White Paper

Lead-Acid Batteries

Comparison between Flat and Tubular Positive Plates

Introduction

The lead-acid battery was originated in 1859 by French physicist Gaston Planté and is the earliest type of rechargeable battery. There are two categories of Lead-acid batteries: Flat plate and Tubular plate. The flat plate battery life is under balance to the tubular battery as the shedding of active material is low in tubular batteries. Tubular batteries also have a more capacity to produce and accept current compared to a flat plate battery. The flat plate batteries are usually more resistant to heat. Tubular construction is a more robust technology with various advantages. With advancements such as the use of non-woven gauntlets encasing the positive spine plate, to more advanced manufacturing techniques, tubular batteries provide enhanced performance and improved reliability as compared to flat plate technology.

Description of Tubular Plate

The first tubular plate with woven gauntlet was introduced in 1973. As the name plan, it is a design in Tubular form for the positive plate, and to accumulate more active material as compared to other plate technologies. Raw Material is used for enhanced battery performance. Tubular construction evolves to being woven multi-tube bags made of glass polyester yarn called as gauntlets, followed some years later by non-woven gauntlets and woven polyester gauntlets fixed by the acrylic bar.

TUBULAR PLATE

The design is more complex and the manufacturing process is more involved than for the flat pasted plates. The manufacturing process starts with the production of the spine which is usually a series of parallel lead rods bars. This is usually fabricated from an Antimonial lead alloy. Following the pitch process, a series of parallel porous glass fiber tubes are shaped over the grid spines, these tubes are then filled with a mixture of lead oxide and red lead powder by vibration. Once the tubes are filled, they are sealed by tap a plastic placing onto the ends of the lead grid spines. The following assembly is then “pickled” by streaming in dilute sulfuric acid to convert the lead oxides to lead sulfate. The concluded product comprises of a series of tubes filled with lead sulfate with a center core of lead to carry the current. Compared to the procedure used to build flat pasted plates, this has considerably more steps and is more difficult to control.

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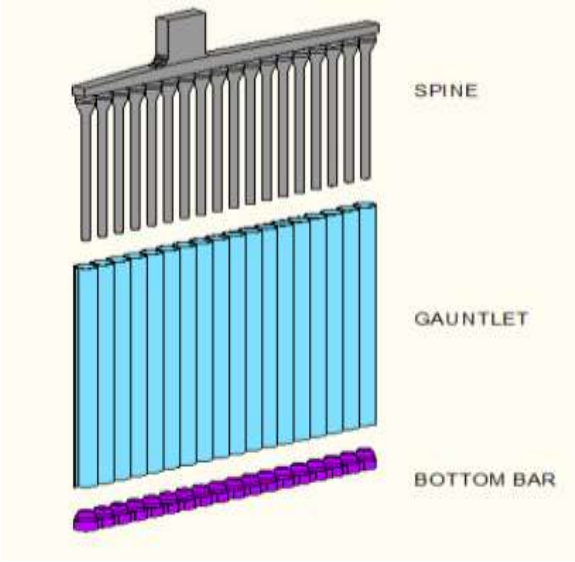

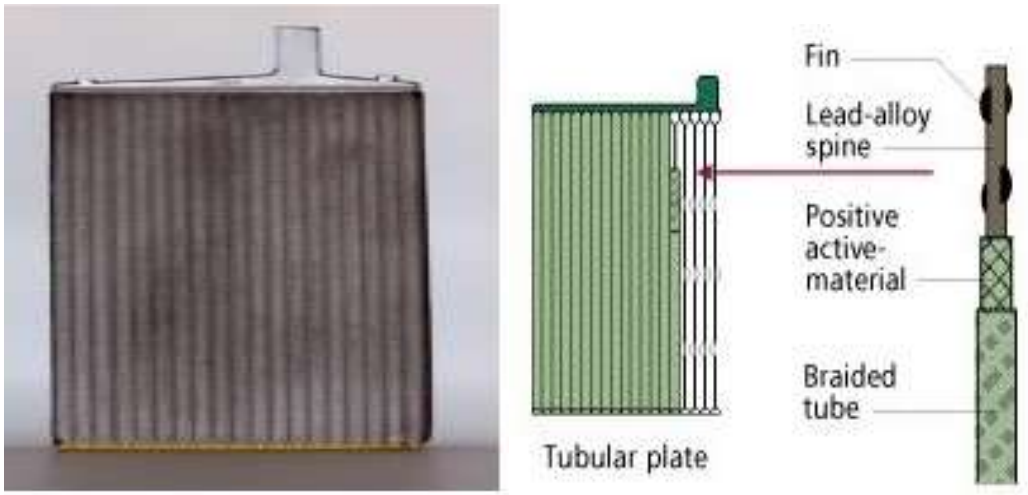

Assembled Tubular Plate

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Key features of Tubular Plate:

- Good electrical performance
- Adequate Life
- Low reserve of lead
- Low reserve of active material
- Sensitive to energetic material shedding which condenses cell life
- Sensitive to top bar breakage with remarkable loss of plate area
- Sensitive to back being off-center of the tube with remarkable loss of plate capacity
- The external shape of the positive plate allows for easier movement for the electrolyte
- Because of the higher relative electrolyte amounts and easier convective heat transport
- Well-defined pore sizes permit easy movement to the electrolyte
- Because there is no electrolyte pollution from reinforcing agents

Gauntlet Characteristics:

- High porosity and low electrical resistance
- Good mechanical resistance and elasticity
- Reduced release speed of antimony
- Semi-rigid stability
- High short-circuit resistance

THE FLAT PASTED PLATE

The manufacturing process begins with a rugged cast grid usually made from a lead alloy containing antimony different composition from a tubular plate. The grating is pasted on an automatic machine with a specially compounded mixture of lead oxide (finely divided lead) water and sulfuric acid. Following the pasting working, the plates are “cured” by a process that converts the active material in the plate to the desired composition and which causes the paste to set to a hard cement-like mass. Plates made this way are extremely irregular and will “ring like a bell” when struck. The plates and cells made in this process are very consistent and have the following characteristics.

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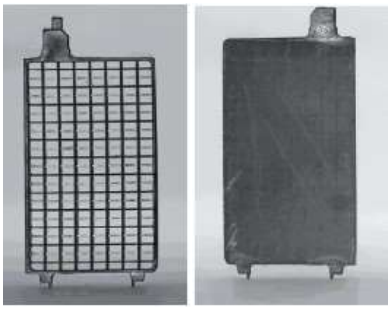
Key features of Flat Plate:

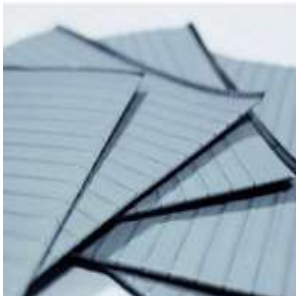
- Good electrical performance
- Long cycle life
- Tough and durable
- The good order of pasted material for long life
- Good reserve of lead for long life
- With their glass cloak, the plate is well saved against life-limiting shedding

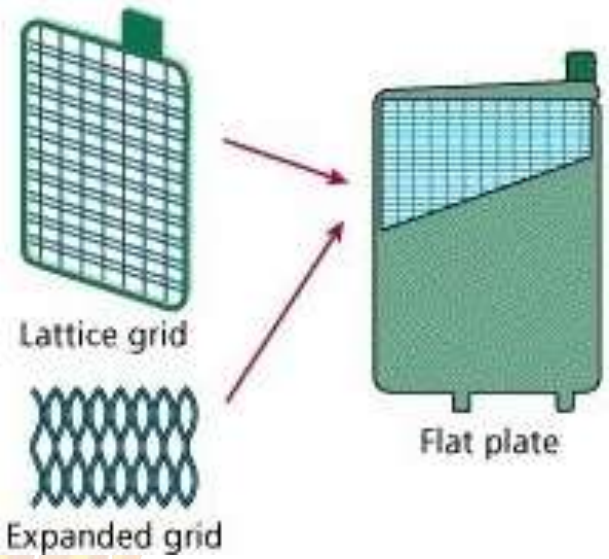


Flat Pasted Plate

Characteristics of PE Separator:

- Eliminates chances of shorting
- High performance even in extreme climatic condition
- Sub-micron pore size eliminates lead growth
- Rough & tough to resist puncture, tear and split
- Technically the best in comparison to other





Grid

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Flat Plate & Tubular Plate Comparison			
	Flat Plate		Tubular
Reliability	Reliable		Most reliable
Charge cycles (at 80% DOD)	50–1000		1100–1800
Electrolyte stratification risk	Medium		Low
Float current	Medium		Low
Thermal management	Medium		High
Interface surface area	Medium		High
Electrical resistance	Mid-to-Low		Low
Charge retention	Long		Longest

Conclusion

The tubular plate design delivers energy faster, has at least 20% more electrical capacity, and up to a 30% longer service life than a flat plate. The battery world favors tubular positive plate design for Flooded, Gel, and even AGM applications. In addition to the superior performance of tubular plate technology, advanced high-tech filling processes and machines have made the tubular design more efficient and reliable to fabricate, allowing tubular batteries to be manufactured at a competitive cost.

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