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4 P.M., Tuesday, April 21, 1964

TECHNICAL FUTURE OF LEAD

By
Schrade F. Rudisill
Director
INTERNATIONAL LEAD ZINC RESEARCH ORGANIZATION
292 Madison Avenue
New York 17, N. Y.

In past years, when I have discussed Lead research, I have referred to lead as a modern metal. Lead is responsive to the latest techniques for alloy development and compatible with the newest products. Only recently, lead compounds have been identified as light sensitive materials to develop new photographic systems. All of these developments, plus the findings of ILZRO research, clearly indicate the foresight of those who recommended and organized an international research program for lead. While there is much yet to be done the road ahead is amply marked with signposts pointing to potentially successful developments with important commercial applications.

One of the most interesting breakthroughs has been in the field of particulate lead metallurgy. New alloy systems for lead have been developed with improved physical and corrosion characteristics. The results have been of such significance, that at least five of our member or associated companies are seriously considering or have begun commercial exploitation of the results arising, not only from our research, but from independent research which they have conducted.

These lead alloys appear promising for batteries, ammunition, as a machinable shielding material and for cable sheathing. The minimization of the self-corrosion characteristics of the lead-lead oxide alloy system as compared to the lead antimony system, offers distinct advantages. It will greatly improve shelf life and thereby open up new markets for the lead acid storage battery for portable tools as well as for all types of electronic and electrically-powered accessories. To insure that these markets can be exploited, we are undertaking research on the joining of particulate metallurgy products, as well as on the corrosion behavior of these alloys in sulphuric acid media when employed as battery grid materials. Our fundamental alloy development program is, of course, continuing to provide background information for the commercial development of these new alloy systems.

Criticism has been leveled at the cost aspects of these new alloy systems. However, research conducted by related industrial organizations indicates that the price of these alloys can be brought within reason with, of course, a far greater potential commercially. We have found time and again that this focusing of joint technical abilities can usually remove cost or other barriers.

Presented at the 36th annual meeting of the
Lead Industries Association, Inc.
St. Louis, Missouri April 21, 1964

This particular development also emphasizes the ILZRO research approach. Every new product, every new alloy development, must be considered as part of a system. In other words, the systems engineering concept must be applied across the board. With these new alloys, not only must we know how to produce the alloys and to develop maximum properties, but we must understand their corrosion characteristics, their strengths and weaknesses, and how to join the materials by welding or adhesive bonding.

It is believed that this approach to new lead alloy systems should produce improved alloys for cable sheathing. With higher strength, thinner sections can be produced which make lead more competitive cost-wise as well as from the standpoint of total weight of the cable system. Some may criticize this drive toward reducing the total amount of lead employed in the sheathing system. We feel that this concept will help us to retain our share of the cable sheathing market, rather than to lose it entirely to competitive materials. There are many new cable sheathing systems which completely ignore the use of lead. However, we feel that the advantages derived from these new alloy systems, should enable us to retain at least a share of the market on a long term basis. Additional research is indicating how the various plastic materials employed for cable sheathing can be bonded to lead with chemical bonds rather than simple mechanical bonds. Although all the answers have not been obtained, we have had sufficient success to indicate that a goal is in sight.

There has been some disappointment with progress in developing a market for lead as an acoustical attenuator. However, a great deal of effort has been, and will be, required in order to fully achieve the potential which lead has in this area. The problems have been truly monumental. There was the problem of educating people, including the architect, on the real need to provide acoustical privacy. Most important, we had to convince the contractor that he must produce a quality building where corners are not cut and acoustical privacy is assured.

This educational process is not accomplished easily or quickly. However, the fact that success can be achieved is indicated by what has been done by our associates in Australia and in England. Progress has also been made in the United States and Canada. With patience on our part, contractors, builders, and state, federal and city building codes will require improved acoustical performance in buildings of all types--not only office buildings--but in dwellings as well. The increasing value of space, and the ability to produce thin wall partitions to maximize the use of available space, will produce a parallel demand for lead.

Present activities are concerned with the utilization of lead in movable building partitions. Panel manufacturers have advised us that they have varying requirements for acoustical performance in office designs. It is often difficult for them to take existing economic panel systems, and upgrade them to provide improved acoustical performance. Lead is virtually the only material which can provide variation in acoustical performance for a given panel system. Investigation of panel designs indicates the compatability of lead and the ability to employ it efficiently and effectively in these designs.

Additional research has shown the effeciency of thin lead for over-the-ceiling acoustical attenuation. The requirement here is for low-cost lead sheet for this application. Lead is uniquely adapted to this application because of its formability and ease of cutting and fitting for field installation. As contractors and architects become aware of the efficiency of lead in this respect, an important market will open.

We have long considered that in the realm of thin, low-cost lead sheet, the IM machine, originally developed by Cominco and converted into a commercial apparatus by Broken Hill Associated Smelters, is uniquely adapted for the production of this material. ILZRO research in this area is pointing-up improvements which can be made in the casting technique for most efficient use of this apparatus. One of the most significant advances in the use of the IM machine is the ability to incorporate wire reinforcement in the lead sheet during the casting process. BHAS has designed and developed auxiliary equipment for the basic IM machine to permit full scale production of wire-reinforced lead sheet. This is a significant development since it permits the utilization of free hanging lead sheet for many applications, not only in the acoustical market, but also in the chemical market. There has been excellent response to our making available drawings of the 36-inch IM machine now installed in Port Pirie, Australia. Many sets of these drawings have been sold throughout the world, and undoubtedly many of these casting units are now under construction or under consideration by management.

Just emerging successfully from the laboratory, is a process for high speed electrodepositing of pore-free coatings of lead and lead-tin alloys. The resulting material should have application for containers for automotive gas tanks as well as in the architectural field. The economics of this system are favorable, particularly in view of the high speed with which the alloy can be laid down on the ferrous substrate, as well as its compatability with existing electrolytic tin-coating lines.

Because of the excellent corrosion resistance of lead coatings on steel, the container industry has indicated that lead or terne coatings would be employed for nonfood containers. Various steps, soldering and welding tests, as well as painting application tests, are under way to provide complete data on the performance of this material.

It is known that the treatment of cotton with metallic compounds will produce special properties such as rot, flame or mildew resistance and water repellency. Lead chromate will extend the life of cotton fabrics exposed to sunlight; lead hydroxide imparts flame resistance to cotton. Our research is designed to find new reactions of lead compounds with cellulose which will provide improved properties for cotton. Other lead compounds are being screened which have the possibility of being insolubilized in or on the cotton. One organolead compound has been shown to give cotton reasonably good water repellency and rot resistance.

A new process for depositing metallic lead within the cotton fiber by chemical reaction methods has been discovered. This significant discovery is being set forth in a patent application.

Lead on concrete will significantly increase resistance to corrosive attack. Corrosive acids in sewage systems have been known to quickly eat away the concrete storage tanks. Our research is directed at the deposition of lead in concrete pores by means of a chemical reaction. Success in this research project will mean that thin films of corrosion-resistant lead can be deposited on concrete with good adherence.

The ceramics industry has used significant quantities of lead in the form of various chemical compounds. Lead compounds are known to lower the firing temperature of various types of enamels, such as glazed glass bottle decoration, glazed enamels on vitreous tiles and some porcelain enamels on steel and aluminum. Smaller quantities are consumed by the specialty items produced by the electronics components manufacturers.

ILZRO contributes to knowledge in the ceramics industry by sponsoring graduate fellowships at leading universities throughout the world. These research data go eventually to the ultimate consumer through articles published in the various journals.

One of the growing areas of technology is in the field of organometallic compounds. These are compounds in which metal atoms are joined to organic groups. The most famous of all organometallic compounds, produced in the greatest quantity throughout the work, is lead tetraethyl. Because of the success of this lead organometallic compound, as well as the potential of the rapidly growing chemical industry over the years, we have expanded our research in the chemical field. This is a market with a tremendous growth potential. It is a market which has produced a tremendous number of new products for industry and for consumer use. Therefore, we feel that we are justified in increasing the scope of our effort in this important area.

The program has been composed of two fundamental synthetic programs, one in the United States and one in Holland, where new and different lead organometallic compounds have been synthesized. As the programs developed and advanced, and with the availability of a number of new compounds, the next step was to explore the potential application of these compounds. These studies were initiated; compounds were made available to government, academic and industrial laboratories. Because of the excellent response, it was decided to initiate pilot production of some of the most interesting of these compounds. Next through announcements in the technical journals, through advertisements and publicity, we advised that these compounds would be made available to qualified laboratories, at no charge, for evaluation of potential applications for these materials.

Early last year, pilot production of significant compounds was initiated. Concurrent with the pilot production of these compounds, it was planned to make available data on the chemical behavior of these compounds, as well as on potential applications based on high-spot screening work done at various chemical laboratories throughout the world. Plans for this program were then submitted to the LIA and to the LDA and to the Italian Lead Institute to assist us in planning dissemination of information regarding the program, and in making announcements and preparing advertisements on the availability of these materials.

Subsequent to the announcements, which have been issued, over a hundred requests have come through for these compounds. Countries included: England, Holland, Israel, Germany, the United States, Australia, Mexico, Spain, India, Italy and France. These compounds are under consideration as antifouling pigments in marine paints, to vulcanize rubber (natural and synthetic), as pesticides, for stabilizing polymers, as catalysts for the polyurethane foaming reaction, for pharmacological applications, for enzyme inhibition, for astereo specific polymerization compounds and as trans-esterification catalysts. Compounds are being studied in a lingo cellulose degradation reaction, as starting materials for synthesizing other compounds, as lubricant additives, as moth-proofing agents and as moth and rodent repellents; as urea condensation catalysts; as bactericides and catalysts for nucleophyllic substitution. They are being studied in commerical paint systems, as fungicides and for treatment of bilharziasis. Bilharziasis is a tropical disease spread by molluscs which appear in the waters of the Middle East. While this may seem a strange and rather unimportant application, the potential is tremendous. It has been estimated that in certain countries such as Syria, the use of organometallic compounds for water treatment alone will require about 10 to 20,000 tons of this material per year. These compounds are also being looked at as antiknock agents, for wood preservation and for textile treatments. The material is being investigated for its steroid harmone activity, and it has been shown to have a significant action against mammary tumors. Another interesting application, is its potential against inflammatory diseases, such as arthritis.

Much of this research is being done by the organizations which I have mentioned before. The companies which are undertaking these application studies, include major chemical corporations throughout the world.

In addition to these studies, we are investigating the use of lead compounds as lubricant additives to improve lubricant performance. Several of the lead compounds show excellent behavior in this respect over a relatively wide range of temperatures as well. The potential in this market area is significant. Results to date have been most promising and we hope by the end of the year we will have identified important lubricant systems employing lead as a principal additive agent.

We are conducting a program jointly supported by ILZRO and the United States Department of Agriculture. Another program of importance is a cooperative effort between ILZRO and the U. S. Navy to investigate, on a large scale, the behavior of lead compounds as antifouling pigments.

In addition to the research which is enumerated above, many publications and papers have arisen from these programs. We have several patents with respect to the synthesis of new lead compounds. A further contribution of interest in lead organometallic chemistry, has been the preparation of a major literature review of research progress on this subject. This has recently been published and will soon be distributed to industrial organizations, government laboratories as well as to universities and colleges in the United States, Canada, England, Europe and Australia. All of this research is awakening interest in lead as an important chemical, and we feel that there will be many important industrial developments arising from this program.

We wish to emphasize that potential success in this field will derive mainly from the wonderful support we are getting from the trade associations with whom we are associated. Without their assistance in disseminating information about this program, response to the availability of these lead compounds would be small indeed. The associations have been extremely helpful, for example, in promoting technical and commercial features of our research assimilated in brochures on completed projects. In this context I would like to mention our ILZRO Research Digest with which most of you are familiar. This book, which summarizes contractors' progress on our metallurgical, chemical and electrochemical programs, has proved very effective for keeping our member companies abreast of the developments I have just reviewed for you.

While a substantial amount of our research is devoted to new product development and the exploration of new areas for lead application, we have not neglected our traditional markets. These include the architectural and building market, the electrical industry in utilizing lead for cable sheathing, developments for the solder market, lead-coated steels and the battery industry. We are consolidating our data on the corrosion behavior of lead in various media. ILZRO's continuing research in the pigment field, as well as in ceramics, should develop a growing interest in lead as an important component in these various systems. A substantial amount of fundamental research is being undertaken on the health and safety aspects of lead, its compounds and its by-products. All of this combined research should contribute to the continuing strength of the market for lead and its compounds.

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