent of 120,000 single-use plastic bags. The road surfaces appear indistinguishable from conventional asphalt.

Eastman upgraded its methanolysis technology for thermoplastic polyesters, which breaks scrap into its constituent chemicals for repolymerization.

BASF and 30 other companies announced formation this year of the Alliance to End Plastic Waste, a global effort that seeks to eliminate waste from the environment and, notably, the oceans.

The industry's message is that it has the will and resources to increase recycling. The issue now, many experts say, is whether the public and regulators are listening and, most importantly, willing to change their personal habits to promote effective recycling programs.

Captions

<NAPIC1>
An autonomous vehicle operated by technology developer Waymo moves along a street in San Francisco. Fully autonomous vehicles could be a feature on many U.S. roads by 2030. (Credit: Waymo)

<NAPIC2>

Boeing tested a prototype autonomous air vehicle early in 2019. Such vehicles could be used as air taxis in the U.S. as soon as 2023. (Credit: Boeing)

<NAPIC3>

Dow paved two roads at its Texas plant in February with a special asphalt modifier that included LLDPE scrap. The process could become a major recycling option for consumer waste. (Credit: Dow)

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