Deep Drawing Technology Development for BEV Battery Cases

Masayuki Tsukamoto, Keisuke Wakasugi

Establishing a high-quality, thin-wall pressing method improves battery quality and reduces costs

As interest in environmental issues grows, the shift toward electric vehicles (EVs) is gaining momentum. In response, Aisan has developed manufacturing methods for lithium-ion battery cases for battery electric vehicles (BEVs). While battery cases are usually cylindrical or rectangular, we have successfully developed a rectangular case (01) that is strong, durable, and lightweight to meet the specific needs of our customers' in-vehicle applications. We achieved this by forming a single aluminum alloy sheet into the desired shape using deep drawing press technology (02).

In addition to applying simple deep drawing on sheet metal, the technology used to manufacture rectangular cans requires corner bending processing to form right angles. Furthermore, to ensure strength and durability, each side of the can requires a different sheet metal thickness. In response to rising aluminum prices, it was necessary to create these shapes and ensure a high yield rate (the ratio of finished products to raw materials input) for aluminum.

To address these issues, Aisan introduced the "ironing press method," which utilizes the material's characteristics. Unlike conventional method that gradually deep draw the sheet material in multiple processes (if drawn all at once, it will crack and the desired shape cannot be achieved), our pressing method (03) reduces the number of processes and improves material yield. Furthermore, we pursued the optimal number of processes (03+) by incorporating a process design that suppresses cracking, as well as press tryout and CAE* analysis.

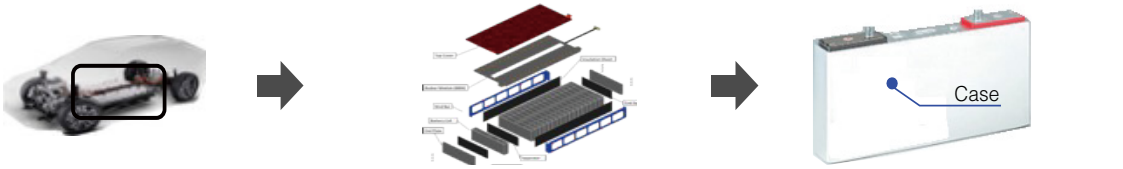
*Computer-aided engineering: design support using computers

Highlights of Achievements

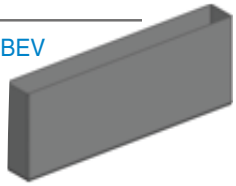
01
Rectangular shape

We have adopted a rectangular shape that offers high strength and durability while remaining lightweight to meet our customers' in-vehicle needs.

Battery pack Battery control　**Battery module** Bundling battery cells　**Battery cells** Charging section



Development model Battery case for BEV



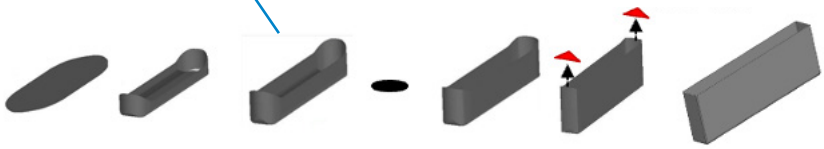
High-strength aluminum deep drawing
W:308, D:40, H:100

<Function and needs>
- Strength and durability: ±10% plate thickness tolerance on each of the five sides
- Cost reduction through thinning and reducing material yield

02
Deep drawing press

A single aluminum alloy sheet is formed into a rectangular shape through deep drawing press.

Offcuts → waste material



High-strength aluminum sheet → Manufacturing through multiple processes (molds) → Rectangular can

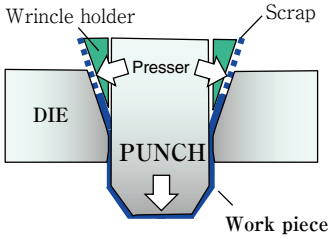
Key points in pursuing MONOZUKURI

◎ Waste reduction:
high material yield (more than 80%)

◎ Reduction in number of processes

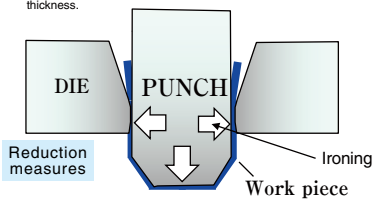
In order to improve material yield

[Conventional: deep drawing while pressing down the workpiece]



[Development: applying ironing force and stretch]

Reducing the gap between the die and punch increases ironing force, which results in a large change in plate thickness.



Less scrap means an improved yield and fewer processes

03
Ironing press method

We have introduced the “ironing press method” among deep drawing press methods that utilize the fact that the elongation rate of materials increases when they are stretched while compressive force is applied in the direction of the high plate thickness. Unlike conventional methods that deep draw the plate material gradually in multiple processes (if drawn all at once, it will crack and the desired shape cannot be achieved), this method has reduced the number of processes and improved material yield.

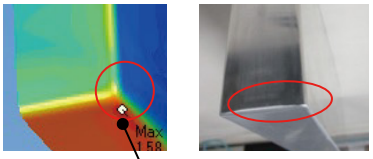
03+
Pursuing the optimal number of processes

We determined the optimal number of processes by incorporating a process design that suppressed cracking, as well as press tryout and CAE analysis.

Cracking

Reducing the number of processes too much (i.e., increasing the amount of deformation per process) can cause cracking

Reduced stress concentration at corners



After improvement

Identified stresses that do not cause cracking through CAE analysis

Successfully determined the process (mold) that suppresses cracking.

Results (Problem Solving)

- Contributed to increasing battery capacity and reducing costs (expected cost reduction of 5%).
- Saved energy through reduction in the number of processes (expected reduction of 140 tons of CO_2 per year).
- Achieved development that ensures high quality, along with safety and durability.
- Currently promoting initiatives with a view to mass production.

Future Developments

- We are developing a new manufacturing method that will increase battery capacity as well as reduce costs by more than 15%, allowing us to make further improvements.