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TETRAETHYL LEAD*

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As is well known, the only commercial use of tetraethyl lead is an antiknock agent to suppress detonation in motor and aviation gasolines. Although restricted to this one use, the increase in United States production of tetraethyl lead has been remarkable, rising from 45 million pounds in 1935 to 145 million pounds in 1940 and to some 350 million pounds in 1950, or nearly an eight-fold increase in 15 years. Over this same 15 year period the annual production of gasoline in the United States increased from about 470 million barrels in 1935 to 1020 million barrels in 1950, or about two and one quarter times. Hence, the increase in demand for tetraethyl lead is due not only to the gain in volume of gasoline but also to a considerable degree to the larger amount of tetraethyl lead that is currently added to a unit of gasoline, as compared with 10 or 15 years ago.

Several factors have been responsible for this growth, among which the following may be named:

A. The necessity for higher antiknock quality motor fuels occasioned by the progressive increases in compression ratio built into successive models of automotive engines.

B. Certain changes in the economic relationships between the relative cost of producing high octane motor fuel by refinery processes and by obtaining the same end through the use of tetraethyl lead as an antiknock agent. The relationships of these factors has been steadily shifting in the direction of the use of larger and larger dosages of tetraethyl lead for the attainment of high octane motor fuel.

C. The growth of civil and military aviation, particularly in the last decade, resulted in the development of piston type engines whose fuel requirements cannot be satisfied without the addition of tetraethyl lead to the gasoline. The efficiency of the gasoline engine increases as its design is modified in the direction of higher compression ratio. This basic factor has been utilized by the automotive engineer to improve motor car performance and steadily over the years there has been a gradual, but constant, increase in the compression ratio in the motor cars produced. Since the octane requirement of automotive engines increases with the compression ratio, the result has been an increase of some 15 octane numbers in the quality of motor fuel since 1930.

Present day motor gasoline is a blend of several components of different antiknock quality. The most important of these components from the standpoint of volumes available are straight-run gasoline, thermally cracked and reformed gasoline,

*Presented at the 23rd Annual Meeting, Lead Industries Association, May 17-18, 1951, at the Panel Discussion of Lead Consumers.

catalytically cracked gasoline and alkylate and polymer. Speaking in general terms, the components are given in the order of ascending octane number and in decreasing availability in respect to volume. Thus the straight-run gasoline with the lowest octane number is available in the largest volume and alkylate and polymer, which possess the highest octane numbers, are available in the lowest volume.

Today the octane number of premium gasolines has reached a level that is above that of all but one or two of the above components, while that of regular grade gasoline is higher than most straight-run, thermally cracked, and thermally reformed gasolines, so that the quality of the motor fuels marketed can only be realized through the use of tetraethyl lead. One of the objectives of the petroleum refiner is to increase his production of high octane components, but processing has become increasingly costly due both to high plant investment costs and because as the octane number of the product increases the cost of plant operation and of losses through processing become more expensive.

The long term future demand for tetraethyl lead is largely dependent upon the compression ratio of motor cars that will be produced and the availability of high octane blending components in the refineries. No attempt will be made to prophesy the trends of these two basic factors, but history has demonstrated a steady increase in the compression ratio and hence octane requirement of automotive engines, and in the quality of refinery stocks. However, the gap between octane requirement and quality of refinery stocks has been widening and it could well be that this trend will continue. On a short term basis, due to the Korean situation and its aftermath, substantial volumes of the highest octane blending components are being diverted into aviation gasoline and the next year or two may see a decrease in the octane level of the motor fuel available to the general public. While increasing military activities have stepped up the demand for aviation gasoline, a fundamental change is taking place in aviation engines which in the long term may decrease the demand for tetraethyl lead for aviation fuels. This change is the partial replacement of the piston type of engine, fueled with gasoline, by the jet type of engine for which the fuel is not required to possess antiknock characteristics.

When plant expansion programs are completed, the two tetraethyl lead producers in the United States should be in the position to produce some 500 million pounds of tetraethyl lead annually. Should production in the next few years reach this volume, the metallic lead requirements would be some 175 thousand tons annually. In retrospect the metallic lead requirements for tetraethyl lead in 1940 were approximately 50 thousand tons, while in 1950 this demand was some 120 thousand tons. Limited quantities of tetraethyl lead are now produced abroad, but at the present time consumption of metallic lead for this purpose is not too significant.