

LEAD INDUSTRIES ASSOCIATION

420 LEXINGTON AVENUE

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METALLIC LEAD PRODUCTS DIVISION

LEAD AS AN ENGINEERING MATERIAL

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Lead Industries Association

About one-third of the lead used each year in America is made into chemical compounds such as red lead, white lead, litharge, tetraethyl lead, etc. How the rest of it is used as metallic lead and where it goes in industry is described briefly below.

Historical Background

Because of its ease of reduction from ores, lead was one of the first metals used by man. Lead pipe manufactured by curving sheet lead together and soldering the seam was used by the early Romans for conducting drinking water. Architecturally, lead served as a roofing material for public buildings and churches. The famous dome of St. Sofia in Istanbul is lead covered. The floors of the Hanging Gardens of Babylon were lead covered to retain the moisture necessary for the vegetation. Lead was used in the construction of the first commercial sulphuric acid box chambers built in 1746 in England.

Production

Lead is mined primarily as the sulphide, the bulk of the domestic ore coming from southeastern Missouri and the Northwestern States. Lead ore is usually associated with zinc ore. The ore mixture is crushed and ground to fine powder and separated by the flotation process.

Lead is recovered by smelting in a blast furnace. A lead blast furnace is similar to an iron blast furnace but constructed on a smaller scale and, of course, operates at lower temperatures. Ore, coke and limestone constitute the normal furnace charge. Oxygen-enriched blast is one of the latest developments in lead smelting.

Lead bullion or unrefined lead containing other metallic constituents is normally first refined in large kettles where it is heated under controlled conditions. Here, silver, gold, copper, zinc and some other metals are removed and, in most cases, recovered. For example, gold and silver are recovered by taking advantage of the fact that these two metals have a greater affinity for zinc than for lead.

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Lead As An Engineering Material

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By deliberately adding zinc to lead bullion containing gold and silver, these two valuable elements form a zinc-silver-gold mixture which subsequently floats to the top of the bath and is removed by skimming. Any zinc remaining in the lead is removed by creating a vacuum over the molten metal so that the zinc will vaporize out and condense as crystals on the cold top of the vacuum drum. The latter technique has been recently perfected and is known as the Vacuum Refining Process.

Pure refining does not remove bismuth and some other rare elements which are close to lead in their characteristics. In order to refine bullion high in these metals, the electrolytic refining process is used. Only one such plant, however, is in existence today in this country.

Grades of Lead

Specifications have been established by the American Society for Testing Materials for the various types and grades of lead that are available commercially.

The purest grade is referred to as corroding lead, simply because it was used originally in the manufacture of white lead where the presence of metallic impurities would discolor the product.

The most commonly used primary lead is chemical grade. This is obtained chiefly from southeastern Missouri ores which retain a small percentage of silver (0.002 to 0.02%) and copper (0.04 to 0.08%) in the refined metal. This grade is referred to in the trade as chemical lead because it is used primarily by the chemical industry. The presence of silver and copper were found to add to the corrosion resistance and improve creep and fatigue resistance.

Common lead is the type most often encountered outside of the chemical industry and consists essentially of secondary lead, that is, lead recovered from scrap sources.

Antimonial or hard lead is ordinary lead to which has been added anywhere from 1 to 12 per cent antimony. This serves to harden the lead and improve the physical characteristics. However, it must be remembered that the presence of antimony lowers the melting point and does not enhance lead's corrosion characteristics.

Tellurium lead is chemical lead to which has been added approximately 0.04 per cent tellurium. Tellurium retards grain growth and thereby increases the fatigue resistance.

Fabrication

Lead is cast into slabs about 5 feet by 10 feet by 4 inches and rolled into sheet on special rolling mills. Because of its softness, lead is relatively easy to roll into sheets from foil thickness up to 2 inches. Average sheet length is 20 feet.

An unusual system of sheet size measurement has developed through the years that is rather unique to the lead industry. Thickness of lead sheet

Lead as a Soldering Material

in addition to its low melting point. In other words, if a lead-solder alloy is used in a solder, the melting point of the alloy is lower than that of the pure lead and the soldering process is easier.

Lead is also used in the form of a solder for joining metals. Lead is a soft metal and is easily deformed. It is also a good conductor of electricity and is used in the form of a solder for joining electrical components.

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Lead melts at 327°F and it is relatively easy to join together by welding. For this process oxy-hydrogen is used with a cup and a burner tip. Joining lead to lead in this manner without solder is known to you as "lead burning." Actually, however, the lead is not burned but merely melted and flowed together.

Soldering is a process familiar to everyone. Solder itself is usually an alloy of 60 per cent tin and 40 per cent lead. Very often lead is joined together by means of solder. Lead wiring is a special method of joining lead that has been used for years by plumbers and other workers. In the form of lead, lead wiring consists simply of melting solder (usually 60-40) which is in the plastic or pasty range around the pieces of lead to be joined.

Why Lead is Used in the Chemical Industry

Lead has played an important role in the chemical industry since the time when alchemical experiments were practiced by the alchemist. The chief reason for the use of lead is its (1) excellent corrosion resistance, especially to sulphuric acid from dilute up to 60% H_2SO_4 acid. Since sulphuric acid is the work horse of the chemical industry, it is easy to understand why lead is an important material of chemical construction. In addition to sulphuric acid, lead is used for its resistance to phosphoric acid, chromic acid, hydrofluoric acid, sulphur dioxide and salts of these acids. Another reason for lead's use in the chemical industry is its (2) low cost compared to other corrosion resistant materials. Adding to its corrosion advantage is that (3) it can be obtained easily and in large quantities (as much as 75 per cent of the entire world's production of lead is used in the chemical industry).

How Lead is Used in the Chemical Industry

Lead is naturally soft and malleable. When used alone, more often it is supported by an external frame of steel or wood. For example, steel or wooden vessels are lined with lead which is fastened at intervals with lead covered steel strips.

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In many processes, lead pipe coils inside the vessel are used for cooling purposes and occasionally for heating with steam or hot water. For use with steam pressures exceeding 10 and up to 200 pounds steam pressure, lead covered copper coils are preferred. Here again, as in a braided lining, the greater strength of copper is combined with the corrosion resistance of lead.

Lead pipe and conduits are used to a great extent for conducting corrosive liquids and fumes. Where the lead pipe is surrounded it is common practice to either lay it in grout or better still, use lead lined cast iron or steel pipe. This consists of casting the lead which is placed a lead pipe expanded by hydraulic pressure to fit exactly.

Lead in Flaming

Lead for many years has been used in household and industrial plumbing. It is used to conduct drinking water from the cast iron water mains in the street to the house. Inside the house it is used in the form of pipe for wastes, lead traps beneath basins, tubs and showers, lead bends on water closets and occasionally as vent pipe. In practically all cases, the lead pipe is joined by welding.

A surprisingly large amount of lead is also used in conjunction with cast iron water mains and soil pipe which is used to connect waste to the sewer or for venting purposes. First it serves as a caulking material to form a water-tight seal between the end sections of pipe. Then the lead is melted and poured into the joints of the water mains with special tools. Sometimes if it is impractical to use molten lead, lead wire is used instead. Because of the soil-moisture, lead wool is easily consolidated or soaked into a soft water-soaked mass.

ANALYST: [REDACTED]

Architecturally, it can also offer considerable service, most prominently as a roofing and cladding material. Its high corrosion resistance and pleasing grey color are the chief advantages. It is also used for gutters.

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In the electrical industry, the chief was for lead and also the greatest consumer of lead in the country. I never believed existed on the average, 25 pounds of metal alloy with one pound of lead both the lead alloy used for making grids as well as the lead oxide used on the battery plates.

In certain applications copper wire is coated with lead before being covered with rubber insulation because the sulphur compounds in some rubbers attack copper and, vice versa, copper affects some insulating materials adversely. The presence of a lead coating eliminates any reaction between the copper and rubber.

In the electroplating industry, particularly chromium, copper and nickel are, however, the most important materials, as so much, and for heating and for electroplating. (a) Because lead is normally resistant to corrosion, it is used in plating these metals. (b) Because lead is a soft metal, it might be formed to suit the shape of the parts. A more recent development is the use of lead in the electroplating process in which a cold lead electrode is used to cool the electrolytic solutions and the parts of circulating bath or from and the tanks themselves are lead lined.

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1. The first step in the process is to identify the problem or issue that needs to be addressed. This involves gathering information and understanding the context of the problem.

References

Best flight bearings are bearings consisting of a layer of lead lining antimony alloy on a base of sintered tin-lead bronze. Conventional bearings are lead on steel. Composite bearings consisting of thin lead babbit on a matrix of copper and nickel powders sintered on a steel backing have been used in automobiles. An average of 2 to 4 per cent lead powder is used in sintered metal powder bearings of the self-lubricating type.

Lead is used universally for protecting patients and operating personnel from harmful exposure to X-rays and gamma rays emitted by Crookes tubes, betatrons, and radium as well as cobalt 60, tantalum 182 and other radioisotopes. While the total quantity of lead used for this purpose is small compared to the overall lead consumption figure, its importance should not be minimized insofar as lead does not itself become radioactive and hence can be used as long as required and moved to other locations without fear of radioactive contamination. For very large atomic energy installations, particularly those being designed from the ground up, shielding is accomplished by using thick concrete walls sandwiched with relatively thin sheets of lead. Probably the bulk of the lead used for protection against atomic radiation is in the form of bricks about the size of common building bricks. In this way barriers can be constructed in practically any location and to protect against any degree of radiation.

How Much Food Is Used

To round out the industry-wide picture, it may be interesting to know how many tons of lead are actually consumed by American industry in a year. In 1939 this figure was more than 1,212,000 tons. Last year we produced five million more 400,000 tons and 355,000 tons were recovered from scrapped equipment such as old storage batteries and cable sheathing. From this it is evident that this country consumes more lead each year than it produces. To account for this at 40 million tons were imported from other countries like Mexico, Canada and South America with minor tonnages coming from overseas sources. The difference between consumption and production is made up of changes in stock and government stockpiling.

Lead Alloy

The lead industry has developed a wide range of storage batteries. These are used in a variety of applications, including automotive, industrial, and marine.

Lead Alloy

Lead alloy is a mixture of lead and other metals, such as antimony, tin, and calcium. It is used in a variety of applications, including automotive, industrial, and marine. Lead alloy is known for its high strength, corrosion resistance, and ability to withstand high temperatures.

Lead is a soft metal, but when alloyed with other metals, it becomes much stronger. Lead alloy is used in a variety of applications, including automotive, industrial, and marine. Lead alloy is known for its high strength, corrosion resistance, and ability to withstand high temperatures.

As an engineering material, lead's characteristics are so diverse that as old uses diminished, new ones such as those described earlier are developed. In addition to new applications, new alloys having improved properties have enhanced the use of lead for many old applications. Lead alloy for cable sheathing has demonstrated greatly improved fatigue and creep characteristics. Calcium-lead grid metal has lengthened the useful life of storage batteries for stand-by "float" service. Other alloys have improved the performance of storage batteries for automotive use, tank linings for chromium plating, etc.

Lead's applications cover a multiplicity of industries which utilize one or more of its many characteristics. It is a metal that has been around for a long time and one which will certainly continue to find considerable use in the changing technology of modern times.

The Lead Industries Association is always willing to cooperate without obligation in the solution of problems involving lead. Inquiries should be addressed to 420 Lexington Avenue, New York 17, New York.