Summary

The theme for the symposium was outlined in the introduction by Dukek and the keynote address by France. Both stressed the major impact on fuel users and producers expected from the 1990 Amendments to the Clean Air Act. Dukek pointed out that the first major step in the present progression of improved fuel quality to reduce air pollution was taken in the 1970s with the introduction of unleaded gasoline. In turn, this change had a drastic impact on refinery processing as well as gasoline composition. Now the latest amendments and the resulting regulations are expected to have an even greater effect because the permitted quality of gasoline and diesel fuels is restricted more closely than before. The purpose of the symposium was to review both fuel user and producer reactions to these restrictions and to help define the ASTM role in the overall picture.

France praised past ASTM cooperative efforts to develop specifications and test methods for the industry and stressed the urgent need for new or revised fuel specifications as well as new methods to determine fuel composition and properties rapidly and with good precision. He mentioned the Auto/Oil Air Quality Research Program, an ongoing, extensive cooperative effort between auto and fuel manufacturers and concluded by challenging ASTM members to create the necessary standards before the 1995 deadline for reformulated gasoline.

Wilson of EPA reviewed the latest Clean Air Act amendments and the accompanying federal regulations in detail. Although the United States has the most restrictive vehicle and fuels pollution program in the world, vehicle emissions represent some 56% of the pollutants in the air, thereby creating the necessity for the latest restrictions. He pointed out that gasoline volatility, diesel fuel quality, oxygenated fuels, reformulated gasoline, and clean alternative fuels are all covered. Thus, gasoline Reid vapor pressure will be limited to 9 psi (62 kPa), that began in the summer of 1992, while diesel fuel sulfur content will be reduced to a maximum of 0.05% by Oct. 1993. Fuel oxygen content, to reduce atmospheric carbon monoxide, will be required in nonattainment areas beginning in Nov. 1992. Later on, reformulated gasoline will be made starting in 1995 to drastically reduce volatile organic compounds and toxics, particularly ozone. A new approach in the development of regulations included the "reg-neg" process, in which advisory committees, representing all sides, negotiated new regulations with the commitment that the agreed-upon results would not be challenged in court.

State and local air quality and fuel regulations were assessed by Gibbs. Originally, such regulations were intended to protect consumers against fraud. Now numerous such regulations have been issued to meet or exceed federal air quality standards. His detailed paper starts with a state-by-state review of existing requirements for spark ignition fuel, followed by a chronology of California regulations to the year 1996. He then deals with the impact of state regulations on vehicle performance with particular emphasis on fuel oxygen content. A second major review involves state regulations for diesel fuel. The paper painstakingly points out agreement with or deviations for ASTM specifications for both types of fuels. Only four states have adopted ASTM spark ignition fuel specifications without modifications, while some 19 states are using the unmodified diesel fuel specification. This state of affairs can be taken as a signal for further specification efforts by ASTM.

McCabe presented available results from the Auto/Oil study mentioned earlier. This program is the largest and most expensive research program undertaken by the automotive

and fuel industries to establish the effects on air quality of various fuels in various spark ignition automotive systems. Fuel variables included aromatic, olefin and oxygenate content, sulfur level, vapor pressure, and 90% distillation point. Two methanol blends were also evaluated. Automotive systems covered new cars, older cars, and flexible fuel cars designed to run on either gasoline or methanol blends. All in all, 28 fuels, 53 vehicles, 2200 emission tests, and some 200 million data points were involved in Phase I. Accompanying this effort is an economic analysis of vehicle/fuel options to estimate a range of potential costs to reach the required air quality. The complexity of the situation is reflected by the fact that no single fuel change was equally effective in the tested car population, pointing out the need for ultimate compromises to obtain the desired solutions.

Jones and Williams gave on overview of refinery trends and the anticipated impact of gasoline reformulation on the quality of other products. Concurrent effects of diesel fuel regulations were also covered. Major new investments are required as reflected by the increasing number of refinery projects. Jones and Williams stressed the need for ASTM to serve as the meeting ground where market demands and government regulations must be merged through timely specifications and test methods.

A panel represented various aspects of the refining industry, with one member comparing today's product slate of a modern refinery with the changes imposed by the manufacture of reformulated gasoline and low sulfur diesel fuel. The shortfall of required oxygenates and particularly the increasing shortage of hydrogen for processing was highlighted.

User input was furnished by a car manufacturer, a diesel manufacturer, and a panel representing the aviation industry. Colucci and Benson underscored the importance of reformulated gasoline to car emission performance. Emphasizing the results of the Auto/Oil program in new cars, they pointed out the relative vehicle emission improvements due to differing fuel changes. Further longer term emission reductions were stated to depend on the elimination of specific compounds such as di- and trialkyl aromatics from gasoline. Such reductions could relieve pressures to reduce total aromatic content. Other benefits of reformulated gasoline include better driveability, lower intake deposits, and better catalyst performance. Echoing others, ASTM was urged to update specifications, but particularly, to improve the precision of analytical procedures to assure specification compliance with minimum quality give-away.

Winsor and Larkin examined the effect of improved fuel quality on diesel exhaust emissions. Starting with the agreed-upon sulfur reduction to 0.05% in 1993, they pointed out that further improvements in cetane number and reductions in aromatic content would further reduce tail pipe emissions. Oxygenated compounds may also play a useful role. More research is required to more accurately delineate these effects. The authors also indicated that the present cetane engine is operated at conditions significantly different from those critical to engine emission formation and a redefinition of diesel fuel ignition quality may be in order.

The aviation industry panel reviewed existing emission limitations of unburned hydrocarbons, smoke, carbon monoxide, and nitrogen oxides. Fuel hydrogen content or smoke point were stated to be the most important fuel properties in controlling these emissions. Concern was expressed over the lack of information presented of the effect of gasoline and diesel reformulation on the future quality of jet fuel. The panel emphasized the importance of such information in view of the lengthy development and certification time required for possible engine changes. Here ASTM is expected to continue in its coordination function between refiners, engine manufacturers, and airlines.

Different concerns and problems were posed by Mason in discussing regulatory impact on large, multiproduct pipelines. Lack of storage capacity will compound the problem of

handling additional fuel grades. Already mandated reductions in gasoline vapor pressure have required more closely controlled scheduling as well as greatly increased testing to document regulation compliance. However, the new requirements for oxygenated fuels will have the greatest impact because of the increased solvency and corrosivity of these materials and their yet unknown long-term effects on elastomers in pipeline equipment. It is quite possible that storage limitations and interface disposal difficulties will require the supply of reformulated gasoline into areas not requiring such fuels. To properly monitor and control the quality of the new fuels, ASTM must develop and approve a number of rapid field tests currently not available.

In conclusion, representatives of three major ASTM subcommittees commented on the proceedings. The chairman of the gasoline subcommittee emphasized that this subcommittee has been actively involved in these efforts for some time and currently has two new specifications in preparation, one for fuel containing ethanol, the other for fuel containing 85% methanol. The distillate/heavy fuel subcommittee is balloting specifications for two grades of low sulfur diesel fuel and has a specification for compression ignition methanol in the final preparation stage. The subcommittee is also active in developing test methods for hydrogen sulfide in heavy fuels and is monitoring proposed regulations on marine emissions in coastal waters. The aviation fuel subcommittee chairman reiterated the need for early warning of possible jet fuel quality changes and suggested that the intervening time be utilized to study the effects of specific aromatic compounds that might be excluded from reformulated gasoline and end up in jet fuel. Lastly, he stressed the need for increased company support of ASTM activities in view of all the new requirements outlined by other speakers.

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