LEAD INDUSTRIES ASSOCIATION, INC.
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AUTOMOTIVE BATTERIES*

By

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As a representative of the Ford Motor Company and as a member of the Association of American Battery Manufacturers, I have been asked to comment on the outlook for the lead-acid battery and the battery industry's consumption of lead.

Because the automotive industry, the battery industry, and the lead industry have several areas of common interest, I am delighted to have an opportunity to share with you several thoughts that I have on this subject.

I should like to begin by telling you a little about the General Parts Division of the Ford Motor Company so that you will know who we are and what we do.

The General Parts Division is a manufacturing division of the Ford Motor Company with the General Offices near Ypsilanti, Michigan. The Division has operating responsibility for six domestic plants, one plant in England, and one under construction in Belfast, Ireland.

We produce some 33 major products for Ford cars, trucks, and tractors, primarily for domestic vehicles, but also some parts for the Company's Canadian, English, and German vehicles. A number of products are also for non-automotive markets such as aircraft and marine.

The Division's products range from starting motors, alternators, generators, and distributors to transistorized ignition systems, fuel systems, plastics, powdered metals, spark plugs, and of course, lead-acid batteries.

It is this product that is most closely related to your industry, and is one of the areas of common interest.

During 1963, more than 82 million vehicles were on the road. As you know, each of these used a battery. During 1963, the automotive industry produced slightly more than 9 million cars, trucks, and buses, and more than 30 million replacement batteries were required for the after-market.

Approximately 34 pounds of lead is required in total for an average Ford vehicle. This includes, in addition to the battery, our requirements for solder finishing, and electrical connections and components.

One hundred and fifty-six thousand tons (156,000) of lead were consumed by the auto industry in the production of new cars, trucks, and buses during 1963. When you add to this the lead required to produce the more than 300 million replacement batteries, the total lead consumption related to the automotive industry is more than 450,000 tons, or about one-third of the total amount of lead consumed in the last year.

Look Ahead with Lead

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This is a pretty good market--in fact, an excellent market for the lead industry. I am sure that this is a market that you will want to maintain.

With an 8 million plus car year in sight for 1964, the immediate outlook is good.

But what about the future? What is the outlook for lead-acid batteries and the lead requirements for batteries in the next decade?

In 1975, we estimate that there will be 100 million cars, trucks and buses in use on our highways. We believe that by 1975 the industry's annual production of automobiles, trucks, buses, and tractors will be at the rate of about 11 million vehicles per year. The battery replacement market will be about 36 million batteries.

It would appear, therefore, that the outlook for the lead-acid battery, and consequently, lead consumption, is very good.

With this background review, I would like to examine with you what I believe is likely to happen to the lead-acid battery in this next decade. I would like to outline for you what I believe will be the compelling factors that will influence the consumption of lead for batteries.

Engine horsepower has increased from 117 in 1950 to an average of 233 in 1964. This is an increase of virtually 100%. Accompanying the horsepower increase is an increase in engine compression ratios from 7 to 1 in 1950 to about 9.36 to 1 in 1964--an increase of 34%. A further increase may be indicated in the next few years.

Vehicle electrical system loads have increased substantially. The electrical load on a typical Ford car, for example, was 170 watts in 1940 and 400 watts in 1964, and will be approximately 500 watts in 1965.

The larger engines and the increase in the compression ratio has required an increase in cranking power. This is necessary to provide satisfactory starting under both cold and hot engine cranking conditions. Until recently, the electrical systems load demand has been met by increasing both the battery and the electrical generating system capacity.

There is every reason to assume that the increased electrical power requirement trend will continue. I believe that it is not unrealistic to assume that within the next 10 years, electrical system loads will be increased to approximately 800 watts.

What will happen to the battery, and consequently, lead requirements over the next 10 years with the many added accessories and conveniences that are being developed each day?

I can assure you that it is not our plan to increase the size and weight of the battery to meet these demands. The electrical power requirements increase will be met primarily through improvements in the electrical generating system.

The use of alternators, as you know, has increased substantially the system's ability to provide electrical energy at low engine speeds. Our design objectives are to provide a generating system that will supply the car's electrical demands as long as the engine is operating.

We will expect the battery, therefore, to provide the energy for the electrical components when the engine is not operating, and to provide engine starting power.

It is evident that the buying public's wants are moving toward multi-car families, and that there is a substantial increase in the popularity of the sporte-type cars.

The current amazing reception of the Mustang is an example. This car offers higher average horsepower engines than the more conventional styles of comparable size. In the larger classes there is also a trend toward more horsepower. The public wants this, we believe, not for reasons of top speed, but because this increased horsepower offers an added margin of safety. It decreases the time you are exposed to danger when passing another car or when entering an expressway.

Because of the need for added cranking power and because we are dedicated to extending the useful life of the battery, I doubt very much that we will be able to make any appreciable reduction in the size of the lead-acid battery—even with greatly improved generating systems.

I believe, therefore, that the outlook for the lead-acid battery and for lead consumption by the automotive industry is very good.

If this favorable market is to continue, however, the battery manufacturers and the lead industry must continue to improve the efficiency of the lead-acid battery.

With respect to this, I should like to review with you some of the things that we are doing, and also to point out several areas in which you might profitably devote your research.

Although Ford plays a dual role as battery producer and vehicle manufacturer, we can never forget that our principal business is to build cars, trucks, and tractors which will result in new and repeat sales to satisfied owners. This demands a high level of quality and trouble-free total performance of every component.

For a number of years, Ford has engaged in an intensive program to develop components that have a long life expectancy, better performance, and greater freedom from maintenance service.

As an expression of the confidence we place in our components, we were the first American manufacturer to offer a 24,000 mile, 24 month warranty on a passenger car. This comprehensive warranty—now on all Ford-built cars—includes the battery, and the battery warranty is extended an additional 12 months on a pro rata basis.

To provide batteries that will meet this objective, positive plate grids, for example, which must operate in the most adverse corrosive chemical environment throughout their life, have been made heavier. To increase the corrosion resistance of the positive plate grids, we have found it necessary to use a corrosion resistant lead alloy and to increase the cross-section of grid mesh wires. This has the disadvantage of increasing the lead content in the battery, and of course, adding to the battery weight and cost.

Second only to corrosion of positive plate grids is the damaging effect of vibration which places the relatively soft, yielding grid metal under stress and promotes corrosion. Vibration causes damage to the separators which separate plates of opposite polarity. The problem of vibration has in the past been partially prevented by shimming the elements in the cell compartments.

We have developed a unique construction to eliminate these harmful effects of vibration by embedding portions of the plate and separator bottom edges in thermo-setting resin. This cementation prevents movement of plates and separators relative to the container and cover, and assures the mechanical integrity of the assembly. This was a positive step forward because it is more effective than shimming, and has been accomplished at a reduced cost.

As an additional quality improvement, a new type of plastic separator has been developed by our suppliers which has improved chemical resistance and micro-pore size to match the longer service life of the plates. We would like to still further reduce the pore size of the separator.

In some instances we have adopted a top cover battery construction in which the intercell connections are shortened to increase the voltage available at high rates of electrical discharge at low temperatures and to reduce the lead weight. The intercell connectors are submerged below a one-piece cover and permanently encapsulated in acid-resisting thermosetting resin. We plan to adopt this design across the board in 1965.

Many batteries suffer damage from neglect when owners forget to replenish the water which is gradually lost through decomposition into hydrogen and oxygen by the charging current. This loss together with evaporation, which occurs from exposure to radiated heat under the hood, results in the concentration of acid which is detrimental to all the cell components. We have provided extra water space in many of our battery types which results in an acid of milder average strength throughout the battery's life. This contributes substantially to life expectancy and increases the service interval.

While this has provided a major improvement so far as owner satisfaction is concerned, we will not be satisfied until we have a battery available that will be service-free for its entire life. In fact, we believe this to be one of the most important deficiencies in the present battery design, and consequently, we believe it offers a most important area for improvement.

These are some of the things that we have been able to do in recent years to improve the over-all efficiency of the lead-acid battery.

You will recall, however, that I mentioned that the compression ratio of our engines would likely increase and that while it is unlikely that we will increase the peak horsepower of our engines, it is entirely possible that the average horsepower of the engines used on all cars will increase over the next 10 years. We expect this increase to be as much as 30%. We will have to provide for an increase in cranking power either by improved battery efficiency or starting motors or both. Because package size and weight must be held at a minimum, our objective is to accomplish this with no added weight or size.

Our objective also is to build a battery with as little lead as the demands for high performance and long life will permit.

Despite the fact that the lead-acid battery has been prominent for over 100 years, there is much that must be done to improve its efficiency, reduce its weight, extend its life, eliminate service, and not add to cost.

Should this not be accomplished, we are increasing the stakes and consequently the incentive for your competitors to produce an entirely different type of battery or system that will not have these disadvantages.

You know what the disadvantages inherent in today's battery are, but we need to continually focus attention on them. We in the battery industry are directing a good deal of research effort toward reducing or minimizing their effects.

We are concerned with weight and size, as I have mentioned. We are also concerned that lead-acid batteries have a decreased high rate discharge capacity at sub-zero temperatures, and that they won't accept an efficient recharge at low temperatures; that they suffer a loss of charge after prolonged standing, especially at high temperatures; and that the internal components of wet batteries, such as positive grids and negative active material deteriorate after prolonged standing.

This is the only part of a car that disintegrates appreciably when not in use. We must find a way to reduce the deterioration of these internal components whether the cause is attributable to service conditions, deep cycling, overcharging, or owner neglect.

I said that starting larger, higher compression engines may require higher battery capacity and increased output, but it must be accomplished within reasonable package size and weight limitations.

This may be achieved by improving the grid alloys which will permit lighter construction and yet provide greater corrosion resistance. The use of antimony in our lead alloys to improve castability of the grids has some undesirable effects in terms of the local discharge action it produces within the battery.

One possibility to prevent these losses is through the development of new alloys that have improved strength and castability without accompanying performance or efficiency penalties.

We do not expect a lead alloy which has the weight of magnesium, the conductivity of silver or copper, and the corrosion resistance and strength of steel—this would be ideal. However, we are looking for improvement toward this Utopia.

We at Ford and others in the automotive industry are not only devoting a great deal of research and advanced product development effort toward improving the lead-acid battery, but I can assure you that our research is also concerned with other methods of storing electrical energy.

We are devoting a good deal of time to this because we are convinced that we will never have complete customer satisfaction until we have considerably improved the reliability of our present batteries, and have eliminated the need for constant customer attention.

In the long run, the customer will make the ultimate decision to continue or discontinue using the lead-acid battery. Your industry can importantly influence this decision, or indeed, you may make a customer decision unnecessary by accelerating the research you do toward improving or eliminating some of the disadvantages that I have just reviewed.

If you do this, and are successful in offering us a means of offsetting the weight, package size, and maintenance disadvantages by improving the over-all efficiency of the lead-acid battery, then I believe the outlook for the continuation of this substantial lead market to the automotive industry is very good.

Certainly, I must agree that research directed toward developing new markets for lead is important, but I am sure that you also will agree with me that it is important that you devote a sizeable share of your research dollar to protect this very substantial share of your market.

A very few of the larger lead producers have been doing a considerable amount of work in this area. It may not be possible for some of the smaller companies to individually devote a great deal of time and resources to this.

I would like to leave you with the thought that your association may wish to accept this challenge. You might consider the advisability of underwriting outside research in some of these areas. I certainly would like to see more of our universities offering graduate work in electrochemistry. We in industry must supply this incentive.

I should like to take this opportunity to express my Company's appreciation to those of you who have in the past seen the need for improvement. You have helped make our cars more acceptable in the market place. We all still have a lot yet to do to improve the reliability and durability of this very important component—the battery. I'm confident it will be done.