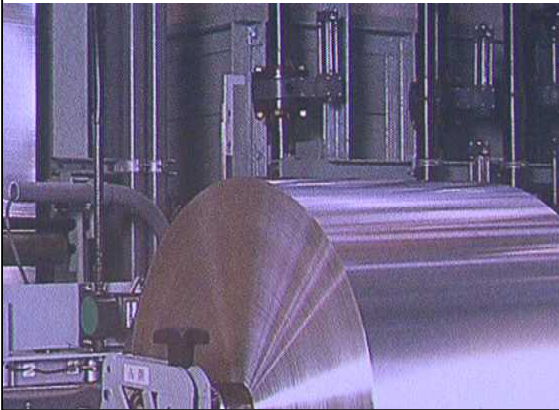


2. MANUFACTURE OF ALUMINUM ELECTROLYTIC CAPACITOR

Raw Aluminum Foil

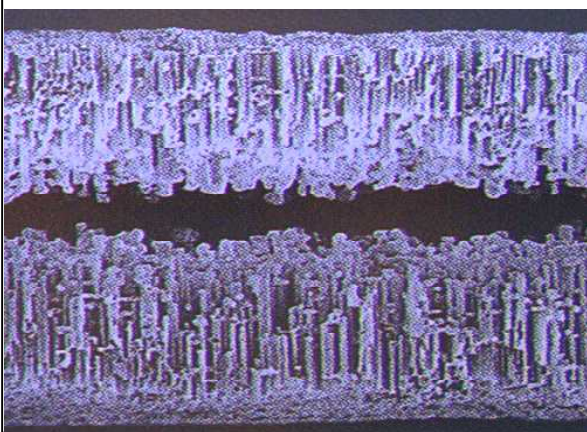


(1) Etching

To obtain higher capacitance, surface area of aluminum foil for electrolytic capacitor increases through etching process.

In etching process, aluminum foil is applied with DC or AC current in a chloride solution to preferentially dissolve the surface. Surface area is increased by 60-150 times for low voltage foils and 10-30 times for high voltage foils.

Etched Aluminum Foil

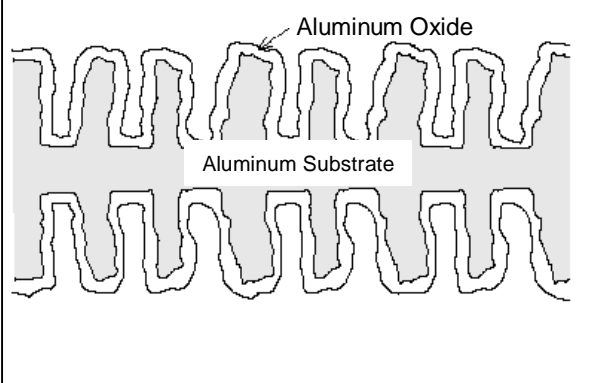


(2) Anodization(Formation of Dielectric Layer)

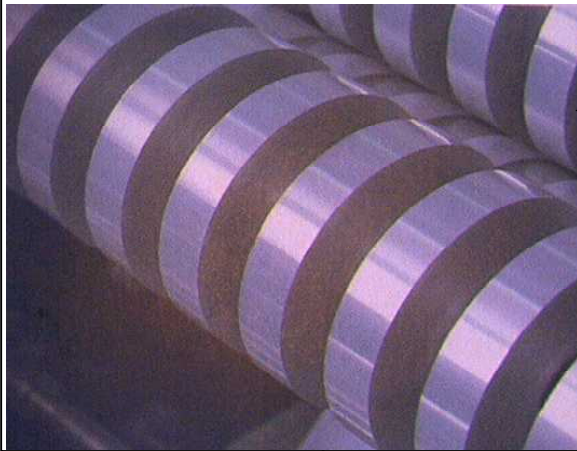
Aluminum foil for electrolytic capacitor is further formed with anodic oxide film (Al_2O_3) on the surface as dielectric layer.

Etched aluminum foil is immersed into a solution including ammonium salt of boric acid or phosphoric acid and applied with DC voltage so that the foil becomes positive and the solution becomes negative. Then aluminum oxide film is formed on the surface in proportion to the applied voltage. The anodic oxide film, having the thickness of 13-15 angstrom/V (1.3-1.5 nm/V), is extremely thin, compact and highly insulating.

Formed Foil



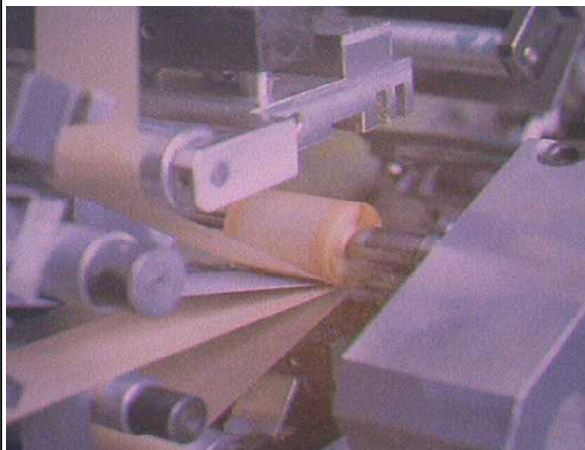
Slitting



(3) Slitting Process

Etching and Forming are processed with wide roll of master foil. Then the master roll is slitted into individual rolls with specified width as per the specification.

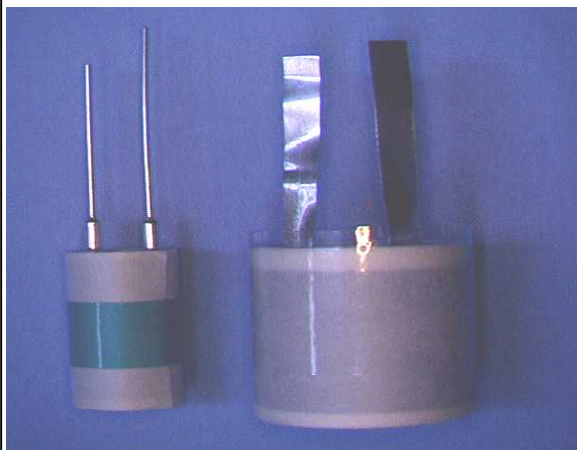
Stitching & Winding



(4) Stitching and Winding

Slit anode and cathode foils after slitting process are stitched with lead tabs and wound into cylindrical element together with spacer paper. Spacer paper is to contain liquid electrolyte that works as real cathode and restores damaged dielectric film, as well as maintaining the distance between anode and cathode foils constant to prevent short circuit.

Wound Element



(5) Impregnation

Wound element is immersed into electrolyte bath under either low air pressure condition or normal pressure to impregnate.

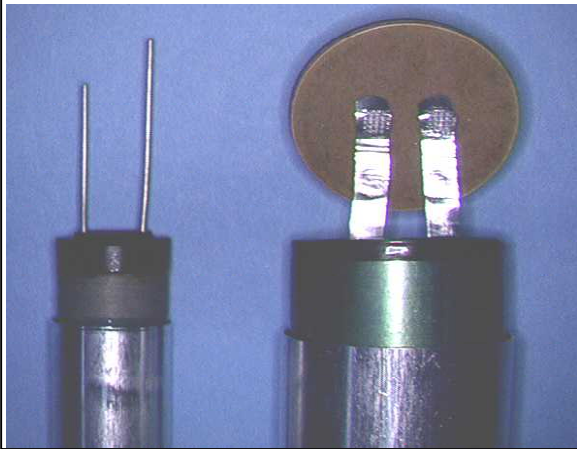
Electrolyte contains one or more polyhydric alcohols such as ethylene glycol as the major solvents and one or more ammonium salts as solutes to restore the damaged oxide film (dielectric) and significantly improve the performance and life of the capacitor.

(6) Assembling

Rubber seal, rubber-lined terminal plate or molded terminal plate is attached to impregnated element.

TECHNICAL NOTES FOR ELECTROLYTIC CAPACITOR

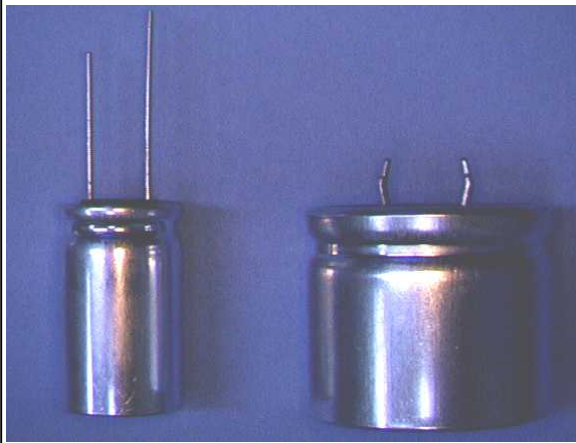
Element



(7) Encapsulation

Capacitor element is put into aluminum case and sealed together with rubber seal or terminal plate. Materials to seal up capacitor are EPT or IIR, which is selected depending on the capacitor series.

After Encapsulation



(8) Sleeve

Sealed capacitor is covered with sleeve made of heat shrinkable PVC or PET.

The purpose of sleeve is to indicate information of the capacitor. When electric insulation of inner element or aluminum case is required, proper materials shall be selected.

(9) Aging (Reforming)

As described above, the oxide film as the dielectric is formed in Anodization (Forming) Process, but aluminum substrate is exposed during slitting process and stitching process. Oxide film layer is possibly damaged or cracked during winding. Restoring oxide film is necessary for capacitor to fully function. In this process, capacitors are applied with DC voltage in high temperature atmosphere to repair damaged oxide film.

Aging makes leakage current of capacitor stable and also debugs initial failure.

Complete Product



(10) Process Inspection & Packaging

Capacitors finished with aging are packaged through electrical screening and appearance inspection.

(11) Outgoing Inspection

Outgoing inspection is conducted based on our own sampling plan and criteria.