HOW IT IS MADE: THE LEAD ACID BATTERY - PART 4

OXIDE PRODUCTION

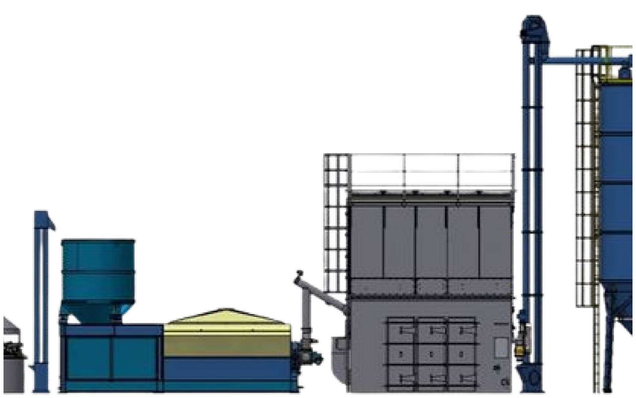
Lead Oxide

All production processes require the right amount of lead oxide to ensure that the active material can be used in the battery. Once the oxide production has been completed, the chemical compound that will be applied to the grids will be formed. Special attention must be paid in this process to dosing the components to be used and mixing them.

Sovema uses the Shimadzu (abrasion) method to produce the oxide, consisting of the oxidation of a surface and the removal of the resulting powder to clear up the new underlying metal surface, which will be subjected to oxidation.

The basic parameters of this process are as follows:

1. Surface;
2. Temperature: the catalyst element of production;
3. Oxygen: an essential element for the oxidation process;
4. Mass of lead components: provides the mechanical stress to remove the oxide. The greater the mass, the greater the power of removal. The smaller the size of the piece, the higher the amount of surface per unit of weight.



Making the paste

The production department consists of the following production systems:

1. Production of pieces to be used;
2. Oxide production machine;
3. Oxide separation filter;
4. Oxide transport and storage systems.

There are two systems to produce single pieces of lead:

1. Production through casting and solidification (thermal system);
2. Production of cubes through a mechanical shape changing system.

Thermal system

With this system, the lead is melted by pumping or distributing it inside the cylindrical equal-sided cavity, i.e., whose height is equal to the diameter. The dimensions must be about 20 mm.

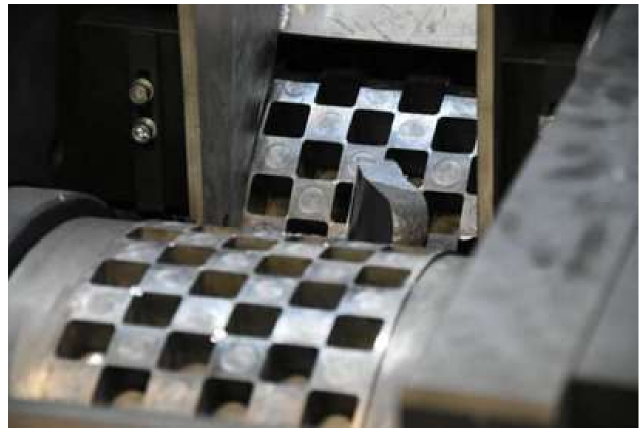
Components needed:

1. Pot;
2. Pump;
3. Cylinder casting machine.

The molten material is pumped into a rotating carousel carrying the sequence of cooled moulds, into which the molten lead is poured. The carousel is kept at a controlled temperature, so the continuous rotation gives enough time for the cylinders to cool down.

At the end of the rotation, they are ejected from their housing by a mechanical system, thus creating solid lead volumes optimized for the oxidation process while leaving room for the new ones.

This machine has low energy efficiency levels and is at high risk of environmental pollution. It requires the manual assistance of an operator.



Mechanical system

The mechanical system consists of a lead ingot loader, a slicer and a moulding system. The ingots are cut into slices of about 18mm and sent to the moulding system, which divides them into numerous cubes.

Since the energy is only needed for the change in shape, the system performance is improved, and the resulting pollution level is almost zero. The only manual intervention required is the ingot loading stage. The material ends up in a hopper designed to feed the plant, which is extracted using a vibrating conveyor system upon request from a mechanism referring to the amount of material inside the mill's drum.

Oxide production mill

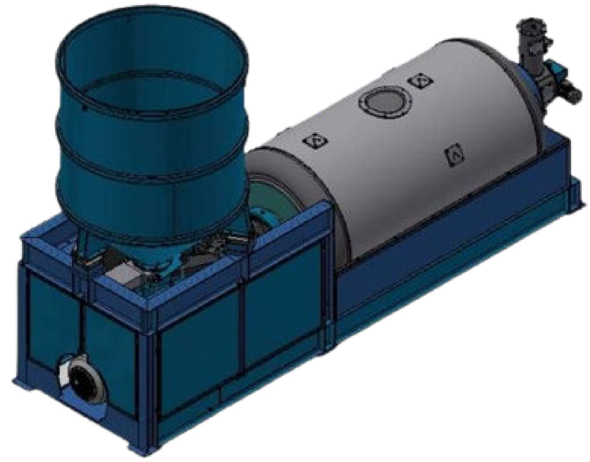
The machine rotates several cylinders or cubes produced as described above. The mechanical stress generated by the engine produces a temperature increase inside the mass of the cubes, bringing the material close to the operating temperature. In these conditions, the oxidation reaction on the lead surface is created by supplying oxygen, thereby generating heat(Fig.12)

To keep the reaction under control, the temperature must be monitored using unique cooling systems. A highly oxidizing atmosphere is then created to coat the cylinder surfaces with oxide powder.

The rotating drum causes the friction of the cylinders, which causes the removal of the oxide powder from the surfaces, thus creating new oxidation areas. The process lasts as long as there is solid material inside the drum.

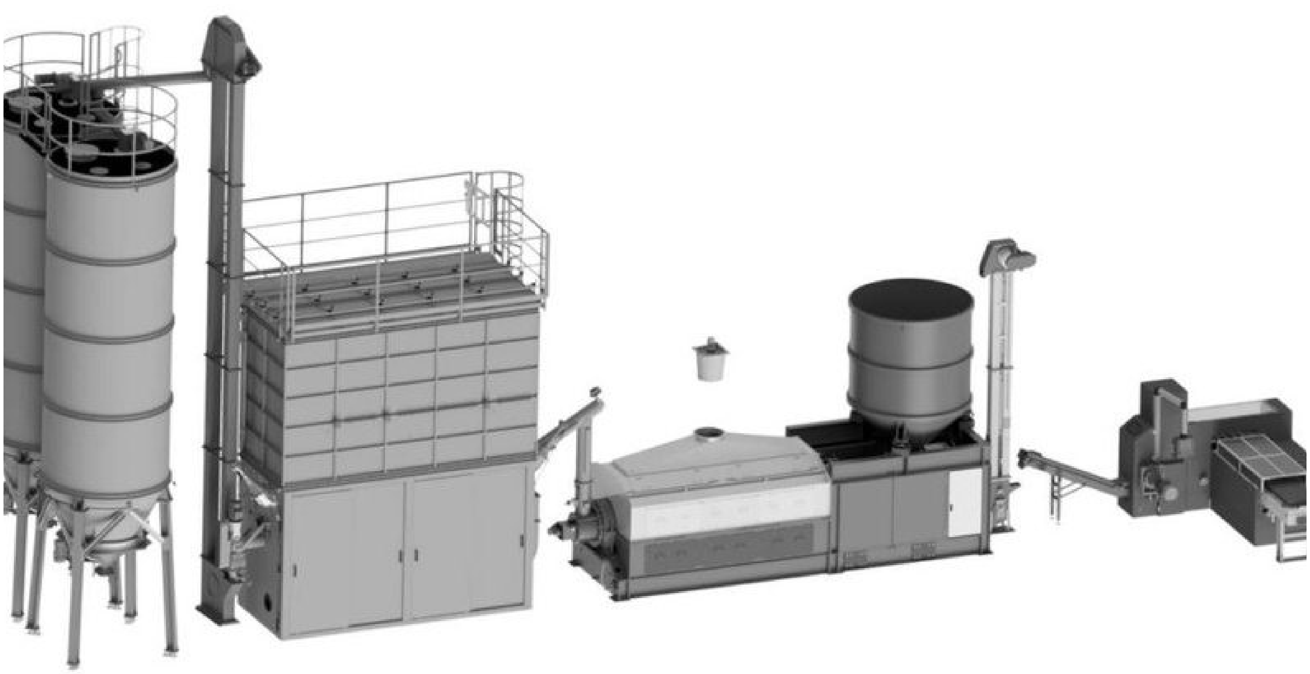
To optimize the process, all the surfaces of the pieces inside the drum must be exposed between them so that they can be rubbed entirely. As a result, the most suitable shape is a sphere. This is achieved by loading the drum with equilateral cylinders or cubes.

The physical form of the oxide, given the production on surfaces, will be of the lamellar type and, consequently, of maximum surface per unit of volume. Its responsiveness will be very high.



This differentiates the abrasion method from the Barton one, in which the oxide is produced via the dispersion of micro drops that are then turned into micro-spheres with a minimal surface compared to the volume. In this case, the responsiveness is very low.

The mill will be controlled by managing the process temperature, the amount of material inside, the airflow passing through it, and the rotation speed. The machine will provide a lead powder oxidised at 70-75%, therefore containing a quantity of metallic lead in micrometric dimensions equal to 30-25%. At this stage, the airflow passing through the drum removes and transports the oxide powder, conveying it into the powder separation filter to detach it from the air.



Filter

The filter is necessary to separate the lead oxide powders from the air transporting it. It consists of two or three sections and operates at about 120°C to avoid triggering the oxidation of the lead left free during the production stage. The operation of this component is characterized by high mechanical stress caused by the extensive washing action of the sleeves.

The filter consists of two filtration sections. The first consists of needle-punched felt sleeves whose clogging is controlled by a pneumatic counter-washing system that performs 99% of the filtering action. The filtered air is further processed by glass fiber cardboard packs that guarantee a reduction of 99.999% of the material (absolute filtration). The data suitable for driving the entire filter system are retrieved from this system. A mechanical unloading system will transport the oxide collected in the filter hopper to the subsequent conveyors that take it to the storage system.

Oxide Storage Silo

The storage plant to contain the oxide consists of a variable set of silos equipped with a weighing system for checking the filling state of the machine and an inlet/outlet air device. These two systems are supported by a vibrating bottom to make it easier for the oxide to come out. The resulting oxide will need two days to balance the oxidation level of the material contained in it. Later, it can be used to prepare the active material for the batteries.

Reference

Batteries Step by Step: The Lead-Acid Battery
SOVEMA: Equipment for Lead Acid Batteries.