Wet Tantalum Capacitor Development – Past, Present, Future

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Today, tantalum capacitors are used in a multitude of applications, including consumer, industrial, telecom, automotive, avionics, space, and medical. The majority of these devices are based on a solid electrolyte cathode system, and there have been many technological advancements that have enabled smaller sizes, increased capacitance, and lower ESR. Due to the relatively large market size and multiple suppliers, device improvements and new products are regularly introduced to customers worldwide.

However, with a smaller and somewhat specialized market, the wet electrolyte tantalum capacitor often does not get the same attention. Yet over the years, there have also been many changes in wet tantalum capacitor technology. Recent advancements have been made in both electrical and environmental performance, as well as mechanical form factor, to address new needs in ongoing applications, as well new applications in new markets. In this presentation, I will review the advantages of wet tantalum capacitors, as well as their applications and new technological developments.

The first tantalum capacitors were developed and introduced in 1955. They consisted of a rolled tantalum foil, with a wet electrolyte system, in an axial leaded non-hermetic silver case. As with all tantalum capacitors, the base positive electrode was a pure tantalum anode. The wet tantalum design is in reality two capacitors in series. The internal anode and the case-cathode are separated by the liquid electrolyte. The negative case-cathode includes the case as well as an internal cathode, which can be comprised of many materials.

Wet tantalum capacitors have several advantages over solid tantalum, aluminum electrolytic, and ceramic devices. As with all other capacitors, these advantages lead to a very specific “sweet spot,” or focused area of application, where the wet tantalum capacitor is the best and preferred choice.

As applications required longer life, the hermetic silver case was developed and an established reliability MIL specification was initiated. With the advance of space exploration programs, the all-tantalum wet tantalum case was developed to insure long life, high vibration, and a reverse voltage capability. This technology was a breakthrough for many avionics, military, and space applications. It also allowed for the introduction of a high temperature, +200 °C, wet tantalum capacitor, which became the standard for the oil exploration industry.

Developments in case cathode technology led to higher capacitance values, as well as new case configurations, including large hybrid high energy capacitors, and a small surface-mount design.

The large hybrid cathode high energy wet tantalums reach capacitance values of over 72 000 μF and are used in energy hold-up and pulse power applications. Very specialized designs are used in medical implantable ICD applications. At the same time, advances in packaging technology led to the first surface-mount wet tantalum capacitors, which have been recently evaluated and rated as acceptable for space applications.