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Conference & Exhibition

MARCH 4-7, 2014
SHANGRI-LA HOTEL SINGAPORE

Fuels & Lubricants: Meeting the Challenges for the Next 20 Years

Souvenir Program sponsored by

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[editorial message]

Mapping out the next 20 years

Vicky Villena-Denton
Editor-in-Chief
F&L Asia Ltd.

To say that the last 20 years have been exciting would be a significant understatement.

The past two decades have been marked by a lot of fundamental changes, social shifts on a global scale with the advent of social networking and the way it provides humanity with a memory, and, perhaps, for the first time, at odds with increasing geopolitical instabilities, a unique opportunity to avoid history repeating itself.

On the economic front, while western markets have now reached maturity, Asia has risen to its new status as Epicentre of the World. The roller coaster of economic events for the past 20 years, spanning from the 1998 Asian Financial Crisis to the most recent (still unfolding) Global Financial Crisis and a succession of bubble booms and bursts in between, have highlighted the systemic pitfalls of our global financial systems and provide us hints for the even more tumultuous 20 years ahead.

I started my career as a trade journalist specializing on the downstream oil industry in Washington D.C. in 1984 and later moved back to Asia in 1992 after a brief stint in the Middle East. F&L Asia was born three years later. Our first-ever conference was held at the Shangri-La Rasa Sentosa in January 1995. The next year, we moved to a bigger venue in Singapore, the Shangri-La on Orange Grove Road, where our 20th conference is now being held. Singapore has been the home of the F&L Conference on and off over the past 19 years and will be its permanent home moving forward.

In tune with its times, F&L Asia has a duty to the industry it serves to continuously re-invent itself and respond to the monumental shifts that are redefining the marketplace. The needs of the market have changed and so must we. Over the coming months, you'll hear more about new F&L Asia media products and services that will allow us to keep on delivering on what we do best: to nurture fluid industry connections, ensuring clients are always first with the latest.

Meanwhile, I would like to take this opportunity to thank our Corporate Sponsors, our Advisory Board Members and our Speakers for their continued support and the invaluable insights they share with the industry through F&L Asia's various platforms.

Sincerely Yours,

Global Landscape: Systemic Risks, Underlying Factors & Foreseeable Trends

Giovanni Di Noto
Head o f Strategy
F&L Asia Ltd.

Giovanni di Noto has recently been appointed Head of Strategy for F&L Asia Ltd. On March 4, he will depict the current global social, environmental and organizational landscape highlighting foreseeable megatrends of potential relevance to the fuels and lubricants industries over the next 20 years and beyond.

The 1st half of the Asian-centric 21st Century is being shaped by critical and converging tipping points:

- Global demographic shifts to millennial generations and mass urbanization
- Client-centric trends and insight-driven organizational models
- Global sustainability crisis and ever-ageing population

The conflicting forces at play are generating new organizational forms and behaviours across social, industry and institutional areas such as the rise of the emergent agile micro-internationals, borderless digital economies, counter-intuitive new economics and neo-corporatism reminiscent of medieval guilds as well as paradigm shifts in mobility, building and urban design.

Meanwhile, massive economic dematerialization and virtualization (via acquisitions, consolidations or shut-downs following succession management and exit strategies gaps, technical skills shortages or market-pressured restructures) are symptomatic of a broad-scale reshaping trend within conventional large corporate and governmental organizations.

In parallel, new forms of industrial risks derived from the ever-ageing population and sustainability crisis are emerging. Conventional market mechanisms once taken for granted now routinely default, increasingly disrupting value chains.

As it grows and ages, human society is entering an uncharted "money can't buy" era which at its core constitutes a "value representation" conundrum, highlighting the profound disconnect between financial and physical worlds.

Recipient of prominent industry recognitions (including Award for Excellence in Human Resources Management, Best Australian IT Implementation Award, Best Australian e-Commerce Award, and many others), Giovanni is a business & technology veteran with three decades of international experience.

During the 1980s, in France, Giovanni developed digital platforms based on the Minitel national public network. In Italy for most of the 1990s, Giovanni created some of the very first commercial internet service providers in Europe, significantly contributing to the rise of the global online industry and making significant inroads into the cloud-computing technology sector. Based in Asia-Pacific since 1998, Giovanni today provides strategy, management and cloud technology consulting advices, occupying senior executive positions and board tenures with a selected number of global fortune-100, institutional and other organizations across industry verticals such as primary production, manufacturing, logistics, distribution, retail, sustainability, publishing, healthcare and hospitality.

Giovanni is also a regular keynote speaker within the professional conference and summit circuit, as well as an academic lecturer at leading universities and professional institutions, on a range of topics pertaining to technology, sustainability and management. Giovanni has a multi-disciplinary tertiary background (economics, business management, information technology & applied sciences).

In his capacity as Head of Strategy at F&L Asia, Giovanni sets, directs and oversees strategy execution globally across all of the organization's publishing and conference assets.

[keynote speaker]

MARCH 4, 2014

ERIC G. HOLTHUSEN
GROUP COO OF PETRONAS LUBRICANTS INTERNATIONAL

Eric has served as Group Chief Operation Officer in PETRONAS Lubricants International since May 2013 overseeing Manufacturing/Engineering, R&D, Global Marketing and Key Accounts Management.

Eric joined Shell in 1989 in Hamburg, Germany as a Product Development Engineer after having worked in the automotive industry on diesel engine development.

Since 1992 he worked on lubricant development in Shell's research center in Grand Couronne, France. In the 1990s he was also involved in Shell's F1 fuels and lubricant development for McLaren and Footwork-Porsche.

From 1995 to 2001 Eric worked in various functions, leading Shell's product testing activities for fuels and lubricants in Hamburg and ultimately leading the three departments for engine, emission and road testing.

In 2001 Eric took up the roles of managing director of Shell Research Eastern in Singapore as Fuels Technology Manager for the region.

In 2004 he moved to Shell's Asia Pacific Service Centre in Kuala Lumpur to lead the regional Fuel Technology Group, taking on the additional responsibility of managing the technical implementation of retail fuels globally in 2010.

In 2011 Eric joined Saudi Aramco as an advisor to its R&D organization, developing its downstream technology strategy and implementing a global R&D network establishing laboratories in Europe, America and Asia.

Eric has published numerous papers on the subject of future and alternative fuels.

He holds a Masters degree in Automotive Engineering from Hamburg University of Applied Science and completed a business leadership program at INSEAD's campus in Singapore.

Looking 20 Years Ahead

Streaming the Future for Lubricants

AS GLOBAL MEGATRENDS, SUCH AS THE SHIFTING ECONOMIC POWER POCKETS, ADVENT OF NEW ENERGY SOURCES AND GROWING ENVIRONMENTAL CONCERNS, DRIVE CHANGING TRENDS IN THE AUTOMOTIVE INDUSTRY, WHAT LIES IN THE FUTURE OF THE LUBRICANTS INDUSTRY?

This paper delves into these drivers of change, these emerging trends in and related to the automotive industry that are hastening the demise of combustion engines, the creation of smaller engines and hybrid vehicles, and the possibility of a quantum leap in engine design over the next 20 years that will have a significant impact on the functions of lubricants.

As emissions standards continue to tighten, pushing more powertrain electrification, how will the roles of lubricant manufacturers and suppliers be affected? Will there be sufficient lead time, extended out by the differing development paces of geographical regions, which the lubricants industry can leverage and maximize?

Mature lubricant markets like the U.S. and Europe pose markedly different scenarios for the industry in the next 20 years compared to ambitious markets such as China, India and Russia. To bridge the different playing fields, lubricant players must be equipped to shift gears effortlessly.

Shifting socio-economic dynamics in developed markets points towards a de-motorization trend, but the point of the discussion will be how real this threat is, how near we are to it and what it spells for the lubricants industry.

Outside of the automotive industry, power-generation and heavy industries are also on the renewable energy and energy efficiency bandwagon, adopting technology to meet increased sustainability requirements and to move machinery towards hydraulic circuitry. This inevitably will impact the industrial lubricants sector as research and development efforts adjust directions to meet these requirements.

This paper also explores the raw material consideration in the lubricants manufacturing and supply chain. With the gradual displacement of Group I and Group II base oils with higher quality base oils, the sustainability factor that will encourage alternative sources of base oil, such as re-refined or bio-based base oils, and the advent of GTL technology should prove viable over the long run.

These drivers of change impacting different segments within the ecosystem of the lubricants business amplify the urgency to focus on how the industry thinks, behaves and markets its products in order to endure beyond the next 20 years. This includes the aptitude to select the right partners in an environment of shifting power bases, making the right call in investing research and technology resources, and driving new-age marketing that compels a new way of looking at lubricants.

[keynote speaker]

MARCH 5, 2014

DR. CHRISTOPHER LOCKE
EXECUTIVE VICE PRESIDENT
MARKETING AND
TECHNOLOGY, INFINEUM

Chris currently holds the post of executive vice president of marketing and technology for Infineum with global accountability for R&D and delivery of new technologies and value propositions to the additives market. He also heads up the Infineum strategy team as chief strategy officer with a particular personal focus and interest on the emerging economy markets.

A PhD chemist, he began his career in the early 1990s with Shell Research in the UK, undertaking fundamental R&D work in the colloid and surface science field. He worked on diesel soot dispersancy which lead to a posting in the Shell Additives formulation development team, followed by three years in Asia-Pacific technical service.

Upon the formation of Infineum in 1999 Chris lead the heavy-duty diesel formulation team for two years, followed by a posting as EMEA/AP technology manager where he oversaw the development of a number of the first reduced sulphated ash, phosphorus and sulphur formulations.

In 2006 Chris transferred to the marketing function, heading up Infineum's Fuel Additives business. During his tenure in the role, a particular focus was placed on innovation and diversification, leading to the development of a significant new business in Fuel Borne Catalysts for use in automotive applications.

In 2009 he moved back to the automotive lubricants division as global business manager, also leading the Infineum strategy development team and China Venture. Chris has a particular personal interest in the rapid development of the emerging market economies and their implications on our industry, something he was personally involved in through the recommendation to invest in major new manufacturing and technology facilities in China (both now under construction).

Finally, in April 2013 Chris was appointed to his current position, following the combination of the prior Marketing and Technology functions into a single entity.

Asia Pacific Influence On Global Automotive Lubricant Specifications

WE LIVE IN A WORLD OF CONTINUAL CHANGE, WHERE THE RATE AND PACE OF CHANGE IS EVER INCREASING BASED ON HARDWARE, BASESTOCK, ADDITIVE AND EMISSION LEGISLATION DRIVERS. THE AUTOMOTIVE FUEL AND LUBRICANT MARKETS OF TOMORROW WILL LOOK VERY DIFFERENT FROM THOSE OF TODAY. THIS IS DUE IN NO SMALL PART TO THE RAPID EMERGENCE OF THE ASIA PACIFIC REGION AS THE CENTRE OF GLOBAL GROWTH. UNLIKE THE NORTH AMERICAN AND WESTERN EUROPEAN MARKETS, ASIA PACIFIC HAS A HUGE DIVERSITY OF TECHNOLOGICAL, MARKET AND CONSUMER NEEDS, LEADING TO A VERY HIGH DEGREE OF FRAGMENTATION.

This presentation will examine the evolving needs of the Asia Pacific region within a wider global context as we approach a potential tipping point in Asia's influence on the global automotive lubricant markets. Without question, the region has established itself as the business growth driver of the automotive lubricant world, but as yet it is still a modest player when it comes to global specification development. Asia Pacific encompasses a complex patchwork of different emissions legislation, varying fuel and lubricant qualities, and very different consumer and/or national market needs. Right now, the predominant Asian lubricant specifications tend to be based on U.S. and Western European standards, but there is a growing question mark over whether this position is truly viable longer term as the region's OEM aspirations (both local and international) develop.

The presentation will look at the implications of an increasingly powerful Asia Pacific region and suggest the changes that should be considered to ensure that the needs – and indeed desires – of the region are successfully integrated into a global whole. Does the process of developing and introducing automotive lubricant specifications across the world fundamentally need to change, with Asia Pacific as a more assertive and influential seat at the table? What sort of dialogue needs to take place within the industry to bring about meaningful change? What would the benefits of such change be, and what are the potential effects of us taking no action?

As Asia continues to grow as a major contributor to global lubricant volumes, it is incumbent upon us as an industry to take stock of how this change can most effectively be managed. Do we stand still and allow sweeping specification complexity to stifle development and innovation in all our markets, both current and future, whilst potentially not delivering real consumer value? Or do we evolve, ensuring that Asia Pacific integrates into the global market effectively, providing us with a process for automotive lubricants specification development that is more economically sustainable and globally balanced?

[keynote speaker]

MARCH 6, 2014

DIPL.-ING.
MICHAEL SCHENK,
DAIMLER AG, STUTTGART,
MANAGER, AUTOMOTIVE
LUBRICANTS

Michael is responsible for automotive lubricants and is Mercedes-Benz´s representative in the European Automobile Manufacturers Association (ACEA) and Coordinating European Council (CEC) working groups for lubricants.

Since he started in the fuels and lubricants department at Daimler in Stuttgart-Untertuerkheim 25 years ago, he has been heavily involved in specifications and approvals for automotive lubricants, focusing on engine oils.

The main objectives of his job can be summarized by the development of specifications, optimization, rating, selection and approval of automotive lubricants according to economical, ecological and logistical aspects. This requires close cooperation with the oil and additive industry, with test laboratories and with experts from Daimler and other OEMs.

Professional Career

- Studied at the University of Stuttgart, degree Dipl.-Ing. Verfahrenstechnik (Chemical Engineering)
- Industrial practical, BASF, Ludwigshafen
- German Army, Military Service & Chemical Laboratory WBK V, Stuttgart
- Daimler AG, Fuels & Lubricants Department
- Started as product manager for engine oils
- Today manager for automotive lubricants and member in various working groups

Mercedes-Benz Oil Specifications

Future Challenges for Engine Oils

MICHAEL SCHENK & TILMAN LINDER, DAIMLER AG

LONG DURABILITY AND RELIABILITY, LOW FUEL CONSUMPTION, LOW EMISSIONS AND GOOD COMPATIBILITY WITH CURRENT AND FUTURE FUELS ARE WHAT CUSTOMERS EXPECT FROM MODERN PASSENGER CARS AND HEAVY-DUTY TRUCKS. THIS IS ONLY POSSIBLE IF ONE OF THE DESIGN ELEMENTS, THE ENGINE OIL, HAS A HIGH QUALITY AND MEETS ALL THE MANY REQUIREMENTS THAT A MODERN DOWN-SIZED AND HIGHLY EFFICIENT ENGINE REQUIRES OVER A LONG TIME.

Our goal is to keep and to further improve the reliability and durability of Mercedes-Benz engines over the expected useful lifetime with the introduction of new requirements for engine oils and by newly developed oil tests.

The targeted oil change intervals should be preserved or, where possible, extended even further. The most important criteria that have to be fulfilled in particular are wear protection and engine cleanliness. High importance in this context and on the functionality of the engine is the compatibility of engine oils with biofuels or biofuel components. Therefore, good biofuel compatibility of engine oils plays an important role in the MB engine oil specifications.

One of the main objectives of the new MB engine oil specifications is to qualify engine oils with good fuel economy to reduce CO2 emissions much further and to meet the EU limit in 2020. The importance of this goal is clearly demonstrated by the introduction of five new fuel economy tests for passenger cars and commercial vehicles and reflects the weight of this requirement.

To meet the current and future emissions standards, exhaust after treatment systems, such as particulate filters, catalytic converters based on the principle of selective catalytic reduction (SCR), exhaust gas recirculation systems (EGR), NOx storage catalysts (NSC) and corresponding exhaust gas and oil sensors are needed. All necessary components must work reliably over a long application period and should be not affected by any engine oil components. The compatibility of engine oils with these exhaust after-treatment systems is therefore a high priority in all current oil specifications.

The presentation in summary shows what engine oil requirements are needed today and what challenges for oils are expected in the future. The agenda of the presentation is:

- MB Product Portfolio
- Structure of Mercedes-Benz Engine Oil Specifications
- Future Challenges - Motivation & Goals for new engine oil requirements and new tests
- New and Modified Oil Tests for Future MB Engine Oil Specifications in Detail
- Actual and Future Mercedes-Benz Engine Oil Specifications
- Summary & Outlook

[keynote speaker]

MARCH 7, 2014

VIJIT TANGNOI
EXECUTIVE VICE PRESIDENT, PTT RESEARCH AND TECHNOLOGY INSTITUTE
PTT PUBLIC COMPANY LIMITED, THAILAND

Vijit received his BSc in chemical engineering from Chulalongkorn University (Thailand), MS in industrial engineering from The University of Texas at Arlington (U.S.A.) and BBA from Sukhothai Thammathirat Open University (Thailand). He has been working with PTT Public Company Limited for 30 years in many areas of the petroleum and petrochemical business such as fuels and lubes research, process technology research, corporate strategy and business development. At present, he is executive vice president, PTT Research and Technology Institute. He has responsibility in managing research and development of product/technology along PTT's value chain of oil & gas, petrochemical, biofuel/biomaterial and renewable energy. In 1981, as a researcher in the R&D Department, he carried out a study on the utilization of Natural Gas and LPG in Thailand. In 1994, he was fuel technology division manager, involved in fuel product development to launch the first unleaded gasoline in Thailand. In 1998, he became corporate business development division manager and in 2005, he moved to the Petrochemicals and Refining Business Development Department. In 2007, he became vice president in the Process Technology Research Department. In 2012, he was named to his current post.

Trends and Directions on Fuels and Lubricants - Research Perspectives

GLOBAL ENERGY CONSUMPTION IS PREDICTED TO INCREASE 41% BETWEEN 2012 AND 2035. THE RISING CONCERNS ON THIS FAST-GROWING ENERGY DEMAND AS WELL AS SUSTAINABLE DEVELOPMENT ARE SPURRING THE PROMOTION AND IMPLEMENTATION OF COST-EFFECTIVE STRATEGIES TO ENHANCE ENERGY EFFICIENCY, DRIVE ENERGY CONSERVATION EFFORTS AND INCREASE THE SHARE OF RENEWABLE ENERGY RESOURCES TO MEET THE REGION'S ENERGY NEEDS.

The challenges arising from the demand for more energy-efficient vehicles, the imposition of more stringent emission regulations and the increasing utilization of sustainable biofuels as well as unconventional fossil energy sources, especially shale gas, have led to various developments in fuels and lubricants technology as well as vehicle technology.

While biofuels are commercialized in some parts of the world, there is continued concern about the use of feedstocks which are mostly derived from edible sources known as first generation feedstock. This concern has amplified the need for further research and development as well as demonstration and deployment of sustainable biofuels technology, process and product development using inedible feedstocks.

From a research perspective, second and third generation biofuels such as lignocellulosic ethanol and substituted diesel will be high on the agenda. The future will therefore focus on sustainable feedstocks that are non-competitive with food crops. Novel technologies will be required to meet the challenges of producing high quality biofuels which will be not only sustainable but also economically competitive with conventional fuels.

Lubricants too need to be developed outside the traditional formulation in the future. Innovation and lubricants technology development will need to focus on effectively meeting the challenges of higher fuel efficiency, extension in oil drain interval and advanced formulation for alternative fuels. We can expect to see higher quality base oils and more green or biodegradable products making inroads into the market. However, bio-based lubricants still need further improvements in terms of cost and performance and will require government mandate, support or incentives before they can move into the mainstream market.

Original Equipment Manufacturers (OEM) have also been playing a significant role in meeting the future challenges with innovation on powertrain technologies which have brought about significant improvements in conventional engines. The development of new generation vehicles have allowed the use of liquid biofuels, natural gas, biogas, electricity and hydrogen, which can be produced from low-carbon or carbon-free sources. Together with the OEMs' continuous efforts towards engine downsizing, use of lightweight materials and new after-treatment systems, all these developments will have a significant impact on both the fuels and lubricants industry.

The world faces significant challenges as we attempt to move towards a low-carbon and resource-efficient economy, but with a strong commitment to research and development and focused investments on innovative technologies to address future challenges as well as strong support and concerted efforts by all concerned, we can look forward to a more sustainable future.

[Advisory Board]

ZHANG CHUNHUI is currently the Director of the Technology Department of the Lubricant Company, SINOPEC Corp. He graduated from Tianjin University with double bachelor-degrees in chemical engineering and industrial management engineering. He received a doctoral degree from the China University of Petroleum. He has been working in the lube industry for more than 20 years. He has received the title professor Senior Engineer. He was awarded a government subsidy from the State Council in 2004.

GARY PARSONS joined Chevron in 1981 after obtaining his Bachelor of Science and Master of Science degrees in Mechanical Engineering from the University of California at Berkeley. From 1981 through 1985, he worked as a Research Engineer in the Fuels Division at Chevron Research and Technology Company. From 1986 through 1995, he was the Oronite Additives Fuels Product Manager in three different assignments in Europe, North America and Asia. In 1995, he took the role of Asia Pacific Region Lubricants Specialist for Oronite Additives. Between 1999 and 2005, he worked in various capacities in the fi nished lubricants business, including Account Manager in the Strategic Accounts Group, Market Manager in the Commercial Automotive Group, Global Consumer Transport Segment Director, and as Commercial Automotive Business Unit Manager. He was named Global OEM and Industry Liaison Manager, Chevron Oronite Company, in January 2005. He has been a member of the Society of Automotive Engineers (SAE) since 1981.

STEPHEN HSU is professor of Engineering and Applied Sciences at George Washington University (GWU), leading the energy effi ciency initiative. He worked in Amoco Chemical Research on additive technology and then joined the National Institute of Standards and Technology conducting research on tribology, lubrication, advanced lubricants and nanotechnology. In 2009, he joined GWU and has been conducting research on surface textures, lubricants and materials. He has published more than 250 papers, has seven U.S. patents and is recognized as one of the world's leading researchers in tribology.

VIJIT TANGNOI received his BSc in chemical engineering from Chulalongkorn University (Thailand), MS in industrial engineering from The University of Texas at Arlington (U.S.A.) and BBA from Sukhothai Thammathirat Open University (Thailand). He has been working with PTT Public Company Limited for 30 years in many areas of petroleum and petrochemical business such as fuels and lubes research, process technology research, corporate strategy and business development. Since 2012, he has been executive vice president, PTT Research and Technology Institute.

R. A. RAO graduated with a Master's Degree in Internal Combustion Engineering from the Indian Institute of Science in 1961 and had served the Indian oil industry at senior management and Board level positions for well over four decades. He worked with the Indian Government's joint venture additive companies of Lubrizol and Chevron Oronite.

He headed the petroleum product standards committees of the Bureau of Indian Standards and also represented India on the International Standards Organisation (ISO), besides chairing one of its working groups. Currently, he is actively involved in voluntary action working for the underpriveleged women and children amongst India's rural poor.

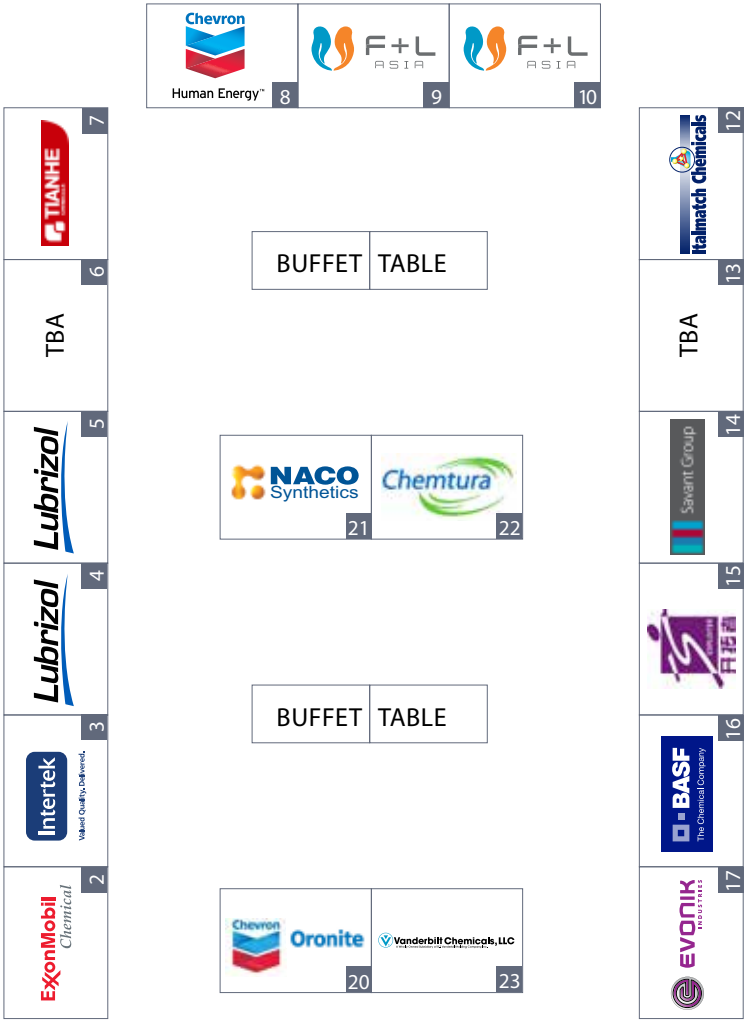
CK CHANG is currently a Director of Asia Pacific Petroleum Associates (and its subsidiary APPA Partners), a company he founded in 2005.

His former roles include:

- Director/GM of Shell Regional Research & Technology Centre; VP for Corporate Development of Environmental Technology Institute; Executive Director of Asian Clean Fuels Association.
- 30 years of diverse experience in the petroleum industry that includes various aspects of marketing; health, safety and environment (HSE); natural gas business: technology management & commercialization. He has worked in Canada, Malaysia, London, Holland and Singapore.
- Independent Director of Lotus Group International Ltd. (LGIL), a U.K.- based sports car and engineering group where he had specific responsibility for R&D.
- Involvement with membrane separation technology (MST) in its technology and commercialization for used lubricating oil recycling.

He is a registered Professional Engineer with a B Eng (Hons) and an M Eng in mechanical engineering from the University of Toronto, Canada. He lives in Singapore.

[F+L Week 2014 Exhibition]



REGISTRATION BOOTH

Exhibition Hours:
March 5, 10 am-5 pm
6:30-8:30 pm
March 6, 10 am-5 pm
Shangri-La Hotel Singapore
Tower Ballroom A

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Asia-Pacific Base Oil, Lubricant & Grease Conference

8th Asia-Pacific Base Oil, Lubricant & Grease Conference

MARCH 4, 2014		
7:30-9:00	Registration	
9:00-9:10	*Vicky Villena-Denton*, Editor-in-Chief & Publisher, F&L Asia Ltd. Welcome and Introductory Remarks	
9:10-9:30	*Giovanni di Noto*, Strategy Director, F&L Asia Ltd. Global Landscape: Systemic Risks, Underlying Factors & Foreseeable Trends	
9:30-10:00	*Eric Holthusen* Chief Operations Officer, Petronas Lubricants International	**Keynote Address** Looking 20 Years Ahead: Streaming the Future for Lubricants
10:00-10:30	**Networking Tea Break** **Sponsored by ExxonMobil Chemical**	
	Base Oil Session Chairman: *Usanee Chatranon* Vice President, PTT Public Co. Ltd., Research & Technology Institute (retired)	
10:30-11:00	*Mike McCabe* Regional Marketing Manager, Asia-Pacific, Lubrizol	The Current and Developing Market Drivers Shaping Lubricant Performance into the Future
11:00-11:30	*Greg Gerhardt* Elevance Renewable Sciences Inc.	New Solutions for Differentiated High-Performance Lubricants
11:30-12:00	*Tony Regan* Principal Consultant, Tri-Zen	The Unconventional Oil Boom in North America and its Impact on International Markets
12:00-1:30	**Networking Lunch**	
1:30-2:00	*Martin Curran* Market Applications Specialist, Croda	Defining The Window of Opportunity For Using Esters in Modern Low Viscosity, High Performance Engine Oils

2:00-2:30	*Jake Bredsguard* Chief Technology Officer, Biosynthetic Technologies	The Use of Estolides to Produce High Performance Motor Oils
2:30-3:00	*Manfred Jungk* Associate Product Development Scientist, Dow Corning GmbH	New Siloxane Based Fluids with Improved Lubricity
3:00-3:30	*Amy Long* MTS Supervisor, Intermediates & Synthetics Technology, ExxonMobil Chemical	Trends in Lubricants and the Roles Synthetic Basestocks Play
3:30-4:00	**Networking Tea Break**	
4:00-4:30	*Sylvain Hantzer* Lead Lube Licensing Manager, ExxonMobil Research & Engineering Co.	Technology Options for Producing Higher Quality Base Stocks
4:30-5:00	*Wilfried J. Bartz* Professor, TAE	Mineral and Synthetic Base Oils for High Performance Lubricants
5:00-5:30	*Wu Hanling* Chairman and CEO, HDS	Outlook for Group II and III in China
6:00-10:00	**Welcome Dinner at the Hard Rock Café** **Sponsored by ExxonMobil Research and Engineering Co.**	
	MARCH 5, 2014	
7:30-9:00	Registration	
9:00-9:30	*Christopher Locke* Executive Vice President, Marketing and Technology, Infineum	**Keynote Address** Asia Pacific Influence on Global Automotive Lubricant Specifications
	Industrial Lubricants & Grease Session Chairman: *Alan Savidge* Vice President-Industrial & MWF, Tianhe Chemicals Additives Division	
9:30-10:00	*Phil Hutchinson* Technical Service Manager, Evonik Oil Additives	Fuel-Efficient Hydraulic Fluids for Mobile Equipment: Background and Field Demonstration

10:00-10:30	**Networking Tea Break: Exhibition Opens Sponsored by Songxian Exploiter Molybdenum**	
10:30-11:00	*Vasu Bala* Global Head of Lubricant Development, BASF	Trends in Industrial Air Compressor Lubrication
11:00-11:30	*Jiangbo Ma* Senior Development Specialist, Application Leader for Lubricant and Metal Working Fluids, Dow Chemical	Performance Improvements in Gear Lubrication
11:30-12:00	*Michael Schneider,* Senior VP, Business Development, Chemspeed Technologies AG	Standardized and Accelerated Additives, Lubricant Oils and Grease Research and Development
12:00-1:30	**Networking Lunch**	
1:30-2:00	*Terry Dicken,* President Global Lubricants Ltd. (ELGI Chairman)	Global Grease Trends
2:00-2:30	*Lon Fanning* Vice President and Technical Director, Perkins Products (ILMA President)	Coping with Change: Views of a Small U.S. Metalworking Manufacturer
2:30-3:00	**Networking Tea Break**	
3:00-3:30	*Pascal Verhoie* Regional Director, AP, Nynas	Transformer Oil Trends
3:30-5:00	*Mehdi Fathi-Najafi* Senior Technical Coordinator, Nynas	Workshop: Base Oil Fundamentals for Grease Applications and Grease Manufacturing Tips
6:30-8:30	**Cocktail Reception sponsored by Evonik Oil Additives, Shangri-La Singapore, Tower Ballroom**	

[Welcome Dinner Sponsor]

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Research and Engineering

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[Conference Kit Sponsor]

SHANGHAI NACO LUBRICATION CO., LTD IS COMMITTED TO high performance Isomerization hydrocarbon fluids.

With 10 years' development, NACO grew to be one of the leading synthetic base oil suppliers in China. NACO passed DNV ISO 9001 certification in 2004. We are an accredited R&D institution and have received the New-High Technology Enterprise Attestation from the Science and Technology Commission of Shanghai. We have achieved many national patents, and several patents are Shanghai Municipal New-High Technology Transfer Projects. Twice, we received support for technology innovation from the National Innovation Investment Fund.

In the synthetics area, we produce medium and high viscosity PAO base oils, alkylnapthalenes and esters. Our products are our own independent intellectual property. We are the new choice in the world. SinoSyn® and Smartsyn® are our registered trademarks for synthetics base oils. Our new plant will be built in the Shanghai Chemical Industry Park (SCIP), which is a national chemical zone, by the first quarter of 2014.

Our Vision:
To be a premier synthetic base oils and specialty chemicals company, providing innovative technologies and services to enhance the quality of life.

Our Products:
SinoSyn® Polyalphaolefins PAOs
SynNaph® Alkylated Aromatics (AN & DAB)
PriEco® Esters
OEM Finished Lube Oils

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ExxonMobil Basestocks

ExxonMobil Basestocks: Enabling Performance and Excellence for Virtually All Mainline Lubricants

As one of the world's largest suppliers of base stocks, ExxonMobil enables formulators to meet their finished-product specifications by offering Group I, II and II+ base stocks with performance capability in virtually all mainline lubricants worldwide. The company also strives to bring efficient production capacity to the marketplace, ensuring customer confidence in its reliable supply of consistent-quality base stocks.

ExxonMobil has a rich heritage of leadership in base stock technology and manufacturing, resulting in more than 500 active or pending patents related to base stock products and manufacturing processes, in addition to the several thousand historical patents it has secured. Many of ExxonMobil's innovations have been adopted as industry standards. For instance, the company's robust and commercially available lube catalyst technologies - MSDW™, MWI™, and MAXSAT™ - are advanced components used in the manufacture of ExxonMobil Basestocks' EHC® slate and are licensed by other major Group II producers.

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By using its patented compositional tools and manufacturing approach across its global network of refineries, ExxonMobil reliably produces its consistent-quality Group I and II slates in multiple locations, efficiently delivering its products to customers when and where they need them.

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ExxonMobil's industry veterans supporting the Basestocks brand collectively possess more than 700 years of experience in market fundamentals and base stock composition, processing and end-use formulation technologies. ExxonMobil actively participates in industry associations to support the development of sound science and product integrity in new standards development.

Customers are supported by ExxonMobil's technical personnel who are experienced in refining processes, quality control and customer applications.

To learn more about how ExxonMobil Basestocks can help enable performance and excellence in lubricants, please contact:

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ExxonMobil Chemical

FOR NEARLY A HALF CENTURY, EXXON MOBIL CHEMICAL has been a leading manufacturer of synthetic base stock fluids for the lubricant industry. Our products have been developed, tested and evaluated for compliance with globally recognized industry standards. The Synthetics business of ExxonMobil Chemical has a distinguished record for the ongoing development of high performance fluids that provide outstanding performance in new and demanding lubricant applications. Available worldwide and backed by global technical support, our products excel in a wide variety of automotive and industrial applications. Visit exxonmobilsynthetics.com.

ExxonMobil Chemical is one of the world's premier chemical companies with manufacturing, technology and marketing operations around the world. In addition to synthetic base stock fluids, the company delivers a broad portfolio of polymer and petrochemical products efficiently and responsibly, with a commitment to create outstanding customer and shareholder value.

ExxonMobil Chemical is committed to the principles of sustainability, which reflect the need to balance economic growth, social development and environmental concerns.

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SONGXIAN EXPLOITER MOLYBDENUM CO., LTD., A CHINESE national high-tech enterprise, is the third largest manufacturer of molybdenum disulfide in the world. With the research and technological strength, Exploiter has been awarded "Henan provincial Tungsten-Molybdenum academician work station" and "Henan Post Doctoral research and development center." Besides, we are the supporting institution of "Henan Nano molybdneum material engineering technology research center" and "Luoyang Nano Molybdenum material project engineering research center," as well as the technological achievements transformation base.

We have passed ISO9001, ISO14001, OHSM28001 and REACH pre-registration. With independent intellectual property rights, we have received national invention patents and 10 utility model patents.

Our strong product high-purity molybdenum disulfide is a lead gray powder with hexagonal structure which is a good lubricant available in three grades—Technical, Technical Fine and Super Fine. MoS2 content is available from 96%-99.9%; typical MoS2 content is 98.5%. As a no-conductor and non-magnetic material, it can be used in -60°C to 400°C and it has pitting resistance, compressive property, high vacuum performance, radiant resistance and metal adhesiveness.

Our molybdenum disulfide has been exported to Europe, U.S., Asia and Africa. We are members of ELGI, NLGI, Euro Brake and CFSMA and attend their conferences and exhibitions every year. Our products are widely praised and enjoy high brand awareness.

We sincerely invite you to visit, and you will see a professional molybdenum manufacturer with complete innovative technology.

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Chevron

Human Energy™

MEETING SPECIFICATIONS WORLD WIDE WITH CONFIDENCE

Chevron Base Oils, a division of Chevron Products Company, provides base oil products for lubricant manufacturers and distributors in practically every consumer and industrial lubricant market in the world. With three plants, producing > 50,000 barrels per day (BPD) (2500 kMT/year) of technically substitutable premium Group II base oils, you can formulate with confidence in reliable supply. All of the major additive companies are experienced at optimizing formulations based on Chevron Group II base oils, and approvals are in place for most ACEA, API, JAMA and major OEM heavy-duty specifications. Our global availability enables you to meet global market demands with fewer formulations, while enjoying the benefits of a short, reliable supply chain.

REGIONAL SUPPLY HUBS REDUCE COMPLEXITY

In addition to having a full range of regional approvals in place, we take our support a step farther. As the market for premium Chevron Group II base oils has grown, our integrated network of logistics and technical support has grown with it. To simplify your needs, we provide both global and in-country logistical support and expertise — from sales to transport, to terminal operations, and even environmental risk management.

PARTNERING TO MEET THE WORLD'S NEEDS

Chevron invented the technology that made premium Group II/III base oils possible. We continue to work closely with lubricant manufacturers, additive companies, original equipment manufacturers and industry groups such as API, SAE, ILSAC and ACEA to advance industry standards that protect engine performance while enabling environmental compliance for new engine designs.

Chevron is one of the world's leading integrated energy companies, with subsidiaries that conduct business worldwide. The company explores for, produces and transports crude oil and natural gas; refines, markets and distributes transportation fuels and other energy products; manufactures and sells petrochemical products; generates power and produces geothermal energy; provides energy efficiency solutions; and develops the energy resources of the future, including biofuels.

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The Current and Developing Market Drivers Shaping Lubricant Performance into the Future

Mike McCabe
Lubrizol

The global industry and market-place drivers continue to place increasing demands on lubricants in all application areas, and this trend is set to accelerate into the future. Modern lubricants are expected to be more productive than ever while also maintaining their fundamental protective properties. Lubricants in automotive applications are increasingly expected to play a key role in delivering vehicle fuel economy and industrial lubricants need to help deliver productivity.

This creates a distinctive set of challenges for the lubricants industry, affecting everyone in the value chain. To best address these challenges, new technology developments need to be focused on the future needs of OEMs, businesses and end users, and the insights gained need to direct product and technology development as well as end user communications. In addition, in order to keep the category relevant, the industry needs to deliver a consistent, intelligible message on the role of lubricants, the value that they deliver and how they deliver it.

This paper will cover the market drivers that are behind this trend and how they will continue to evolve in the coming years. These market drivers will require everyone in the industry to react to ensure that end users remain educated and market value is maintained into the future.

Mike McCabe is the manager of Lubrizol's marketing group in Asia Pacific. He moved to Singapore in 2012 after two years in Beijing, China.

Previously he was the regional business manager at Lubrizol's Hazelwood Technical Centre in the UK and was responsible for the management of Lubrizol's European passenger car additive product line.

He joined Lubrizol in 1997 from Castrol where he worked in a variety of roles ranging from product development to industry and OEM liaison.

Mike has a degree in Physics from Reading University and an MBA from Nottingham University.

New Solutions for Differentiated High-Performance Lubricants

Gregory E. Gerhardt
Elevance Renewable Sciences

The lubricants market faces growing performance challenges due to increasing regulatory requirements across a variety of markets. This paper reviews the latest developments in the design and development of high-performance, bio-based lubricant components, key market trends and the global impact these factors are having on base stock choices and performance requirements. The paper will also examine new technologies and processes to create unique building block molecules from natural oil feedstocks. Using a wide range of renewable oils, these unique building block molecules enable a level of performance unavailable until now.

Renewable building blocks produced by Elevance Renewable Sciences provide significant versatility in the design and development of high-performance synthetic base stocks for transportation, industrial, metalworking and grease applications. The recently developed high-performance, bio-based synthetic base stocks

and additives show promising results in bench and engine testing. For example, the tests demonstrated wide temperature performance, additive solubility and lower friction and wear.

Greg has worked in the specialty chemicals industry for more than 20 years for Cognis, S.C. Johnson Polymer and BASF. Greg has held a variety of roles in supply chain and marketing in North America and Germany. Prior to his current role in business development at Elevance, Greg held regional and global marketing roles within the US$1 billion Functional Products SBU at Cognis with responsibilities including market development, product portfolio management and business strategy in synthetic lubricants. Greg holds a Masters in Business Administration from the Lindner College of Business and Bachelors of Science in Chemistry from the University of Cincinnati, located in Cincinnati, Ohio, U.S.A.

Defining the Window of Opportunity for Using Esters in Modern Low Viscosity, High Performance Engine Oils

Inga A. Polec and Martin Curran
Croda

The continued drive towards increased fuel economy and reduction in CO2 emissions has forced OEMs and lubricant formulators to look to new engine lubricant technology. Lubricant formulators are looking to achieve improved fuel economy through lower viscosity engine oils and through the use of new and more effective friction modifiers.

Lowering the viscosity of the engine oil is seen as the primary means to increase the fuel efficiency of the engine lubricant, which means using lower viscosity base fluids. Whilst lower viscosity brings fuel efficiency gains, it also brings with it some problems that need to be addressed and overcome, such as increased volatility, thinner and weaker film formation, increased friction and increased engine wear.
In recent years there has been a very significant investment in manufacturing capability around the world to meet demand for base stocks suitable for use in the formulation of high performance engine oils. There is a general consensus that Group II oils will be suited to 5W and 10W oils and that Group III oils, including GTL oils, will be particularly suited to the formulation of 0W and 5W oils.

The interest in low viscosity engine oils has stimulated interest in the use of Group V base oils, such as esters. The use of esters is nothing new in engine oils. They have been used for many years but principally as additive solubilizers and seal swell agents in commercial engine oils and as base fluids for racing fluids.

Although esters may still be considered as seal swell agents and additive solubilizers in the future, if they are to be recognized as a more mainstream (co-) base fluid they must be able to bring new attributes to new engine oils.

This paper will outline the key performance characteristics of esters, relative to other synthetic base oils. It will also begin to define the window of opportunities open to esters and the benefits they could bring to modern high performance engine oils and consequently to the environment as well.

Martin grew up in Dublin and graduated with a PhD in Chemistry (Inorganic) from the National University of Ireland, Maynooth College.

After university he joined Reckitt Benckiser at its Fabric Care Research Centre in Mira, Italy. After a year in Italy, he moved to China as R&D manager for East Asia.

He subsequently returned to Italy and

became Global R&D manager for Fabric Softeners & Ironing Aids.

In 2004 he joined Infineum at its R&D center in Milton Hill, Oxfordshire. He joined their Crankcase Technology group responsible for the development of new engine oil additive formulations and became the global technical lead for one of the oil majors. This role involved leading joint development programs in partnership with this customer, including development of factory fill oils for PCMO and HDD OEMs. Prior to this role, he was responsible for supporting Infineum's distributor network in the Middle East and Africa. This role included organizing training seminars for customers in South Africa, Europe and the UK.

The Use of Estolides to Produce High Performance Motor Oils

Jake Bredsguard
Biosynthetic Technologies

The use of estolides in developing the next generation of lubricants has continued to grow in popularity. Many lubricant companies are now developing a wide variety of products using estolides to enhance performance and reduce environmental impact. Estolides are a new type of environmentally friendly synthetic oil often referred to as a "biosynthetic." They are synthesized from vegetable oil and are biodegradable and nontoxic. Vegetable oils have been used in lubricants for many years but have inherent deficiencies related to longevity in use and cold temperature performance that greatly limit their acceptance and feasibility in the industry. These issues are overcome with the estolide technology as estolides exhibit superior performance characteristics, allowing environmentally friendly products to be used in a wider range of lubricant applications. Estolides offer unique benefits to lubricant formulations beyond being biobased and biodegradable. They have low volatility, good hydrolytic stability and in some applications such as PCMO have been found to offer formulation-valuable cleanliness credits by reducing piston deposits. Formulations containing estolides have been able to successfully pass all engine tests required for API SN approval with one of the highest piston deposit ratings among current synthetic motor oils on the market. The use of estolides will allow lubricant formulators to generate quality products that meet or exceed required performance standards while using more environmentally acceptable ingredients in the formulation.

Jake is chief technical officer of Biosynthetic Technologies. He directs the work of a sizable team of chemists and engineers involved in technical research and product development for Biosynthetic Technologies, leading the company's ongoing efforts to develop synthetic base oils for new applications and managing the formulation of finished products in partnership with outside oil and additive companies. In addition, he oversees the company´s manufacturing efforts, including process development, toll manufacturing and the design and engineering of a planned large-scale production facility. Jake is the inventor of more than 30 of the company's issued or pending patents.

Jake began his career as a process engineer at Jacobs Engineering, one of the world´s largest engineering firms. He specialized in improving process efficiency, reducing energy consumption and mitigating operating costs, working with clients such as ConocoPhillips, BP, Tesoro, Valero and Chevron. As part of one energy reduction project for ConocoPhillips, he helped reengineer an FCC unit at a California refinery, which resulted in an estimated energy cost savings of more than US$15 million annually. In another project he was asked to reengineer an existing vacuum tower to allow for increased gasoline production. As part of the new design, Jake found a way to recover 45 MMBtu/hr of energy that was previously wasted. During his tenure, he also

evaluated and studied new technologies as part of the company's effort to support the growing demand for clean technology.

After Jacobs Engineering, Trinity Consultants retained Jake for his experience to help expand the portfolio of services Trinity could offer clients. He was part of a team that focused on sustainability and energy efficiency projects and was the point person for such projects in the California area.

He holds a B.S. in Chemical Engineering from the University of California, Irvine with a specialization in biochemical engineering.

New Siloxane Based Fluids with Improved Lubricity

Manfred Jungk
Dow Corning

Siloxanes (also known as silicones) exhibit many unique properties that are desirable for lubricant base stocks. The Si-O bonds of siloxanes are more than 30% stronger than the C-C bonds of typical hydrocarbons. The Si-O bond length is about 7% greater than a typical C-C bond, and the branch substituents of most specimens are only attached to the silicon atom, thereby giving them great flexibility. This strength, length and flexibility of siloxane bonds impart many unique properties, including low melting temperatures, low glass transition temperatures and increased compactness. For the use as lubricating base fluid, their exceptional oxidative stability and temperature-viscosity indices stand out versus other synthetic lubricant base fluids such as polyalphaolefins, polyalkyleneglycols, polyol- or dibasic-esters.

However, siloxane fluids find limited use as lubricants due to poor lubricity of the Polydimethylsiloxanes or even the phenyl-substituted polyphenylmethylsiloxanes. Therefore, research was conducted to investigate the tribological performance of other new siloxane-based fluids with cyclohexylmethyl branches, aryl-alkyl branch structures and a range of n-alkyl branches where alkyl length, percent branching and siloxane polymer length were varied.

Elastohydrodynamic film thickness was measured from 303 to 398 K using a PCS thin-film tribometer. A polished AISI 52100 steel ball of 19.050 mm was loaded against a transparent glass disk under 20 N load, resulting in a maximum Hertzian pressure of 0.54 GPa. The glass disk has a 500 nm thick silica spacer layer that allows film thickness measurements with a precision up to 1 nm for films under 30 nm and within 5% for film thicknesses greater than 30 nm. Film thickness measurements were made from 0.020 to 4.35 m/s under nominally pure-rolling conditions. Additional measurements were made with the ball attached to a motor-driven shaft to allow variation of the slide-to-roll ratio Σ from pure rolling ($\Sigma = 0$) to pure sliding ($\Sigma = 2$).

Friction measurements were also made from 303 to 398 K using the same PCS instrument used to measure film thickness. The friction tests were undertaken using AISI 52100 steel balls of 19.050 mm loaded against a steel disk under 20 N load, resulting in a maximum Hertzian pressure of 0.82 GPa. Friction measurements were made at disk speeds from 0.025 to 5.00 m/s with the ball attached to a motor-driven shaft to vary the slide-to-roll ratio.

Results obtained showed that depending on the type and percentage of substitution on the siloxane backbone, the fluids showed high or low traction, viscosity index from as low as polyalphaolefins (around 150) to more than 300, while some of the new siloxane based materials demonstrated a wear and load carrying capacity comparable to those of polyalphaolefins.

EDUCATION AND TRAINING
University of Cologne, Germany, Chemistry PhD, 1986

PROFESSIONAL EXPERIENCE
1987-1990 Development Chemist, Dow Corning, Munich, Germany
1990-1994 Technical Service Group Leader, Dow Corning, Plymouth, Michigan
1995- 2003 Various global roles in management, technology and marketing of lubricants.
2004-present Associate Industry Scientist, Dow Corning, Wiesbaden, Germany

Trends in Lubricants and the Roles Synthetic Basestocks Play

Amy Long
ExxonMobil Chemical

Energy demand is increasing rapidly as populations grow and economies expand. The rising use of energy and need to reduce environmental emissions will drive demand for improved energy efficiency and lower emissions. Meanwhile, equipment builders are also looking for higher efficiency and better durability, such as longer machine life, reduced maintenance cost and longer drain intervals. All of these drive the need for higher performance synthetic lubricants.

This paper will look at global lubricant trends and the role that synthetic base oils play with a focus on how to address the challenges with advanced polyalphaolefin technology.

Amy is the marketing technical support supervisor of the Intermediates and Synthetics Technology Division of ExxonMobil Asia Pacific Research & Development Co., Ltd. Amy has more than 10 years of experience in the lubricants industry and has provided technical support for additives, synthetic fluids and lubricant base stocks.

Technology Options for Producing Higher Quality Base Stocks

Sylvain Hantzer (presenter), Alberto Ravella, Mary McGuiness
ExxonMobil Research and Engineering Company

Demand for higher quality Group II and III base oils is expected to grow, driven by increasingly tighter specifications for passenger car motor oils. Lube plant operators, currently capable of producing only Group I base oils, are evaluating available process alternatives for upgrading their lube plant facilities to produce high quality base oils. These include stand-alone grass roots facilities such as a hydrocracker followed by a hydroisomerization unit, which provides the greatest capability and flexibility and also the highest investment. Other options can be attractive, such as raffinate hydrotreating and isomerization, or raffinate hydroconversion, processes that make maximum use of existing solvent processing equipment and require lower investment. Hydroisomerization of slack wax from an existing unit may also be an attractive lower investment alternative for producing smaller quantities of very high quality base oil (e.g. 130+ VI) for use as a blend stock.

We will discuss some of the recent advances in both process engineering and catalytic materials for meeting the needs of both Group II and Group III manufacturers.

We will also highlight the improved selectivity of the MSDW™ hydrodewaxing catalyst for the highly isoparaffinic lube components resulting in higher lube yields and VIs.

Sylvain is the lead lube licensing manager and director in ExxonMobil Research and Engineering Company's (EMRE) Technology Sales and Licensing Department with global responsibilities for lubes technology and is currently located in Fairfax, Virginia, U.S.A.

Prior to his current position, Sylvain assumed the position of licensing manager and director for the Asia region from 2011 to 2013 and for the China region from 2009 to 2011. Sylvain's first position in the Technology Sales and Licensing Department was as lubes catalyst manager from 2005 to 2009; during that time Sylvain was also responsible for the Catalyst Manufacturing portfolio, coordinating catalyst R&D and Downstream Catalyst Manufacturing. In this role, he provided a variety of sales and project coordination services to EMRE's customers for refining process licensing.

Sylvain started his career in 1988 in EMRE's Corporate Strategic Research organization (Clinton, N.J., U.S.A.) on fundamentals of various hydroprocessing processes. He then worked in EMRE's R&D (Baton Rouge, La., U.S.A., where he worked in the Lubes Hydroprocessing group, taking a leadership role in Catalytic Dewaxing and Hydrofinishing developments as well as being a Group Leader for Catalytic White Oils R&D. Sylvain holds a PhD in Chemistry and Catalysis from Strasbourg University (France).

Mineral and Synthetic Base Oils for High Performance Lubricants

Wilfried J. Bartz
TAE

In order to formulate high performance lubricants, base fluids with outstanding properties have to be used. The following fluids are available: newly developed mineral oils, synthetic oils, environmentally acceptable oils and fire-resistant oils. Of course, additive packages have to be incorporated into the base fluids to fulfill the requirements of the specific application. The most important base oils are based on mineral and synthetic stocks.

In the field of mineral oils, tremendous advantages during the last years or even decades have been achieved. In the field of paraffinic oils, sulphur content could be decreased and VI could be increased. Also the properties of naphthenic oils now allow more application fields than in the past. An important step forward could be achieved by realizing new refining processes for mineral oils and using new base stocks. Besides hydrocracking feedstocks from crude oils, gas-to-liquids (GTL), coal-to-liquid (CTL) and biomass-to liquid (BTL) oils complete the list of base oils for high performance applications.

Despite tremendous improvements in the field of mineral oils, the application requirements in some fields characterized by low and high temperature behavior, oxidation stability, viscosity index and other properties, can exceed the possibilities of mineral oils. With the excellent general properties of polyalphaolefins, some esters and polyglycol types allow the formulation of lubricants for applications where service times, extreme low and high temperature suitability or compatibility with certain materials are required. In these cases, e.g. silicone oils, polyphenylethers or polybutenes can be used to formulate high performance lubricants.

In principle, it can be stated that synthetic oils will be used if mineral oils with additives cannot meet the requirements of frictional contacts or specific applications.

PROFESSIONAL CAREER

Mineral Oil Industry, Consulting Engineer for lubricants application; Institute of Oil Research, Director of Department Tribology and Lubrication Engineering, Development and Testing of Lubricants; Tech-

nische Akademie Esslingen, Scientific Director, Head of Department T + S, Coordinator and Head of International Colloquia, "Tribology," "Fuels" and "Nano-Tribology"

TEACHING BACKGROUND

Honorary Professorships, Technical University Vienna (Austria); University of Applied Sciences Esslingen

INDUSTRIAL LUBRICANTS & GREASE SESSION, MARCH 5, 2014

Fuel-Efficient Hydraulic Fluids for Mobile Equipment: Background and Field Demonstration

Phil Hutchinson (presenter), Thomas Schimmel,
Michaël Alibert, Thorsten Bartels,
Evonik Oil Additives

Fuel economy and improved efficiency have become key parameters and main drivers for modern equipment design. In the light of upcoming emission standards for off-highway vehicles, modern hydraulic equipment manufacturers must follow these developments, which are similar to recent moves within the automotive industry. Hydraulic hybrid systems are good examples of advanced equipment with significantly increased efficiency.

Hydraulic fluid can contribute to overall efficiency gains. A higher performance hydraulic fluid can deliver efficiency gains and be an important part of necessary improvements to achieve maximum performance.

In this paper, we will focus on the impact of the hydraulic fluid on efficiency. We will look at how minimizing the hydraulic fluid variation of viscosity with temperature and shear can improve efficiency, especially in mobile hydraulic equipment exposed to significant temperature variations. We will also present the latest field trial results that show significant improvement in equipment efficiency that can be realized when multigrade, shear-stable hydraulic fluids (high viscosity index, HV fluids) are employed instead of conventional, monograde (HM) fluids.

Phil graduated in Chemistry (Honours) from Durham University, UK in 1979. He worked for many years in the Chemical Industry in the UK in various product development and plant support roles in the surfactant and lubricant additives areas. He joined Evonik Oil Additives in 2001 as a technical service manager and is particularly involved in the development of viscosity index improvers for fuel-efficient engine oils.

Trends in Industrial Air Compressor Lubrication

Kai Su, Mark Hesseling, Vasu Bala (presenter)
BASF

Nearly every industry, including mining, water treatment, construction, energy generation, manufacturing, transportation and shipping, relies significantly on compressed air, often provided by using rotary screw compressors. In these types of compressors, the lubricating oil must not only function as a lubricant for the meshing rotors and roller and plain bearings, but also as a sealant and coolant.

Due to the rotary screw compressor design, the lubricant is typically subjected to high temperature, high shear, high moisture and high oxygen concentration conditions. Depending on the lubricant type used, these conditions will result in accelerated levels of thermal-oxidative degradation and viscosity decrease due to hydrolysis and mechanical shearing. In other words, there are several tremendous pressures on a compressor coolant's overall fluid life during operation.

Compressor lubricants are typically based on one of five basic technologies:

- Polyalkylene glycol (PAG) and ester
- Poly-alpha-olefin (PAO)
- Polyol ester (POE)
- Diester
- Mineral oil

Each of these technologies has intrinsic strengths and weaknesses. In every case, however, the common objective is a long drain interval to ensure less downtime and low overall operating costs.

A balanced formulation approach using high performance basestocks, heavy basestocks (or thickeners) and additives ensures achieving the longest drain intervals possible no matter what technology is used.

This presentation will explore recent trends in industrial air compressor lubrication and address recent advances in lubricant development, particularly addressing fluid life.

Vasu completed his PhD and Post Doctoral studies in Chemical Engineering from Pennsylvania State University in 1988 and 1993, respectively. His research interest lies in the fundamentals of lubricant rheology, additive synthesis and lubricant formulation development, mechanics of elastohydrodynamics and boundary lubrication, electrorheology, lubricant and material durability, wear characterization and frictional behavior of ferrous and non-ferrous materials. Vasu is currently the global head of lubricant development at BASF Corp. His responsibilities include developing new lubricant technologies for North American, European, Japanese and Chinese automotive OEM driveline and industrial systems. Vasu was recently nominated in Who's Who for Outstanding Scientists. He is currently a member of the following societies, serving them in several official capacities since 1984: Alpha Chi National Honor Society, Tau Beta Phi National Engineering Honor Society, Society of Automotive Engineers (SAE), TAE Germany, Industrial Tribology-UK and the Society of Tribologists and Lubrication Engineers (STLE).

Performance Improvements in Gear Lubrication

Jiangbo Ma
Dow Chemical

One of the technical trends of industrial gear box is to increase power transfer without increasing the size and weight of the gear box. This is achieved with increased hardness of the steel material and reduced oil reservoirs, which, in turn, result in higher teeth loads and increased operational temperature. As a result, the performances of gear lubricants need to be improved accordingly.

Gear boxes operate in a mixed lubrication regime. Therefore, the performance characteristics of the base stock used in a gear box lubricant formulation, such as its film forming and rheological properties under high pressure and high temperature, often play a critical role.

In this work, an in-depth study has been carried out to evaluate the performances of oil soluble PAGs (OSP) for use as base stocks for gear lubricants. The results demonstrate that compared to mineral oils and PAO, OSPs offer unique performance advantages in many areas, including faster air release, excellent deposit control, good anti-oxidation and hydrolytic stability at high temperature, low traction and friction coefficients in both EHD and boundary lubrication regions, good film-forming capability, high heat capacity and thermal

conductivity. It is concluded that OSPs can be used as base stocks to develop upgraded synthetic and semi-synthetic gear lubricants to achieve enhanced micropitting resistance, lower energy efficiency, better protection and longer lifetime for a gear box operating at high temperature and pressure conditions.

2009-12-Present Dow Chemical (China) Company Limited, Senior Development Specialist, Application Leader for Lubricant and Metal Working Fluids
2004-09-2009-12 Quaker Chemical Corporation (China), China laboratory manager
2003-06-2004-09 State Key Laboratory of Tribology, Qinghua University, Post Doctorate

Standardized and Accelerated Additives, Lubricant Oils and Greases Research and Development

Michael Schneider
Chemspeed Technologies

The increasing demand in supply, the increasing environmental regulations and the dynamically changing feedstock fluxes require faster, better and flexible development of industrially relevant, scaleable and more efficient lubricant oil and grease solutions. Corresponding R&D organizations need to cope with these challenges with, in best case, the same amount of resources.

The only way out of this "catch 22" is to standardize and accelerate R&D via enabling automated technologies for making/blending with integrated testing, allowing standardized and accelerated investigation of the raw material space and the process space, and the testing space resulting in e.g. better performing raw materials, more cost effective raw materials, saving raw materials, more robust processes and more effective processes.

This presentation will show some exemplary case studies about:

- Formulation of oil libraries with e.g. subsequent, integrated TFOUT, temperature program related viscosity, IR, particle size distribution measurements (forced stability/degradation testing)
- Formulation of grease libraries with e.g. subsequent, integrated temperature program and shearing program and related viscosity measurement (forced stability/degradation testing).

Michael graduated in organic, inorganic and analytical chemistry at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland in 1989. He made his PhD thesis on catalysis, materials science and reaction engineering in the Laboratory of Technical Chemistry of ETH Zurich. This work was awarded a silver medal by ETH Zurich in 1994. After a postdoctoral fellowship in the group of Prof. Dr. A. Baiker at ETH Zurich, he joined the process research and development department of the Vitamins and Fine Chemicals Division of Roche in Kaiseraugst, Switzerland in 1995. As project manager and laboratory head, he was in charge of several projects in the area of process research and development, which resulted in significant cost savings. In 2001, he joined Chemspeed as chief scientific officer. In 2003, he became he responsible for Chemspeed's technology overall, i.e. Head of R&D and Production. He was appointed VP Business Development in 2004 and Senior VP Business Development in 2010. He holds more than 30 publications and patents.

Grease Global Trends

Terry Dicken
Global Lubricants Ltd.

The global grease market continues to change and develop with the key drivers being green technologies, legislative compliance, end user demands and availability of raw materials.

This presentation looks at these issues in detail and demonstrates how grease development is meeting these requirements. In addition it reviews technological developments in grease formulation and manufacture and seeks to show foresight into global trends for the future and how institutes like ELGI can assist the global grease industry.

Terry is a chartered chemist and holds a BSc (Hons) degree in applied chemistry and an MSc in Instrumental Chemical Analysis. He has worked for a number of lubricant companies in various roles including: research and development, technical services & marketing and technology transfer; in addition, he has designed and supervised the construction of several lubricant and grease manufacturing facilities around the world.

He is currently managing director of Global Lubricants Ltd., a specialty lubricants company he founded in the UK in 1997, but also works as an independent consultant for several companies on REACH compliance.

He has published many papers on lubrication and is a regular speaker at international conferences.

Terry has been chairman of the European Lubricating Grease Institute (ELGI) since 1998 and is also chairman of the Institute of Energy's cutting fluids test methods panel, STC5, a role he has fulfilled since the early 1980s.

Coping with Change: Views of a Small U.S. Metalworking Manufacturer

Lon Fanning
Perkins Products

Perkins Products is a small, privately held metalworking fluid manufacturer in the upper Midwest of the United States of America. Coping with environmental and regulatory changes and challenges can be very difficult for a company with limited resources. Having organizations like the Independent Lubricant Manufacturers Association (ILMA) and the Society of Tribologists and Lubrication Engineers (STLE) to inform, educate and provide advocacy in Washington D.C. and beyond is vital to the success of metalworking fluid manufacturers and the metalworking industry as a whole in the U.S. These challenges will be discussed along with the role of ILMA and the STLE in managing the day-to-day life in the industry, as well as a preview of the Fifth Metal Removal Symposium to be held in September 2015 in Chicago, Ill.

Lon is vice president and technical director for Perkins Products Inc. and has nearly 30 years experience in the metalworking fluids arena. He is currently president of the Independent Lubrication Manufacturers Association (ILMA) and past chairman of their Metalworking Committee. He is an active member of the Chicago Chapter of STLE as well as SME and was the ILMA representative to UEIL's fourth symposium on metalworking fluids held in Barcelona, Spain on Sept. 14-16, 2011. Lon is currently involved in the planning of the Fifth Metal Removal symposium to be held in September 2015 in Chicago, Ill. He is a graduate of the Virginia Polytechnic Institute and State University (Virginia Tech) with a BS in chemistry and an MBA.

Workshop: Base Oil Fundamentals for Grease Applications and Grease Manufacturing Tips

Mehdi Fathi-Najafi
Nynas

The core of the workshop covers fundamentals about mineral base oil production and trends. It offers an overview of the entire oil industry (from crude oil to base oil for grease application), trends within the base oil industry and possibilities for grease formulators.

The workshop is recommended for:

- Those wanting an overview over the entire industry from crude to base oils for grease applications
- Purchasers, technical and laboratory personnel
- Newcomers to the industry

OUTLINE:

Base Oil Production

- Crude types and terminology
- Base oil overview – API base oil groups
- Base oil manufacturing and process comparison

Drivers and Trends

- Changes in the base oil pool
- Impact of external drivers on the grease industry

Lubricating Greases

- Introduction to lubricating greases
- Thickeners
- Manufacturing process of a few types of greases
- Grease failures in some applications
- Tips for grease manufacturers

Base Oil Production

This part provides an overview of the production cycle of the main types of mineral base oils. The module starts with a short background about crude oil, covering main crude types and crude terminology and illustrating as well the impact of crude selection on base oil yield and quality. The different processes used in the production of Group I, II and III paraffinic oils, Gas-to-Liquid (GTL) and naphthenic oils will also be described.

Drivers and Trends

This part illustrates the on-going and future changes in the global base oil market (rationalization of Group I production, increase in global capacity of Group II and Group III base oils). Particular attention is aimed at the evaluation of the impact of changes in the base oil production landscape on the grease industry's requirements.

Lubricating Grease

This part of the workshop will cover the fundamentals of lubricating greases, such as different thickeners and some manufacturing processes of some grease types. Furthermore, the impact of different base oils in grease formulations and some typical grease failures in bearing applications will be discussed.

Mehdi is senior technical coordinator of Nynas AB. He received his Licentiate Engineering and MSc in Chemical Engineering from Chalmers University of Technology in Gothenburg, Sweden. Prior to joining Nynas in 2008, Mehdi worked in senior technical positions within the grease industry for 13 years.

Mehdi is a frequent speaker at lube and grease conferences, has one patent on non-ionic thickener and has published more than 30 articles covering a variety of areas, including filtration of compressible materials, applied rheology and tribology, base oils and lubricating greases.

Fuels & Lubes Asia Conference

Program: 20th Annual Fuels & Lubes Asia Conference

6:00 pm	**Registration**	
6:30-8:30 pm	**Cocktail Reception** **Sponsored by Evonik Oil Additives** **Shangri-La Singapore, Tower Ballroom**	
MARCH 6, 2014		
7:30-9:00	Registration	
9:00-9:30	*Michael Schenk* Manager, Automotive Lubricants, Daimler AG	Keynote Address Mercedes-Benz Oil Specifications – Future Challenges for Engine Oils
	OEM Session Chairman: Gary Parsons *Global OEM and Industry Liaison Manager, Chevron Oronite Co. Products and Technology*	
9:30-10:00	*Geng Zhang* Technical Director for the Asia Region, Johnson Matthey	Fuel Economy and GHG Impacts on Light Duty Emissions Control
10:00-10:30	**Networking Tea Break: Exhibition Opens** **Sponsored by Infineum**	
10:30-11:00	*Eric Johnson* Industry Liaison, Fuels & Lubricants Group, General Motors Corp.	GM dexos, The Sequel
11:00-11:30	*Li Liguang* Executive Vice Dean, College of Mechanical Engineering, Tongji University	Challenges for the Chinese Auto Industry in Globalization for the Next Upgrade - Chinese OEM Requirements
11:30-12:00	*R.K. Malhotra* Director (R&D), Indian Oil Corp.	Indian Fuels and Lubricants Scenario – OEM Needs
12:00-1:30	**Networking Lunch**	

	SAE F&L Steering Committee for Asia Colloquia Chairman: *Paul Nai, Regional Business Director, Lubrizol Southeast Asia Pte Ltd* Vice Chairman: *Minoru Yamashita, Project Manager, Tribology Material Dept., Toyota Motor Corp.*	
1:30-2:00	*Yoshinobu Yashiro* Manager, Motor Sport Development Division, Yamaha Motor Co. Ltd.	JASO Motorcycle Engine Oil Standards: Current Status and Future Trends
2:00-2:30	*Kenji Tomizawa* Manager, Power Train Evaluation & Engineering Division, Hino Motors	Update of JASO Diesel Engine Oil Standard for Piston Detergency Test
2:30-3:00	*Teri Kowalski* Senior Engineer, Toyota Motor Engineering & Manufacturing North America	ILSAC GF-6 Update
3:00-3:30	**Networking Tea Break** **Sponsored by Tianhe Chemicals**	
3:30-4:00	*Takashi Nagashima* Chief Engineer, Technology Development Division 3, Honda R&D Co., Ltd.	The Proposal for Low Viscosity Engine Oils Below 0W-16
4:00-4:30	*Satoshi Hirano* Project Manager, Engine Design & Engineering Division, Toyota Motor Corp.	Investigation of Engine Oil Effect on Abnormal Combustion in Turbocharged Direct Injection - Spark Ignition Engines (Part 2)
4:30-5:00	*Kevin Ferrick* Engine Oil Program Manager, American Petroleum Institute	API's Online Engine Oil Licensing and Certification System
5:00-5:30	*Kyouji Hosono* Powertrain Materials Group, Materials Engineering Dept., Nissan Motor Co., Ltd.	Update on World Wide Fuel Charter
6:00-10:00	*Offsite Dinner: Da Paolo Bistro Bar at Rochester Park*	

	MARCH 7, 2014	
7:30-9:00	Registration	
9:00-9:30	*Vijit Tangnoi* Executive Vice President, PTT Research & Technology Institute	Keynote Address Trends and Directions on Fuels and Lubricants-Research Perspectives
	Automotive Fuels & Lubricants Session Chairman: Christopher Locke Executive Vice President Marketing and Technology, Infineum	
9:30-10:00	*Richard Tucker* General Manager of Commercial and Industrial Lubricants, Shell	Lubricants and Fuels for Commercial Vehicles – A Future Perspective
10:00-10:30	**Networking Tea Break** **Sponsored by Vanderbilt Chemicals**	
10:30-11:00	*Derek Ong* Managing Director, Neste Oil (Singapore)	NExBTL HVO – A Premium Renewable Biofuel For Diesel Engines
11:00-11:30	*Jonathan C. Evans* Vice President, Technical Development, Savant Group	The Indispensable Automobile, Its Engine and Its Engine's Lubricant
11:30-12:00	*Simon Tung and Glenn Mazzamaro* Global OEM Liaison Manager; Global Business Manager, Vanberbilt Chemicals	Development of Energy-Efficient Lubricant for Future GF-6 Needs
12:00-1:30	**Networking Lunch**	
	Automotive Fuels & Lubricants Session Chairman: R.A. Rao, Advisory Board Member, F&L Asia Co-Chairman: Giovanni di Noto, Strategy Director, F&L Asia Ltd.	
1:30-2:00	*Leo Kin Mun* Technology Manager, Motorcycle Engine Oils, Shell	Evaluation of Motorcycle Oil's Wet Clutch Friction Properties

2:00-2:30	*Kedar Shrestha, Ryoji Umehara* Chevron Japan Ltd.	Fuel Economy Benefits of Lower Viscosity, Lower Friction Oil over Conventional Motorcycle Oil for 4T Scooter Applications
2:30-3:00	*Gary Parsons* *Global OEM and Industry Liaison Manager, Chevron Oronite Co. Products and Technology*	Progress in Heavy Duty Diesel Engine Oils: Maintaining the Status Quo Is Not an Option
3:00-3:30	**Networking Tea Break**	
3:30-4:00	*Lim Jing Jing* *Lubes Deployment Technologist* Infineum	Meeting PC-11 Fuel Economy Requirements with Low Viscosity HDD Lubricant Technology
4:00-4:30	*Damien Browne* Engineer – Mechanical Testing, Lubrizol Ltd.	Sludge Formation and Issues over Shortening the Life of the Vehicle
4:30-5:00	*Gareth Browne* Technology Manager, Manual Transmission Fluids, Lubrizol Ltd.	Manual Transmission Lubrication - The Benefits of an Optimized Fluid
5:00-5:30	*Giovanni di Noto*, Strategy Director, F&L Asia Ltd. *Vicky Villena-Denton*, Editor-in-Chief & Publisher, F&L Asia Ltd.	Summary and Closing Remarks

[Cocktail reception sponsor]

The latest innovations in lubricant additive technology from the oil additives specialists at Evonik target both engine oils and ATF formulations. Working with OEMs and Tier 1 suppliers of lubricants, Evonik is enabling their efforts to develop low-viscosity oils that deliver fuel economy improvements, retain film strength in critical engine and transmission components and maintain both low and high temperature operability and protection.

Multi-grade engine oils and ATF fluids use viscosity index improvers, or modifiers, to boost the viscosity of oils at high operating temperatures and provide a more consistent viscosity over the operating range. The viscosity index defines the viscosity-temperature relationship. Viscous oils steal fuel efficiency from internal fluid friction or churning losses and convert the energy into heat proportionately to the viscosity, but exponentially to the square of the shear rate with increasing engine speed.

Low viscosity oils require a careful balance of components. The 0W and some 5W viscosity engine oils and most current ATF fluids depend on polyalkyl methacrylate (PAMA) chemistry to achieve the necessary viscosity index. Evonik is a major producer of traditional PAMA viscosity index improvers for the oil industry.

Recent market introduction of a new family of PAMA lubricant viscosity index improvers based on a new polymer structure, COMB polymers, move the industry into new formulating potentials beyond traditional statistical polymer designs. The oil additives team's patented COMB polymers use novel raw materials and processes to achieve a unique molecular structure and properties. COMB polymers allow for lower treatment rates in oil, higher viscosity index lift, and provide needed compatibility, durability and full-fluid service life.

The new expansion of the viscosity envelope takes advantage of PAMA chemistry's ability to also depress wax production, and hence avoid oil thickening/gel formation due to low temperatures (e.g. which can occur in winter overnight cooling in engine or transmission sumps).

ATF lubricants formulated using COMB polymer technology have demonstrated fuel efficiency over existing, state-of-the-art, factory-fill blends at major OEMs. Work conducted in European independent laboratories has shown up to 1.5% absolute fuel economy improvement in an Asian crossover vehicle run to NEDC cycles.

For more information on our technologies and products, please visit:
evonik.com/oil-additives.

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BASF is the world's leading chemical company: the Chemical Company. Its portfolio ranges from chemicals, plastics, performance products and crop protection products to oil and gas. Our portfolio for the automotive, lubricant and mineral oil industries includes:

Glysantin®, the original from BASF, is Europe's largest selling engine coolant. The products in the Glysantin® range reliably protect engines all year round from corrosion, overheating and freezing, even under extreme climatic conditions.

Hydraulan® Brake Fluids provide maximum safety. As a result of numerous fleet tests in conjunction with the automotive industry, our brake fluids stand for safety and top-class performance for the highest operating requirements.

Keropur® Fuel Performance Packages are the secret behind premium performance fuels and fuel differentiation. Th ey help to diff erentiate fuels and enable a variety of marketing claims to support your marketing campaign. Our portfolio comprises multifunctional gasoline and diesel performance packages for maximum engine cleanliness, better fuel economy, lower emissions and a better driving experience. In addition to our Keropur® fuel performance packages we also offer a range of aviation fuel additives under the brand name of Kerojet®.

We offer refinery additives which enhance the essential performance features of middle distillates to comply with specifications and market standards. From Keroflux®, cold flow improvers assuring the operability of diesel fuels even at extremely cold ambient temperatures, and Kerokorr® LA, lubricity additives preventing wear in diesel distribution pumps, to Kerostat®, antistatics guaranteeing a minimum conductivity in low sulfur fuels.

We manufacture low-molecular-weight polyisobutene (Glissopal ®) as well as medium and high-molecular-weight polyisobutenes (Oppanol®). All three ranges play an important role in a wide variety of applications such as fuel and lubricant additives, industrial lubricants and oils, adhesives, sealants and chewing gum.

Lubricant Additives:
We offer a broad range of additives needed to formulate high quality solutions for the lubricant industry including Irganox® antioxidants, Irgalube® antiwear additives and packages, Irgamet® metal deactivators, Irgacor ® corrosion inhibitors and Irgaflo® rheology modifiers.

Base Stocks and Components for Metalworking Fluids:
We off er a broad portfolio of synthetic base stocks that allow the formulation of metalworking fl uids as well as high performance driveline and industrial lubricants. In the metalworking industry we are also a leading global supplier of emulsifiers. Ester base stocks and emulsifiers are sold under the well-known Synative® brand. Our portfolio of Breox® polyalkylene glycol base stocks with a wide variety of viscosity grades completes our range of products.

Compounded Lubricants:
We supply finished formulated high-performance lubricants under the Emgard® and Plurasafe ® brand to the lubricant markets which extend oil drain intervals and help customers to use energy more efficiently. They are used in transportation (e.g. axle oils) and industrial applications (e.g. wind energy). For environmentally sensitive applications like hydraulic systems for water gates we also offer biodegradable hydraulic fluids under the Proeco® brand.

Additional information and contact details can be found on the internet at: **www.basf.com** and **www.basf.com/fuel-lubricant-solutions.**

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CHEVRON ORONITE WOULD LIKE TO EXTEND ITS deepest appreciation to our customers, suppliers and business partners for your support over the last year and offer you our best wishes for success in 2014. With your commitment to providing customers with the industry's best fuels and lubricants, we hope that you will continue to see how working with Chevron Oronite adds up for our mutual success.

In the Asia-Pacific region, an expansion of the Singapore manufacturing plant on Jurong Island is on schedule for completion in the first half of 2014. When combined with other projects undertaken since its start up, the plant's capacity will have essentially doubled when the expansion is complete. Already the largest additive manufacturing facility in the Asia-Pacific region, the project will grow component manufacturing, blending and shipping capabilities, as well as overall infrastructure, enabling a significant increase in total supply capacity for the region. Further expansion is also expected, as Oronite also continues to advance a planned project to add Carboxylate detergent production capability at the plant.

We have also expanded our Product & Technology teams to support our Automotive and Industrial/Specialties product lines in the Asia Pacific region. These teams are set to conduct activities such as field-testing across a wide range of applications. Our technology center in Omaezaki, Japan is fully-equipped to perform a comprehensive range of engine and bench tests while supporting laboratory facilities in Shanghai that help provide quick turnaround of used oil analysis and testing for customers in China.

Chevron Oronite would also like to congratulate F&L Asia on their 20th Anniversary of the Asia Fuels & Lubricants Conference. This annual event has been a prominent fixture for the fuels and lubricants industry in the region and we wish F&L Asia continued success for the future!

[Satchel Sponsor]

ISP is an independent, privately owned company and operates engine test beds, chassis dynamometers and chemical-physical laboratories for the evaluation of fuels and lubricants. Many years of experience, qualified and motivated teams as well as the modern technical equipment guarantee the quality and the worldwide service, hence fulfilling the requirements of the automotive, mineral oil and chemical industry. ISP is situated in Salzbergen, Germany, and in Grand-Couronne, France. With modern infrastructure and particular know-how in the area of fuels and lubes testing, ISP became the development partner of all major European car manufacturers. Several new engine tests have been developed with the support of ISP experts. Consequently, all standard (ACEA) engine and laboratory tests as well as a wide range of OEM in-house specification tests are available at ISP. Furthermore, Euro 6 emission chassis dynamometers allow emission and fuel economy tests according to international standards.

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VANDERBILT CHEMICALS, LLC, A WHOLLY OWNED SUBSIDIARY of R.T. Vanderbilt Holding Co., Inc., has been supplying the petroleum industry with lubricant additives for nearly 60 years. We market a wide range of chemical products which improve or enhance the performance characteristics of finished lubricating oils and greases. Oxidation inhibitors, extreme pressure additives, antiwear agents, friction reducers, metal deactivators and rust inhibitors are examples of the types of additives we supply. These products are used in automotive, gasoline and diesel engine oils, automatic transmission fluids, turbine oils and many other industrial oil and grease applications.

Our products' trade names are VANLUBE® Lubricant Additive, CUVAN® Metal Deactivator, VANCHEM® Metal Deactivator and MOLYVAN® Friction Reducer. Our research scientists have been very active in the area of lubricant additive technology. To get a better idea of new developments in our petroleum department, please visit our website at **www.vanderbiltchemicals.com** or contact:

Desmond Tang
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Chevron Base Oils, a division of Chevron Products Company, provides base oil products for lubricant manufacturers and distributors in practically every consumer and industrial lubricant market in the world. With three plants, producing > 50,000 barrels per day (BPD) (2500 kMT/year) of technically substitutable premium Group II base oils, you can formulate with confidence in reliable supply. All of the major additive companies are experienced at optimizing formulations based on Chevron Group II base oils, and approvals are in place for most ACEA, API, JAMA and major OEM heavy-duty specifications. Our global availability enables you to meet global market demands with fewer formulations, while enjoying the benefits of a short, reliable supply chain.

REGIONAL SUPPLY HUBS REDUCE COMPLEXITY

In addition to having a full range of regional approvals in place, we take our support a step farther. As the market for premium Chevron Group II base oils has grown, our integrated network of logistics and technical support has grown with it. To simplify your needs, we provide both global and in-country logistical support and expertise — from sales to transport, to terminal operations, and even environmental risk management.

PARTNERING TO MEET THE WORLD'S NEEDS

Chevron invented the technology that made premium Group II/III base oils possible. We continue to work closely with lubricant manufacturers, additive companies, original equipment manufacturers and industry groups such as API, SAE, ILSAC and ACEA to advance industry standards that protect engine performance while enabling environmental compliance for new engine designs.

Chevron is one of the world's leading integrated energy companies, with subsidiaries that conduct business worldwide. The company explores for, produces and transports crude oil and natural gas; refines, markets and distributes transportation fuels and other energy products; manufactures and sells petrochemical products; generates power and produces geothermal energy; provides energy efficiency solutions; and develops the energy resources of the future, including biofuels.

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Fuel Economy and GHG Impacts on Light Duty Emissions Control

Geng Zhang, Julian Cox
Johnson Matthey

New fuel economy and greenhouse gas targets to minimize global warming are key drivers for light-duty vehicle development around the world. The engineering changes needed to meet these targets will generate unique challenges and opportunities for emission control systems. The industry trends in light-duty emissions control systems for gasoline and diesel vehicles will be discussed and compared for different global markets. This will include the impact of engine strategies for CO2 reduction together with new legislative focus on real world emissions and GHG reduction while still needing to meet the tightening criteria of pollutants standards.

Geng received his PhD from the Faculty of Science, Hokkaido University, Japan in 1990. He joined Sumitomo Metal Mining Company as a researcher of catalysis to develop heterogeneous catalyst for NOx purification by direct decomposition and selective catalytic reduction with hydrocarbon. He then worked as a research fellow in the University of New South Wales, Australia, studying SCR by NH3 using transition metal oxides as catalysts. He joined Johnson Matthey in 1993 and has taken part in the development of catalyst solutions for automotive applications to this today.

GM dexos, The Sequel

Eric Johnson
General Motors Corp.

The dexos engine oil specification was based on a General Motors initiative to harmonize specifications on a global sale. This presentation reviews the original specification, its goals and objectives and its subsequent rollout to the oil and additive industry. The presentation also provides information on the next generation specification, its goals and objectives, and its current status of test development.

Eric is industry liaison, General Motors Powertrain – Fuels and Lubricants Group
He studied mining engineering at West Virginia University.

WORK EXPERIENCE:
20+ years in the oil industry, mostly at Texaco
6 years with Cobasys – Advanced technology battery systems
Started with General Motors in 2008, returned in 2013
Responsible for the rollout of dexos, The Sequel

Challenges for the Chinese Auto Industry in Globalization for the Next Upgrade -Chinese OEM Requirements

Li Liguang
College of Mechanical Engineering, Tongji University

In the last 30 years, the Chinese auto industry started from an annual production of less than 300,000 to more than 20 million units in 2013, the growth especially great in the last decade. The Chinese auto industry faces several challenges, which include sustainable development under more stringent requirements on emissions and fuel economy and the competition for markets within China and new growing markets in the world. This and other challenges are discussed.

This presentation introduces firstly the general situation of the Chinese auto industry and key OEMs; secondly, competition between Chinese OEMs and foreign OEMs; lastly, the challenges for Chinese OEMs for the next upgrade, such as new cooperation in both China and international markets, innovations for the next generation vehicles—new energy vehicles—and investments of Chinese OEMs in the new growing markets outside China.

Liguang is a professor at Tongji University Shanghai where he serves as executive vice dean of the College of Mechanical Engineering and serves as the leading professor of the Internal Combustion Engine Section of the School of Automotive Studies. He also is a Tongji-privileged professor and the KSPG AG professorship chair. An SAE Fellow, he has been involved in engine spray combustion research and alternative fuels for 30 years. His research includes fuel spray, combustion diagnostic and control, the clean alternative fuels—LPG, alcohols and biodiesel and the advanced powertrain of the HEV. He has co-published more than 300 journal and academic conference publications and is also the principal of 10 patents.

Indian Fuels and Lubricants Scenario - OEM Needs

R.K. Malhotra
IndianOil Corporation Limited, R&D Centre

The Indian automobile industry holds several global distinctions as the second largest two-wheeler market, fourth largest commercial vehicle market, sixth largest passenger vehicle market and the largest three-wheeler and farm tractor markets. Although there has been some slow down in automobile sales in the last two years, the industry is expected to grow at a rate of 6-8% up to 2017 and double its contribution from the present 5% to 10% of the national gross domestic product (GDP). The growth trajectory of the automobile industry, coupled with the influx of new technology and stringent emission norms, imposes great challenges on the quality levels of fuels and lubricants available in India.

Euro IV-equivalent Bharat Stage (BS) IV fuel is being supplied in about 30 cities and BS III fuel in the rest of the country. Further, BS IV fuel is likely to be extended to an additional 20 cities by 2015 or 2016. The Government of India has constituted a committee to review the national auto fuel policy; the committee is presently in discussions with all stake holders regarding issues such as making BS IV quality fuel available all over the country and moving to the next higher stage of fuel quality norms (Euro V) sometime in the 2020-22 timeframe. Final recommendations and road map to be adopted are still being awaited.

The Indian lubricant market is pegged at 1.45 million metric tons (MMT) and is growing at an average rate of approximately 3%, with the presence of more than 30 national and international players. There is a growing emphasis on lubricant quality and energy efficiency as well as durability.

This presentation will cover the evolving trends in the automotive sector and the roadmap for future auto fuel policy considerations. The existing emission norms, available fuel quality and preparedness of Indian refineries to meet the demand for high quality fuels and efforts in framing India's new auto fuel policy will be covered in the presentation. A special mention will be made about the role of fuel additives in improving fuel quality. On the lubricant front, the general

quality levels of passenger car motor oils, heavy-duty diesel engine oils and drive-line lubricant trends will be highlighted. To meet the impending national fuel efficiency standards, spurt in the usage of low and ultra low viscosity grade engine and gear oils will be discussed. Specific customizations in the quality of automotive lubricants commensurate with OEM needs also will be highlighted.

R.K. is a mechanical engineering graduate from the Institute of Technology, Banaras Hindu University and PhD (Energy Studies) from IIT, Delhi. He is currently a director on the Board of Indian Oil Corp. (IOC) as director of R&D. He is also the non-executive chairman of Indocat Pvt. Limited, a JV company of IOC and Intercat. He is also a board member of Lubrizol India, a JV company of IOC and Lubrizol Corp.

He has more than 35 years of research experience in the downstream petroleum sector and is currently leading research at the R&D Centre of IOC in areas such as refining technologies, lubricant technologies, alternative energy, bio-technology, nanotechnology and gasification.

He is chairman of the Bureau of Indian Standards (BIS) Committee (PCD:3) responsible for formulating specifications of petroleum products in India. He is presently on important national committees responsible for review of the Auto Fuel Policy, environmental regulations, etc. He is on the advisory boards of the International Centre for Automotive Technology (I-CAT) under the Ministry of Heavy Industries, Research Advisory & Monitoring Committee of the Central Pollution Control Board (CPCB), CII Committee on Biofuels & Renewable Energy and Vision Group on Nanotechnology amongst others.

He has published and/or presented more than 180 research papers and holds 27 patents.

SAE F&L STEERING COMMITTEE FOR ASIA COLLOQUIA, MARCH 6, 2014

JASO Motorcycle Engine Oil Standards: Current Status and Future Trends

Yoshinobu Yashiro
YAMAHA Motor Co., Ltd

It has been 20 years since the first JASO motorcycle engine oil standards were enacted in 1994. Initially, the JASO standard was only for 2T engine oils, but 4T engine oil standards have been added.

The JASO motorcycle engine oil standards are widely used around the world.

I will report on the current status and future trends of the JASO motorcycle oil standard.

Yoshinobu is currently in charge of the Motor Sport Development Division of Yamaha Motor Co., Ltd.
In 1974, he graduated from Nagaoka National College of Technology in industrial chemistry and joined Yamaha Motor Co. He has been in charge of the research and development department of Yamaha Motorcycle. From 2004 to 2012, he has been a leader of the MCO-WG of JAMA.

Update of JASO Diesel Engine Oil Standard for Piston Detergency Test

Kenji Tomizawa
Hino Motors Ltd.

The update of the JASO M336 (Piston detergency test) will be shown, as follows:

- The test method was introduced more than 15 years ago.

■ The test engine TD25 and the REOs have been discontinued.
■ Diesel engines are highly advanced technically to meet every stringent emissions regulations, and also diesel engine oil technologies such as their formulations and additives.
■ In April 2012, the JASO Diesel Engine Oil Standard Revision Task Force (TF) was established consisting of the Petroleum Association of Japan (PAJ) and the Japan Automobile Manufacturers Association (JAMA).
■ After some feasibility study, the TF has developed the new detergency test method as follows:

- The alternative test engine instead of TD25, Japan-made-model, Hino N04C
- The updated REOs
- WTD method instead of TGF for new piston detergency test (because of piston heating load increase due to downsizing engine technology for fuel economy)
- Backward compatibility for JASO on-file oils
- JASO M336 (2014), M355 (2014) will be released in April2014

The Next Step:
■ Revise JASO M354 (Valve-train Wear Test) with the N04C replacing 4D34T4 engine and updated REOs.
■ A draft of the revised JASO M354 will be completed in the second half of 2014.
■ The TF has been discussing an engine test method for fuel economy oil performance as a JASO Diesel Oil Standard.

Kenji is currently manager of the Power Train Evaluation & Engineering Division of Hino Motors. He has 25 years' experience, especially in durability and reliability issues of heavy-duty diesel engines for trucks and buses. He has been in charge of the development of Hino J-series engines from 1992 to 1999.

He is a member of the JAMA Engine Oil Sub-committee and PAJ/JAMA Engine Oil Joint Sub-committee. He was the leader of the JASO DH-1 Promotion Team for Asia from 2004 to 2009.

Since April 2013, he has chaired the JASO Diesel Engine Oil Standard Revision Task Force consisting of PAJ and JAMA. He is also a member of the JAMA Unregulated Exhaust Emissions Sub-committee and the leader of the Nano-Particles Measurement Working Group.

The Proposal for Low Viscosity Engine Oils Below 0W-16

Takashi Nagashima
Honda R&D

Low viscosity engine oil is effective for improving vehicle fuel economy. At Honda, we have been developing low viscosity fuel economy engine oils since the 1990s.

The development technology of the past low viscosity engine oil is introduced. Then, the new viscosity grade below 0W-16 viscosity grade that has been proposed to the SAE Engine Oil Viscosity Classification (EOVC) Task Force is now introduced. The fuel economy effect of the low viscosity engine oil will be shown.

The ultra-low viscosity engine oil finally applied in Japan is introduced.

Takashi is Chief Engineer Department 3, Technology Development Division 3 of Honda R&D Co., Ltd., Automobile R&D Center.

Takashi joined Honda R&D after graduating from the department of engineering of Niigata University. He is assigned to the Power Train Material Research

Department, developing engine oils, transmission oils and radiator fluids.

Investigation of Engine Oil Effect on Abnormal Combustion in Turbocharged Direct Injection - Spark Ignition Engines (Part 2)

Satoshi Hirano (presenter), Minoru Yamashita, Yoshikatsu Kato
Toyota Motor Corporation

As one of the spark ignition (SI) engine solutions to improve fuel economy while maintaining drivability, the concept of combining turbocharging and direct injection (DI) fuel injection system with engine downsizing has increased its application in the market. An abnormal combustion phenomena referred to as Low Speed Pre-Ignition (LSPI) has been recognized as a potential restriction to improving low speed engine torque, which contributes to fuel economy improvements. As reported in Part 1 (SAE 2012-01-1615), the study showed that engine oil composition had a significant influence on the frequency of LSPI in both preventive and contributory effects.

Further investigation was conducted to evaluate engine oil formulation variables and other factors that may have influences on LSPI, such as engine oil degradation.

Engine tests, which consisted of two phases, were designed to confirm the correlation between LSPI frequency and engine oil degradation. The LSPI frequency measurement phase and engine oil degradation operation phase were conducted alternatively without changing the engine oil. It was observed that the engine oil degradation increased LSPI frequency.

Several different types of engine oils, including both experimental oils that represent possible chemical and physical properties found in the market and a few commercially available engine oil products that meet industry standards, such as API S category and ACEA specification, were also evaluated to understand the feasibility of engine oil that has LSPI prevention performance.

These results showed it is feasible to formulate engine oils that prevent LSPI while maintaining basic engine oil performances.

Satoshi is a project manager in the Engine Design & Engineering Division of Toyota Motor Corporation.
He has been responsible for the engine lubricant development and the research of engine oil related phenomena in the engine division since 2007. Before joining Toyota in 2006, he had 12 years' experience in engine lubricants as an engine oil formulator in the additive industry.
He received a master's degree of science and engineering in chemistry from Tsukuba University in Japan in 1994.

API's Online Engine Oil Licensing and Certification System

Kevin Ferrick
American Petroleum Institute

The American Petroleum Institute (API) recently launched an online application system for API's Engine Oil Licensing and Certification System (EOLCS). This application system replaces the paper-based application that API has used since EOLCS' inception in the 1990s. The new system allows prospective licensees to submit applications and licensed oil marketers to renew their

licenses, apply for and remove oil brands and formulations and monitor the progress of product approvals. Later this year, the system will be upgraded to support API's Aftermarket Audit Program.

Kevin currently manages API's Engine Oil Licensing and Certification System, a voluntary licensing program designed to define, certify, and monitor engine oil performance. The program's marks, the Service Symbol "donut" and Certification Mark "starburst," help consumers identify quality engine oils for their gasoline and diesel-powered vehicles. He also manages API's Diesel Exhaust Fluid Certification and Motor Oil Matters programs.

Kevin became the engine oil program manager in March 1998. His duties include the management of the API Lubricants Group and its work groups and task forces.

Update on World Wide Fuel Charter

Kyouji Hosono
Nissan Motor Co., Ltd.

The World Wide Fuel Charter (WWFC) was first established in 1998 to increase the understanding of the fuel quality needs of motor vehicles and engine technologies and to promote fuel quality harmonization worldwide in accordance with those needs. Importantly, the Charter matches fuel specifications to the vehicle and engine specifications required to meet various customer needs around the world.

The Fifth Edition introduces Category 5 for markets with highly advanced requirements for emission control and fuel efficiency. As many countries take steps to require vehicles and engines to meet strict fuel economy standards in addition to stringent emission standards, Category 5, which raises the minimum research octane number (RON) to 95, will enable some gasoline technologies that can help increase vehicle and engine efficiency.

For diesel fuel, this category establishes a high quality hydrocarbon-only specification that takes advantage of the characteristics of certain advanced biofuels, including hydrotreated vegetable oil (HVO) and Biomass-to-Liquid (BTL), provided all other specifications are respected and the resulting blend meets defined legislated limits.

Kyouji joined Nissan Motor Co., Ltd. in April 1985. He works in the Powertrain Materials Group, Materials Engineering Dept. In April 2000, he became a member of the Fuels and Lubricants Committee of the Japan Automobile Manufacturers Association (JAMA).

AUTOMOTIVE FUELS & LUBRICANTS SESSION, MARCH 7, 2014

Lubricants and Fuels for Commercial Vehicles - A Future Perspective

Richard Tucker
Shell

Shell Lubricants are being used in many different types of transport modes across the world. The relationship between fuel economy and correct lubrication is an area of intense work for the organization. In this paper, Shell will set out three key areas of focus that are helping to address the energy challenge that the world is facing.

- Smarter Mobility
- Energy Efficient Fuels and Lubricants

■ The Role of Gas (GTL and LNG)

In this paper, Shell will describe the concept of "SmarterMobility," an approach that has been conceived to help address the expected rise in demand for energy between now and 2050. It will also describe the role that lubricants have to play in aiming to improve fuel economy and lower CO2 emissions, in particular when they are developed in close collaboration with OEMs.

Industries such as the heavy transport and logistics sectors have an acute need for enhanced fuel economy in a drive to reduce operating costs. The paper will set out Shell's approach to delivering fuel economies in road transport vehicles. Specifically produced lubricants working in tandem with technologically advanced fuels are able to deliver equipment protection as well as fuel economy benefits.

Finally, this paper will provide an overview of what Shell is doing in the field of delivering a range of gas-based products. Shell's GTL projects are securing base-oil supplies for future use globally, while the rise in the use of LNG products offers a compelling value proposition for long-haul road transportation.

Richard is general manager of commercial and industrial lubricants for Shell Lubricants and Commercial Fuels.

Richard is responsible for technology development for Shell's commercial and industrial lubricants and fuels. Prior to 2006, when he was appointed to this role, Richard held a number of marketing roles for Shell in the automotive and auto components industry.

Richard has extensive experience developing lubricants technology alongside Original Equipment Manufacturers (OEMs) from time spent at Shell's Westhollow Technology Centre in Houston, Texas where he was responsible for lubricants technology and OEM relationships.

Richard joined Shell in 1987 after completing a PhD in Chemical Engineering at Cambridge. He joined Shell Research at Thornton in the UK where he ran a program to enhance safety at Liquefied Natural Gas (LNG) facilities. Richard then followed a variety of roles in diesel fuels research and development (R&D) and in fuels marketing.

Richard is currently based at Shell Centre, London, UK.

NExBTL HVO - A Premium Renewable Biofuel for Diesel Engines

Derek Ong
Neste Oil (Singapore)

Demand for sustainable biofuels will increase as the availability of fossil fuels will be limited and the need to reduce environmental pollution and greenhouse gas emissions will grow. HVO – hydrotreated vegetable oil– is produced from vegetable oils and animal fats utilizing oil refining know-how, catalysts and processes: hydrotreating and isomerization. The auxiliary feedstock is hydrogen instead of methanol, which is used in FAME (Fatty Acid Methyl Esters) production.

Numerous feedstocks have been tested to be fit for HVO production: waste animal fats, waste fish fats, non-food fractions of palm oil, stearin, technical corn oil, palm oil, camelina oil, jatropha oil, soybean oil and rapeseed oil. Research is going on for mircobial oils made from biomass using yeast and molds and algae oils. With effective hydrotreating and isomerization pro-

cesses, the quality of NExBTL HVO is excellent regardless of the feedstock used.

HVO is fully accepted by the FQD and RED directives. However, biofuel markets have not been open for all products since member states have created complicated regulations that differ from one country to another. This is a major obstacle for fuel producers when they export biofuels. The low density, zero aromatics and very high cetane number make it a valuable blending component for upgrading diesel fuels to premium grades. Refinery gas oil streams not meeting EN590 can be upgraded to meet EN590, which offers immediate economic benefits and higher diesel fuel volumes to be available for refineries and blenders. By using HVO, the same fuel grade with higher bioenergy content can be used in all diesel vehicles even though majority of vehicles are approved only for B7.

This presentation will introduce the HVO process and describe the properties of this renewable diesel fuel. A summary of findings and studies of exhaust emission characteristics and data on greenhouse gas reduction will be presented. Comparison between HVO and biodiesel FAME as a way to achieve biofuel optimization will be discussed. Finally, some data from the commercial use of HVO diesel will be shared.

Derek is the managing director of Neste Oil (Singapore). He has 20 years of working experience in Power, Chemical, Petrochemical and Renewable Energy industries. His current areas of work include operating one of the world's largest renewable energy refineries in Singapore and conducting studies on emerging energy markets in Asia Pacific. Derek obtained his degree from Nanyang Technological University in Singapore in 1994.

The Indispensable Automobile, Its Engine and Its Engine's Lubricant

Theodore W. Selby, Jonathan C. Evans, (presenter), Tina Dasbach
Savant Group

In today's societies around the world, the commonly recognized symbol of achievement – individually and nationally – is the level of availability and use of the personal automobile. The desire for personal transportation, the cost of such conveyance, the close personal identification with this expensive device that faithfully serves the owner's individual needs are all reasons for this symbol of achievement.

However, this symbol brings a major challenge to automobile owners, the societies within which they reside, and to others who are concerned with the vulnerability of the automobile engine to its lubricant, particularly the manufacturers of the automobile whose reputations and warranty costs are also vulnerable.

By far, most engine oil manufacturers are similarly concerned. It is important to them to use their knowledge and understanding to make competitive or superior engine oils that will meet the performance and durability needs of engines in their growing complexity. However, there are a few engine oil manufacturers who are not sufficiently knowledgeable or skilled concerning the required properties of engine oils – especially in societies in which the automobile is a relatively new addition to their lifestyle.

Unfortunately, it is very difficult and costly to distinguish the difference in

engine oil quality except by its positive or adverse effects on the engine. The only other approach – and limited to those that are technically experienced — is through carefully run engine-simulating bench tests. In this latter regard, the Institute of Materials (IOM) has for the last 30 years generated a yearly database on hundreds of oils collected directly from around the world. This presentation will focus on recent studies of the variations found in some important engine oil properties.

Jon is Vice President of Technical Development at Savant Group.

Responsible for managing the development and direction of research within the Savant Group of companies, he drives the delivery of innovative solutions to customer and industry needs, improves current products and services and generates ideas for new products and services.

Prior to joining the Savant Group, Jon spent 25 years with The Dow Chemical Company directing technical new business development and research in the areas of advanced materials and polymer synthesis, pharmaceuticals and drug delivery.

He graduated from Wayne State University, PhD (Organic Chemistry), Detroit, Mich., U.S.A., and Ithaca College, BS (Chemistry), Ithaca, N.Y., U.S.A.

Development of Energy -Efficient Lubricant for Future GF-6 Needs

Simon Tung and Glenn Mazzamaro
Vanderbilt Chemicals Inc.

Responding to global green energy challenges, OEM engine design engineers and lubrication scientists are constantly being challenged to develop advanced energy efficient products to meet more demanding fuel economy and greenhouse emission reduction targets. Based on these critical needs, the International Lubricant Standards Advisory Committee (ILSAC) will develop a new performance standard GF-6 for automotive engine lubricants to replace the current GF-5 standard. This new performance standard GF-6 would provide improvements relative to ILSAC GF-5 in the following categories:

- Fuel economy and fuel economy retention
- Emission system compatibility
- Engine oil robustness and green environmental attributes to provide performance levels required to protect engines in all global markets

An advanced fuel-efficient engine oil formulation prototype with low phosphorus and high molybdenum content has been developed. Tribological characteristics of these energy efficient lubricants have been determined using different bench tests. Bench friction and wear test results have shown that molybdenum-containing additives with low phosphorus formulation can significantly reduce friction and wear. Besides automotive lubricant bench tests, engine sequence tests and field tests were performed. "Low Phosphorus, High Molybdenum" (LPHM) additive technology has demonstrated improved fuel economy and exhaust catalyst compatibility compared to conventional GF-5, technology in a 100,000-mile Las Vegas taxi test as follows:

1) Excellent oil robustness with improved piston deposit control and camshaft wear control.
2) Fuel economy improvement of 5-6% was demonstrated over conventional GF-5 technology, and
3) Phosphorus loading on the exhaust catalyst after 100,000 miles was reduced by 73%.

Simon holds a PhD in Chemical Engineering from Rensselaer Polytechnic Institute and an MBA from the University of Michigan-Ann Arbor. Simon has been involved in the automotive industry since joining General Motors Research Laboratories in 1982. While there, he led pioneering research and development on automotive powertrain tribology and lubrication engineering and was appointed Technical Fellow to lead the advanced energy efficient lubricant technology and discovery research programs at the General Motors R&D Center in 2003. In 2008, he joined the Industrial Technology Research Institute as general director, where he was responsible for managing all R&D programs in the Energy and Environmental Research Laboratories. Simon made significant contributions in the research areas of green energy, energy storage systems, hydrogen energy, biofuels and greenhouse emission reduction. His technical expertise includes powertrain tribology, automotive lubrication, energy technology, environmental engineering and surface engineering.

Later, Simon joined Vanderbilt Chemicals as global OEM liaison manager, to lead the company's global OEM liaison activities to develop and disseminate global OEM advanced powertrain lubricant requirements and energy resource technologies. In addition, he is responsible for leading the advanced tribology and lubricant technology programs and bringing new technology into the existing automotive and petroleum industries especially in the area of advanced fuel-efficient lubricants, energy efficiency, and identification of OEM requirements for advanced powertrain lubricants.

Glenn is currently global business manager for Vanderbilt Chemical's Petroleum Department, based in Norwalk, Connecticut, U.S.A. He has nearly 30 years of experience in the lubricant industry. Glenn joined the company in 2006 after a 16-year career with Ciba Specialty Chemicals and a 12-year career with ExxonMobil Chemical, where he held various manufacturing, technology, marketing and sales positions. Glenn currently serves as Vanderbilt Chemical's representative on the API Lubricants Committee and has previously served on the API Detroit Advisory Panel, the ILSAC GF-5 Sequence VID Fuel Economy Consortium, the GF-4 ILSAC/Oil Committee as American Chemistry Council representative and as secretary of the ASTM Passenger Car Engine Oil Classification Panel. Glenn holds a Bachelor of Science degree in Chemical Engineering from Cornell University.

Evaluation of Motorcycle Oil's Wet Clutch Friction Properties

Scott Rappaport, Hong Gao, Brian Papke, Coleen Chin, Kin-Mun Leo (presenter)
Shell Global Solutions

Motorcycle oil's (MCO) influence on wet clutch friction can affect gear change performance. Therefore, it is important to understand and quantify MCO's wet clutch friction so that gear change performance is optimized for the rider. The evaluation of MCO wet clutch friction was conducted through oil formulation investigation and the development of a laboratory test. The laboratory test simulated conditions from the Japanese Automobile Standards Organizations (JASO) specified wet clutch test for MCO. In the end, the test was able to compare low-speed and high-speed clutch friction characteristics among several different commercial MCOs. Through the comparison of low-and high-speed friction characteristics in the lab test, it was found that oil formulation

in terms of base oil and additive selection quantifiably influence wet clutch friction.

Leo graduated with a degree in mechanical engineering from Loughborough University (UK). He started his career with Shell when the company first set up its first Asia-Pacific R&D laboratory in Singapore in the mid-90s.

In his early role, Leo was involved in providing technical advisory to a variety of lubricants-related application and trouble-shooting issues. He eventually took on the role of project leader, focusing on motorcycle oils development, given the significant growth in the motorcycle markets in Asia. To meet the growing demand and enhancing technical intimacy with the customers, Leo joined a small team of Lubricants Product Application Specialists, offering dedicated technical services to selected, key automotive OEMs in the East.

In 2010, Leo took on the position of Shell Advance Motorcycle Oil technology manager, responsible for the global motorcycle oils development and deployment program. He is now based in Shanghai, leading a team of lubricant product developers.

Fuel Economy Benefits of Lower Viscosity, Lower Friction Oil over Conventional Motorcycle Oil for 4T Scooter Applications

Kedar Shrestha[1], Hiroki Andoh[1], Ryoji Umehara[1], Yasuhiro Ogasawara[1], Joseph Timar[2] and P. Rajagopalan[3]
Chevron Japan Ltd.[1], Chevron Oronite Co., LCC[2], Chevron Oronite Pte Ltd[3]

In recent years, we have been seeing a rapid expansion of scooter production globally with the Asia-Pacific region being the main market. Consequently, demand for oils specifically designed for scooters is also increasing. Aside from the scooter market growth, motorcycles, including scooters are under government legislated emission controls, which will result in stricter standards in the foreseeable future. Given these circumstances, end users, OEMs and oil companies are becoming sensitive to fuel economy performance of motorcycle/scooter engine oils.

Currently, there is no industry-recognized laboratory engine test sequence to evaluate the fuel economy performance of 4T motorcycles. Previously, we developed a fuel economy engine test sequence for 4T motorcycles and measured the fuel economy of SAE 10W-30, 20W-40 and 20W-50 engine oils. We reported that a lower viscosity SAE 10W-30 oil showed better fuel economy performance than 20W-40 and 20W-50 oils.

In this study, we expanded our focus to include 4T scooters and developed an engine test sequence to evaluate the fuel economy performance of both motorcycle and scooter engine oils. We developed two JASO MA2 motorcycle oils (SAE 10W-30 and 20W-40) and a third SAE 10W-30 JASO MB scooter oil from the same additive package. The JASO MB oil was formulated with a representative molybdenum friction modifier. Among the three oils, the 10W-30 JASO MB scooter oil yielded the highest improvement in fuel economy, followed by the 10W-30 JASO MA oil. We attribute this improvement in fuel economy performance to the lower friction and reduced viscous drag of the oil in the scooter engine. In this presentation, we will discuss further the details of the test procedure and data analysis technique.

Kedar Shrestha
Team Leader, IEO & Specialties, Chevron Japan Technology Center

EDUCATIONAL BACKGROUND

PhD in Material Science and Chemical Engineering (1998), Yokohama National University, Yokohama, Japan
MSc in Renewable Energy (1993), Carl von Ossietzky University of Oldenburg, Oldenburg, Germany
MSc in Organic Chemistry (1985), Tribhuvan University, Kathamandu, Nepal

Involvement in the lubricant additive R&D, tribology study and lubricant business for the last 17 years. Published more than 25 papers (including international papers, conference papers, patent filing, etc.)

Ryoji Umehara
IEO & Specialties, Chevron Japan Technology Center

EDUCATIONAL BACKGROUND

PhD. in Chemistry (2012), Tokyo Institute of Technology
MSc in Chemistry (2008), Tokyo Institute of Technology

Ryoji joined Chevron Japan Technology Center in 2012 and has been engaged in R&D and technical service for motorcycle oils.

Progress in Heavy-Duty Diesel Engine Oils: Maintaining the Status Quo Is Not an Option

Wim van Dam, James Booth, Gary Parsons (presenter)
Chevron Oronite Company Products and Technology

Advancement in heavy-duty diesel engine oils has, for approximately two decades, been driven by the ever more stringent emission legislation. Formulation adjustments were necessary to deal with the impact of lower sulfur diesel fuel, increased engine operating temperatures leading to more oxidation, increased levels of soot contamination as a result of EGR, and reductions in maximum allowable sulfated ash, sulfur and phosphorus for the benefit of exhaust gas after-treatment devices that were necessary to reduce NOx and particulate matter emissions. It seems that the industry has reached the point of diminishing returns when it comes to reducing emissions.

In the absence of a NOx and particulate emission legislation-driven, technical need for renewing diesel engine oils, the current API CJ-4 specification has had the longest lifetime of any API diesel engine oil specification in the last 25 years. However, economical, market-driven developments seem to have taken over the task as drivers for the renewal of diesel engine oils. Increased fuel cost and a need to control operations cost in a weaker economy have triggered a heightened interest in fuel-efficient lubricants. Where the trucking industry was reluctant to move away from the tried and true API 15W-40 viscosity grade, there is now a strong interest in pushing the boundaries of lower viscosity to reduce internal friction in the engine and thereby improve fuel efficiency. Consequently, the industry is exploring and introducing diesel engine oils of viscosity grades that used to be applied solely in passenger car engines, such as 10W-30 and even 5W-30. To avoid misapplication, API has decided that diesel engine oils, most of which are formulated close to the maximum 0.12% phosphorus limit in the API C specification, can no longer add the API S gasoline engine claim. The only way to create a lubricant that carries both an API C and S claim for mixed fleet or municipality application, is to formulate at less than 0.08%

phosphorus, a limit that was adopted in API S specifications because there are indications that phosphorus may foul three-way catalysts used with gasoline engines to control tailpipe emissions.

And there lies the dilemma. The market wants to move to lower viscosity grades and maintain all the capabilities that current diesel engine oils exhibit, including universal applicability in both diesel and gasoline engines, and the robustness that is required for extended drain capability and engine durability. The conclusion seems obvious: A real performance upgrade, to reduce engine friction and maintain durability despite lower viscosity and a lower phosphorus limit, is necessary, and the need to improve fuel economy has become the main driver for the renewal of diesel engine oil technology. This presentation describes the steps that were taken to successfully meet the seemingly contradicting demands of tomorrow's diesel engine oils.

Gary joined Chevron in 1981 after obtaining his Bachelor of Science and Master of Science degrees in Mechanical Engineering from the University of California at Berkeley. From 1981 through 1985, Gary worked as a research engineer in the Fuels Division at Chevron Research and Technology Company. From 1986 through 1995, Gary was the Oronite Additives Fuels Product Manager in three different assignments in Europe, North America and Asia. In 1995, Gary took the role of Asia Pacific Region lubricants specialist for Oronite. Between 1999 and 2005, he worked in various capacities in the finished lubricants business, including account manager in the Strategic Accounts Group, market manager in the Commercial Automotive Group, global consumer transport segment director, and as commercial automotive business unit manager. Gary was named global OEM and industry liaison manager of Chevron Oronite Company in January 2005. He has been a member of the Society of Automotive Engineers (SAE) since 1981 and is a member of the Advisory Board for the Annual Fuels & Lubes Asia Conference.

Meeting PC-11 Fuel Economy Requirements with Low Viscosity HDD Lubricant Technology

Wang Kan Lin and Lim Jing Jing
Infineum

A new HDD engine lubricant category (PC-11) is being introduced with the first license date set on January 2016. In addition to improvements in oxidation stability and shear stability and the resistance to aeration and the use of biodiesel fuel, the new category will address the concern over fuel economy and greenhouse gas emissions. PC-11 will be split into two sub-categories where one will meet the evolving market needs of fuel economy through lower limits of HTHS 2.9–3.3 mPa in SAE XW-30 grade while providing backwards compatibility in higher viscosity grades like SAE 15W-40. However, the low viscosity category presents a new set of challenges to engine oil performance. The most important issue is how low HTHS oils are able to give the same protection in current CJ-4 engine tests and also the upcoming new PC-11 engine tests like Mack T13, Detroit Diesel DD13 and the new aeration test.

This paper will discuss Infineum's approach to tackle the challenges in the new PC-11 low viscosity category. They include the study on critical areas of fuel economy in heavy-duty diesel engines, and how to maintain engine durability in the low viscosity regime, ultimately leading to the development of

low-viscosity, heavy-duty, diesel engine oils. The technical capability is supported by years of fundamental research and extensive engine and field-testing experience. Finally, the paper concludes by discussing how this technology is ready to meet the new PC-11 tests requirements and beyond.

Jing Jing is a crankcase technologist from Infineum. She has been in the research and development field for more than 10 years and since joining Infineum, she has been doing deployment projects of PCMO and HDD products.

Sludge formation and issues over shortening the life of a vehicle

Damien Browne (presenter), Mark Dewey, Mike Sutton
Lubrizol Ltd.

Engine sludge has been a known failure mechanism for engine oils for many decades. There has been considerable work undertaken on the subject within the lubricants industry over that timeframe and many of the underlying mechanisms have been determined. These include the fuel quality and the engine operating conditions. The measurement of sludge in these studies have typically been by operating a new engine over a single drain interval and rating the level of sludge at the end of that drain interval. Over time this has enabled higher quality lubricants to be produced that can ameliorate the tendency of an engine to generate sludge with a specific fuel.

New engine technology has increasingly been introduced, specifically the introduction of gasoline direct injection (GDI) or turbocharged GDI (TGDI) engines as they offer up to a 25% potential improvement in fuel economy compared to a traditional port fuel injection (PFI) engine. GDI engines have many design features and characteristics that promote sludge formation. The key features of GDI engines that have an impact on sludge formation include turbochargers, high compression ratios, high NOx emissions, wall wetting and fuel enrichment. Significantly, these characteristics induce high levels of heat from cooling the turbocharger and the significant levels of fuel dilution that become present due to the wall wetting. The use of GDI engines alone, however, is not certain to cause sludge. Fuel quality plays a significant role in the generation of sludge. As the quality of fuel varies by country, or even within a country, sludge can be a problem in some areas where fuel quality and engine technology interact.

With the high quantity of new GDI technology within the Chinese market, a study was commissioned to investigate the use of TGDI engines within China using fuel sourced locally. This particular study also investigated the effect on the vehicle over multiple drain intervals using a market-available, low quality oil. The field study was run in a controlled manner to enable repeatable drive cycles across the three standard-duration oil drain intervals. The data generated highlights that during the third oil drain interval the vehicle suffered significant engine failures due to sludge formation within the engine. The conclusion from this study is that the cumulative effect of poor quality oil in areas where new engine hardware is available and where fuel quality varies will impact the life of the vehicle and have significant maintenance costs to the vehicle owner.

Damien graduated in Automotive Engineering from Loughborough University.
His present emphasis

of activities is on mechanical testing, specifically:
• Passenger car engine oil, field and vehicle testing
• Focus on fuel economy and durability testing with respect to engine oils

Manual Transmission Lubrication - The Benefits of an Optimized Fluid

Gareth Brown
Lubrizol Ltd.

Dedicated manual transmission fluids (MTFs) are vital to delivering the correct balance of performance and longevity to the transmission. One area in which an incorrect lubricant can be directly felt by the driver is synchromesh friction. The wrong friction coefficient may lead to a poor gear-shift feel through incorrect synchronization along with elevated wear of the transmission. In addition, since manual transmission fluids are long-drain fluids, commonly being fill-for-life in passenger cars, and having drain intervals of up to 500,000 km in commercial vehicles, they must maintain a high level of performance for an extended lifetime with minimal degradation.

In order to provide the best shift feel to the driver and to maximize transmission life, it is desirable to create manual transmission fluids that provide optimal synchronizer friction along with reduced synchronizer wear. Adding to this challenge is an increasing diversity of synchronizer materials being used in transmissions by OEMs globally, meaning that different friction modifiers may be optimal for use on each friction material. There are a number of broad classes of synchronizer in use today, which may be grouped by material type; however, some of these can only be grouped to a certain degree, as different materials of a similar type may have very different frictional appetites.

Developing fluids with this balance of shift quality and wear protection requires a fundamental understanding of the friction characteristics of different systems. In order to provide this fundamental understanding, a study of the structure performance drivers of synchronizer friction was undertaken. Specifically, the structure performance of the friction modifier on brass synchronizers will be discussed. Furthermore, mechanistic reasoning will be explored with supporting data from surface analysis. These results will show the importance of understanding synchronizer materials when developing an MTF.

Gareth is currently driveline technology manager for Lubrizol, based in Hazelwood, UK. He is responsible for global MTF technology development, which includes developing new platforms and supporting customer developments and fundamental knowledge generation for global manual transmission applications. He is also responsible for automotive gear oil technology deployment within China and Korea.

Gareth joined Lubrizol as an applications chemist in 2002, working on screen test development, thermal analysis and rheology before moving to the driveline group in 2006, initially supporting automatic transmission fluid and off-highway products before moving to his current role in 2009.

Gareth received an MChem and DPhil in Chemistry from the University of Oxford in 1999 and 2002, respectively.

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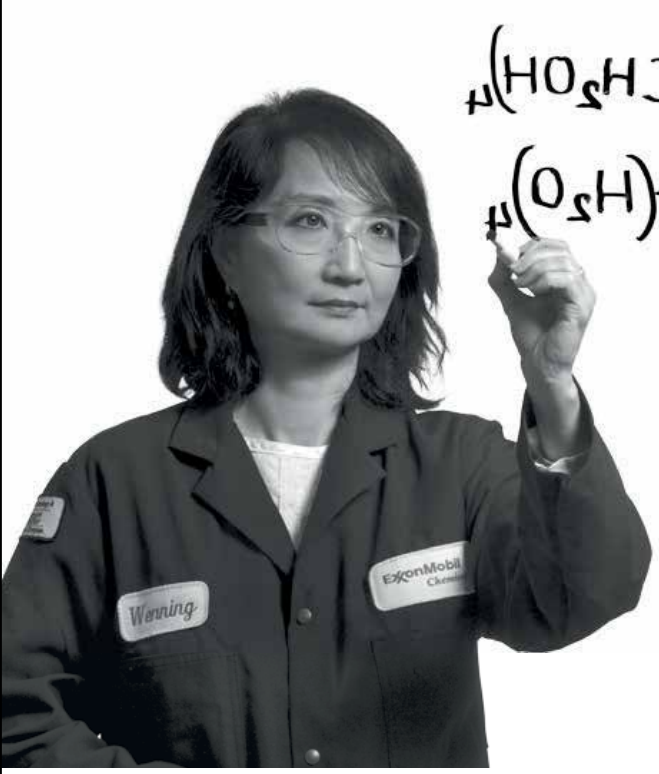

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