Electric Vehicles as An Opportunity for the Chinese Chemical Industry

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Electric vehicles were among the earliest automobiles invented, and at one point actually had higher sales than gasoline-powered vehicles. In 1900, 28% of all cars in the USA were electric. However, a variety of factors led to their decline, among them the discovery of cheap oil in the USA, improvements in the combustion engine and requirements for greater range as a consequence of an improved road network. Only recently, environmental issues as well as concerns over peak oil have led to a renewed interest in the technology, though models developed in the late 1990s were not commercially successful. By the end of 2015, Nissan's Leaf and Tesla's Model S had been sold at volumes of 200 000 and 100 000, respectively, and many other car producers such as BMW, Chevrolet, Mercedes, Mitsubishi, Renault and Volkswagen have electric vehicles in their portfolio. Chinese producers and brands include BYD, Geely, JAC, Roewe and Venucia.

Electric vehicles can obtain the electricity they consume from a variety of sources including oil, nuclear power, coal power or renewable sources such as wind and solar power. With current models, the energy is stored on board using batteries. These batteries can also be used to store energy generated during braking of the car.

In China, the success of electric bicycles laid some of the groundwork for the subsequent development of electric cars. Another driver was strong government support, e.g., "863 EV Project" started in 2001, which comprised research into pure and hybrid EVs. By 2010, EVs were categorized as a strategic emerging industry, which allowed manufacturers to claim subsidies. In 2012, the State Council published the goal of producing at least 500 000 electric and hybrid vehicles by 2015. With 331 000 electric vehicles actually sold, this figure was not quite achieved but the increase over 2014 (+343%) and the further year-on-year increase for January - February 2016 (+70%) indicate that China's hope to increase the number of EVs to at least 2 million by 2020 may be realistic.

The Chinese government incentivizes plug-in vehicles with subsidies of up to US$9 000 per car as well as with registration privileges. This has made China the dominant market for EVs – the country accounted for about 60% of all EVs sold globally in 2015. Strong further growth is expected for the next few years as the government will subsidize the maintenance and construction of electric vehicle charging infrastructure. As a consequence, leading Chinese producers are optimistic about their sales prospects. BYD aims to almost triple its sales volume of 58 000 in 2015 to 150 000 in 2016, and Geely announced a target of achieving 90% of its sales with hybrid and electric vehicles by 2020.

Clearly, these prospects make EVs a highly interesting market for chemical companies in China. But where exactly are the main opportunities for chemical companies to profit from the expected surge in EV sales?

Reducing the vehicle weight is especially important for electric and hybrid vehicles. By using lightweight materials, the weight of power systems (batteries and electric motors) can be offset, resulting in an increased all-electric range or alternatively in reduced costs for a smaller battery at a constant all-electric range. According to the US-American Institute for Advanced Composites Manufacturing Innovation, in automotive applications, advanced composites could reduce the weight of a passenger car by up to 50% and increase the range of an EV by approximately the same percentage without compromising performance or safety.

At present, plastics account for about 10-15% of the total weight of vehicles in developed economies. In China, the average plastics share is thought to be somewhat lower than in developed markets. A push towards EV and the concurring pressure to reduce vehicle weight should bring substantial opportunities for thermoplastics and composites. Current main areas of use are exterior, interior, E/E and powertrain. The rise of these applications has supported plastics compounders with a strong automotive focus, such as Kingfa, China XD and Shanghai Pret. Any shift towards EV will drive metal substitution in these areas further.

In contrast, structural parts like body and chassis of a vehicle have so far been limited to metals such as aluminum alloy and steel, as standard plastics cannot achieve the mechanical properties of metal required for car bodies. However, carbon fiber composites can compete with metals while substantially reducing vehicle weight. The BMW i3 compact hatchback is far lighter than comparable cars as its body is made mostly of carbon composites -carbon fiber is 30% lighter than aluminum and actually stronger. Open issues include the much higher cost of carbon fibers and the different processes used for achieving the required shapes. However, both are likely to become less of an obstacle once production volume of carbon fiber bodies increases. The spread of electric vehicles could speed up the market penetration of these materials and increase sales of carbon fiber composite materials. The economic viability of carbon fiber reinforced composites may also be increased by the opportunity to produce larger, more complex parts, and the potential longer lifespan of carbon fiber based vehicles.

Weight reduction may also promote the use of alternatives to glass in automotive applications. For example, Evonik has introduced its Plexiglass glazing, which is 40-50% lighter than conventional glass, making it of great interest to EV manufacturers. Advanced glazing materials may also offer better insulating properties than current materials – an important factor as the range of EVs on hot summer days currently can be cut by 30%, mostly due to the energy requirements of the air-conditioning. Alternatively, EV manufacturers may in the future incorporate photovoltaic cells into the glass components of cars to further increase the range.

The second big development area driven by the increased interest in EVs obviously is the development of batteries. It is note worthy that BYD started out as a battery developer, supplying half of the global market for global phone batteries before expanding into electric vehicles. Indeed, BYD's workforce includes a reported 15 000 engineers in battery development. And the current Lithium-Ion batteries, which themselves are already the successor of Nickel-Metal Hydride batteries, are likely to be replaced by other types with even greater storage capacity, such as Lithium-Sulfur batteries or even Graphene-based materials, though some renowned industry experts such as battery materials expert Dr Dahn predict that these alternatives are still far from being commercialized. Still, in the meantime the chemical industry will have the tasks of incrementally enhancing Li-Ion batteries in terms of energy density and cost. This includes improvements not only of the core technology but also of the overall system, e.g., via the development of superior polymeric battery separators, as offered by companies such as Targray and DuPont.

While improvements in vehicle weight and in battery technology will remain the key focus of EV development, many other areas will also be affected. Examples include tires, air conditioning and lubrication.

Low-rolling resistance tires reduce the amount of power required to move a vehicle, thus allowing a single charge of an EV to go further. This may put a further premium on these tires, which are steadily being improved via varying combinations of specialty rubbers and filler materials. For example, the 20-inch Conti.eContact for electric vehicles claims to have a rolling resistance that is about 30% lower than that of a conventional tire. In the long run, concepts such as Goodyear's BHO3 may well be successful. This concept product offers the possibility of charging the batteries of electric cars by transforming the heat generated by the rolling tire into electrical energy.

Heating a combustion engine vehicle was straight forward as waste heat from the engines could be used to directly heat the passenger compartments. But efficient electric motors generate very limited waste heat, requiring a different solution. This will likely accelerate the spread of carbon dioxide based air conditioners in vehicles rather than those employing fluorocarbon refrigerants.

As EVs do not have pistons, there is less need for lubrication, potentially shrinking the volume of the lubricant market. On the other hand, any rotating parts of vehicles will still need lubrication. And car producers may increase the requirements for the remaining lubricants, e.g., via introduction of ultra-low viscosity oils, as this is another approach to save energy and thus extend the range of EVs.

China's government seems to be determined to give electric vehicles a substantial share of the local market. As shown above, this will affect many chemical companies that are current or future suppliers of the industry – not only in some obvious areas such as battery materials but also in many others. Chemical companies wishing to participate in the growth market for EVs are well advised to examine their overall portfolio for suitable products, and to market them actively. ■