LUBRICANT ADDITIVES

CHEMISTRY AND APPLICATIONS

edited by

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Preface

I first conceived of writing this book at the close of the last millennium, and it has become a reality in this new millennium, a time in which we have already experienced many changes. Perhaps there is a parallel in the development of additives for lubricants. In the earlier development of additives, the main objectives were to maintain the life of the oil and to protect mechanical components. In the new millennium, these features will be important, but, in addition, the long-term impact of lubricants and additive components will become design and marketing issues based on such concerns as the environment, toxicity, and fuel economy. Development of lubricant and lubricant additives directly from natural and renewable materials will play a far more important role than in the last millennium. Ultimately, it will become desirable to design lubricant materials (base oils and additives) that are derived directly from renewable resources that grow naturally or can be grown in bio-factories. If this type of lubricant could be developed and used on a fill-for-life basis, it could then be recycled with little or no environmental impact. This may seem like a dream, but prior to 1960, so did the use of synthetic lubricants, passenger car transmission oils that would last 200,000 km, and axle or transmission lubes capable of lasting 800,000 km in heavy truck applications. These lubricants are available today.

Additives are materials that impart new and improved properties to lubricants. Continuing demands will be placed on lubricant properties and performance as we move from the end of the 20th century toward the new technologies that await us in this century. One of the current driving forces in the development of new lubricants is protection of the environment. These efforts are driven mostly by government regulations rather than by corporate belief that these are the ultimate

materials of the future. Cost and performance will remain critical aspects of industrial development of petroleum-derived lubricating oils and additives. These demands will result in the synthesis and application of new lubricants and additives necessary to formulate these more stable and better-performing fluids.

It is anticipated that additive development will change from the synthesis of complex mixtures based on petroleum-derived components to the use of naturally occurring or bio-derived components that have antioxidant and corrosion-resistant properties. There are many potent natural antioxidants that could be employed in lubricant fluids to minimize impact on the environment, especially for lower-temperature industrial applications. Cradle-to-grave study (life cycle analysis, LCA) of lubricant, lubricant additives, and lubricant technologies in general will become an integral part of the overall development and evaluation programs of the future. Extreme-pressure additives will present a challenge in terms of being found in nature, but I believe that advances in the synthesis of biodegradable additives will progress, if not from companies in the United States, then from other countries where regulations are more stringent.

The properties and performance of commercialized lubricants are governed by many nonchemical factors, including vehicle manufacturers, regulators, and customers. Collectively, these groups help to provide input on desired lubricant performance. Future developments will require a multidisciplinary effort by equipment builders, regulatory agencies, organic and inorganic chemists, biochemists, and chemical engineers. It will become necessary to rely on input from customers and end users of these new materials to a greater extent than ever before in our history.

Crankcase lubricants and additives will require molecular structures having thermal and oxidative stability sufficient to withstand the rigors of low-heat-rejection, high-performance diesel engines. The lubricants and additives will need to be able to do this with chemistries that have a low environmental impact in terms of both manufacture and disposal of the used oils.

This new century will also experience the application of new types of lubricants, containing new additive chemistries required for space exploration and for development of undersea technologies (perhaps including farming and habitation). These remote locations and extremes of environment will place new demands on lubricant properties and performance and will require low maintenence.

I thank all my colleagues who encouraged me to make this book a reality. I also want to thank all the contributors for responding to the deadlines of this project, knowing the many constraints placed on them by their other responsibilities. There is always a balance between job responsibilities and publishing projects like this one. Again, my heartfelt thank you to everybody involved in this project; it is your contributions that have created this resource for our industry. Essentially all the major classes of currently used lubricant additives are described herein.

I especially want to thank Rita Lazzazaro at Marcel Dekker, Inc., with whom I have worked before on '*Synthetic Lubricants and High-Performance Functional Fluids*,' and Erin Nihill, who has provided much needed information and has been a pleasure to work with on this project. Regina Walker also offered excellent advice throughout the project. Thanks also go to Russell Dekker for helpful discussions and for agreeing to support publication of this book.

Thank you, Paula, for remaining my constant companion, and Eric and Rachel for all your interest and support during this project. I enjoy knowing that each of you will continue to create in your own ways and in your own chosen fields of endeavor.

Leslie R. Rudnick

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