



Dow, Innovative Driver

From the bare-footed running after the sun by KuaFu, a giant deity in ancient Chinese tales, to the unfettered outer-space travel nowadays, in the past millenniums, the human species never stops dreaming of traveling a thousand miles in a single day. Just as vision decides view, with the ever-increasing velocity and travel range, the boundaries for human activities are also ever-expanding, and the generation after generation evolution of transport facilities embodies the endless and audacious quest for the unknown ultimates by human species.

In a globalized 21st century, an increasing number of high-tech companies have joined this journey that spans over thousands of years, to jointly provide the human species with more convenient life, more open view and much easier communication. Dow Chemical, a globally leading technology company, is one of the most prominent players.

Automobile, the Continued Technology Fairy Tales



For the courtesy of Photographer Clement Martin

The development of automobile is a miracle nourished by science and technology advents. Born in late 19th century, the invention has essentially reshaped the worldwide industry structure and people's life style. It is inevitable for the automobile era to dawn, and since then on, though being slow-moving bipedal, human beings at large have got rid of the intrinsic fear for distance. No more restrictions of route or course, no more worry for traveling with strangers, just sit into the car—a private territory, and let the wheel in hands decide when and where, then you can go to any place at any time. This combination of unprecedented independence, freedom and liberation represents exactly the fundamental yearnings from human nature.

In 21st century when the world is becoming smaller and cities are becoming larger, for modern people, automobile is not just a traffic tool but a moving "home" on road. When we are enjoying the ease and convenience provided by this moving "home", however, a series of unexpected problems have emerged, such as congested roads, inadequate parking spaces, shorted energy, polluted environment and repeated accidents. Innovative technologies from Dow have offered the car era feasible solutions that make cars lighter, more comfortable, more powerful, safer and environment-friendlier.

Dow light-weight solution mainly consists of serials of system solutions such as BETAFUSE™ acrylic adhesion system, BETAFORCE™ polyurethane adhesion system and BETAMATE™ structural adhesion system. All three solutions are able to bond together different types of materials and promote the adoption of light-weighted materials in cars, such

as aluminum and composites, etc. They can make bonded parts have better structural advantage and better impact resistance, while maintaining car's mechanical performance and ductility.

These technologies have been commercially adopted by some key EU car makers since 2009, and debuted in China in late 2010. Epoxy resin and polyurethane composite can directly replace metal and other composites for car's inner and outer decoration to reduce car's weight. It is also notable that this total set of solutions from Dow has being extensively applied in commercial vehicle sectors like trains, buses and trucks.

The "Super Bus" of TU Delft in Holland, is one of the projects aiming to create the next generation of high performance public transport system. To realize innovative light-weighted bodywork, the Super Bus has introduced a variety of light-weighted materials including aluminum, carbon reinforced composite and polycarbonate screen as a replacement for glass. Dow as the technology leader in innovative adhesive field has provided BETAMATE™ single component and bi-component adhesives to this project.

Safety serves as the priority. Car's safety can be greatly improved by using small amount of DOW's BETAMATE™ FLEX structural adhesive. This adhesive can provided balanced mechanical performance and ductility to prevent thermo deformation that might be caused by solidification of aluminum and other light-weighted metals, thus reducing the welding spots in car making process and improving impact resistance.

DOW's BETAWIPE™ Hydro glass adhesive can add more safety to car manufacturing process by effectively improving the working environment for car workers. BETAWIPE™ Hydro glass adhesion, as the first single component hydro-activated product in the world, contains no volatile organic compound (VOC), greatly shortening the time needed for car windshield installation and improving productivity.

Comfort in driving experience. Suspension system is the general designation for all force transmission and connection assemblies between car chassis and car bridges or wheels. It plays the role like the bones in human body to transmit the forces and torques applied between wheels and chassis, and to buffer the impulse force on the chassis or bodywork caused by bumpy road surface, hence reducing the resulted vibrations. DOW's AUTOTHANE™ high performance micro-porous polyurethane material system can help car makers and Tier 1 suppliers to realize control over the vibration in suspension system and enable better riding experience. DOW's BETAFOAM™ soundproof foam achieves perfect sealing performance by effectively insulating wind noise, exhaust noise, engine noise and other ambient noises. In addition, DOW's rubber and metal adhesive series, including MEGUM™, THIXON™ and ROBOND™, can effectively bond flexible materials with metal, engineering plastics and other types of flexible materials under various conditions to make car driving/riding a more comfortable and pleasant experience.

Control emission and create eco-friendly environment. Car emission has gradually become the major cause of urban air pollution. Particularly, the particles contained in car emissions may absorb a large amount of hazardous materials owing to its relatively small size, becoming a huge menace to human health. DOW's AERIFY™ diesel engine particle filter can effectively improve this situation by offering better particle

filtering performance to direct-injection diesel and gasoline engines, thus controlling emission and reducing carbon footprint. AERIFY™ diesel engine particle filter features low back pressure to enhance engine efficiency, smaller size to improve packaging productivity and outstanding dust- and chemical-resistance to offer unrivalled durability.

Catalyst is a crucial part of the car emission system. It serves as the purification equipment that converts the CO, HC and NO_x in the emission into gases harmless to human health via catalyzer. Its key component, the catalyzer carrier, in most cases is made of honeycomb-like porcelain that is produced through the process of mold extruding. The METHOCEL™ cellulose ether from DOW Wolf Cellulosics can be used as temporary adhesive and processing aid to offer accurate flow change control over the mixed slurry used to make porcelain carrier, and allow wider operating range. It can provide ideal lubrication to lower energy consumption and wear of the extruding mold and assist the formation of smoother surface, while the METHOCEL™ thermo gel can help the formation of fine thin-wall shape without any concave or deformation.

FIA World Endurance Championship annually held in Le Mans, France, is one of the most historical car racing contests in the world, which tests both car's speed and durability. As the cars are to experience very demanding stress conditions during the rally, it is necessary to use lubricants, consumables and other parts that can meet such stringent requirements. In the 2011 Le Mans World Endurance Championship, DOW's UCON™ oil-soluble poly alkylene glycol (OSP) base fluid has demonstrated superb performance.

By applying the patented oil-soluble polyalkylene glycol (PAG) technology, UCON™ OSP base fluid features some key advantages of synthesized PAG-based lubricants including low friction, easy to form films, easy to control deposits, ideal polarization and high viscosity index. It also has the ability to dissolve in mineral oils and oils based upon synthetic hydrocarbons, which can help lubricant producers to develop formulas for fully-synthetic or half-synthetic friction-reducing lubricants.

High-Speed Railways: Providing Safe Guarantee for "The China Speed"



There is no doubt that "high-speed railway" will become a keyword of 2011.

On June 30, 2011, the Beijing-Shanghai High-Speed Railway was officially open for service. As the longest course, the technically most advanced and the fastest running high-speed railway in the world, its opening ushers in an era of "bus-like



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inter-city railways" in China. Together with Beijing-Tianjin Inter-City Railway, Wuhan-Guangzhou High-Speed Railway, Zhengzhou-Xi'an High-Speed Railway and Shanghai-Nanjing High-Speed Railway which became operational before it, China's high-speed railway network has taken shape.

And, all this happened within less than 10 years—In June 2004, construction began for Wuhan-Guangzhou High-Speed Railway, which heralded the start of high-speed railway building in China. In 2008, Beijing-Tianjin W High-Speed Railway was open to service. At the end of 2009, Wuhan-Guangzhou High-Speed Railway became operational. In 2011, the whole Beijing-Shanghai High-Speed Railway was completed. "The China Speed" has shocked the whole world. According to China's *Mid and Long Term Railway Network Plan*, the operating railway mileage in the country will increase to around 120,000Km from 91,000Km at present by the end of the Twelfth Five-Year Plan Period. Of this, high-speed railways will account for 45,000Km.

As China's railway network expands and railway speed increases, frequent high-speed railway accidents, especially those which took place in 2011, have made high-speed railway operational safety a focus of attention for the public and the railway operation departments.

Among the various factors affecting railway operation safety, rail track maintenance is one of particular importance. This is because when trains run at a high speed, the intense friction between metal wheels and the track will leave wear traces on the track surface, and the accumulated of wear traces will speed up the wear of track surfaces and result in hidden safety defects. For this reason, various railway bureaus in China have successively imported some special maintenance vehicles to polish and maintain railway tracks, and related domestic enterprises have developed special maintenance vehicles that meet local requirements, which have gradually become the leading equipment for all railway bureaus in China to maintain their high-speed railways.

When special track maintenance vehicles polish the track surface, several pairs of polishing heads will perform, supported by a hydraulic system, high-speed polishing close to the tracks, and drastic friction between metal surfaces generate high temperature. If any leakage occurs to the hydraulic system, hydraulic fuels may well run into the danger of burning at such high temperature. Therefore, it is an inevitable choice to adopt high-performance, fire-resistant hydraulic fluids for special railway maintenance vehicles.

In close cooperation with the Chinese Ministry of Railway's Machinery Equipment Company, Dow Chemical has brought into the Chinese market UCOM™ Hydrolube HP-5046D, a technically-advanced, mature, full-synthetic, pressure-durable and fire-resistant hydraulic fluids, for use in the hydraulic systems of Chinese-made special track maintenance vehicles.

The product uses Dow's PAG full-synthetic base oil, with a VI of 192 and a pour point of -63°C. Therefore, it can be used in the field all seasons across China. Meanwhile, the product also uses Dow's unique formula technology that helps ultra high-pressure hydraulic systems to maintain good hydraulic pressure and lubrication properties. Most importantly, in line with Dow's persistent attention to and commitment to safety and environmental protection, the product can be biological degraded and maximally reduce "its footprint" in the environment.

Ships: Build an "Antifouling" Shield

Ships have been the oldest transportation means. In order to



survive, human ancestors lived by water and started to use rivers and other natural watercourses for transportation purposes in ancient times. With the large-scale construction of railways and the rapid rise of automobiles, water transportation is no longer as dominant as it used to be. However, thanks to its huge freight volume, low freight and wide shipping lanes, water transportation still occupies a vital position in the transportation field. Ocean shipping is the most important transport means in world trade and accounts for 2/3 of the world's total trade freight volume.

However, ships face the threat from marine biofouling. Marine biofouling can be defined as the undesirable accumulation of microorganisms, such as bacteria and microalgae, plants and invertebrates on artificial surfaces submerged in seawater. Fouling of a ship's hull by marine plants and animals changes its hydrodynamic characteristics resulting in increased fuel consumption, decreased speed, increased maintenance cost, and increased time out of service.

Dow Microbial Control has a long-term commitment in bringing to the market high-performing and sustainable active substances and products to solve most microbial control problems. For example, 4,5-dichloro-2-n-octyl-4-isothiazolin-3-one (DCOIT), the active ingredient in Sea-Nine™ antifouling agent, offers long-term viable and sustainable microbial control in marine antifouling applications.

In 1996, a commercial formulation of DCOIT, Sea-Nine 211 Antifouling Agent won the prestigious Presidential Green Chemistry Challenge Award in the category of Designing Safer Chemical Products. This award was established by an alliance of the chemical industry, the EPA and the Clinton Administration to recognize and promote fundamental breakthroughs in chemistry that prevent pollution and have broad applicability in industry. In 1997, Sea-Nine 211 was also recognized as an Environmental Champion by the Chemical Engineering and Environmental Engineering World.

Road: Draw traffic lifeline

Road marking paint is an indispensable material for highway construction. Lines, arrows, text, 3G and protrusive road marks, inform us of traffic rules and road directions on highways and conveys various important information to vehicle drivers and pedestrians. As traffic marking lines are mainly used on road surfaces, they need to bear the impact and wear of vehicles. There are strict performance requirements for such marking lines. First, short drying time and simple application to reduce interference to traffic; Second, high reflection ability, distinct colors, high shine and good visibility during day and night; Third, good anti-skid and wearability to ensure driving safety and service life.

As public awareness of environmental protection and traffic safety strengthens and thanks to the support and promotional efforts by governments of various countries, water-based road marking lines have been more widely used worldwide. It offers outstanding environmental performance, excellent durability, longer visibility at night and especially under rainy conditions and have high construction efficiency.

One of the technologies used is Dow Fastrack™, a water-based acrylic fast-drying road making technology which has just won the 2011 Ringier Technology Innovation Award for the Coating Industry. Building on the previous generation of water-based acrylic road marking systems, Fastrack™ adopts self-crosslinking technology to greatly improve drying speed under high humidity, low temperature (around 0°C), wind-free and other harsh construction conditions, and can effectively resist the washing of rainwater in early periods, thereby extending the construction season. Its improved glass bead binding technology improves marking line durability. In addition, Fastrack™ also enhances the force of wetting and adhesion to cement and asphalt road surfaces, is suitable for different base materials and road surface conditions this expands the scope of applications. The technology has been successfully applied in important highways, including Jingcheng Expressway, Huning Expressway, Baolong Expressway, Xianyang Expressway, Shanghai Pudong Airport, Airport Expressway, Central Ring Road in Shanghai, Chongming Yangtze Tunnel and Hangzhou Bay Bridge.

From ships traveling on rivers and seas to railways running across the globe and automobiles on various continents, the Earth has become smaller and smaller in the succession of transport means. From the land to the sky and from the Earth to the universe, the human world is growing bigger and bigger. From walking on feet to horse riding, sitting on sedans and traveling on rivers, the pace of human walking has never stopped. With advancing technologies, a new journey of exploration is unfolding.

