UPDATE OF SEPARATOR TECHNOLOGY FOR LEAD/ACID BATTERIES

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Introduction

Since the First Asian Battery Conference, Evanite Battery Separator, Inc. has developed two new separator products that are now available commercially. These are both further refinements of products that Evanite has been supplying in large quantities over a number of years.

10-G Plus technology

In the early 1980s, Evanite made available to the automotive battery industry the first all-glass-fibre leaf separator which was marketed under the 10-G™ brand name. This separator provides significant improvement in battery performance when compared with cellulose fibre or polyvinyl chloride (PVC) separators. The major attributes of Evanite 10-G are: (i) extremely low electrical resistance; (ii) low acid displacement; (iii) extreme chemical cleanliness; (iv) high oxidation resistance.

The low electrical resistance of Evanite 10-G can yield an additional 5 - 10% cold-cranking amperes (CCAs) from a given battery design when compared with an identical battery built with cellulose or PVC separators. This improvement in CCAs is significant and has allowed battery manufacturers to either improve battery performance, or maintain similar battery performance, by reducing the number of plates, thus lowering manufacturing costs — a significant feature in these days of escalating lead costs.

Evanite 10-G separators displace 50% and 67% less acid than cellulose and PVC separators, respectively. This reduction in acid displacement increases the reserve capacity of batteries. If, for example, the separator has dimensions of 133 mm × 148 mm and there are ten separators per cell (or $\sim 2 \times 10^3$ cm^2 of separator), then the acid displacement per cell is 19.55, 39.10 and 58.65 cm^3 for Evanite 10-G, cellulose and PVC separators, respectively. In a cell, each cm^3 of acid at a specific gravity of 1.260 can contribute about 7 s of reserve capacity at 25 A, assuming that the specific gravity is 1.120 at the end of discharge. Thus, in the example given, a glass-fibre separator would yield about 2.3 min more of reserve capacity than a cellulose separator, and about 4.6 min more compared with PVC.

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The use of Evanite 10-G separators has presented a problem for some battery manufacturers. It is less rigid than cellulose or PVC separators and this can have an adverse effect on battery-assembly rates. In fact, the current type is the fourth generation of product and each generation has improved the handling of the separator. These advances have been achieved through the development of improved paper and improved binders. Evanite 10-G Plus is the newest version of the 10-G separator and, as with previous types, it is available in thicknesses from 1.0 to 2.8 mm. The material is reinforced by the inclusion of a phenolic resin in the binder system; this procedure dramatically improves the stiffness of the separator, and thus its handling characteristics during the battery manufacturing process. The major binder continues to be latex; the phenol–formaldehyde resin (the traditional binder for cellulose separators) is present at $< 1\%$ of the total separator weight. 10-G Plus offers identical performance and acid displacement as 10-G. It is the intention of Evanite to phase out 10-G separators in favour of the 10-G Plus variety.

007 Submicro technology

Many manufacturers of automotive batteries utilize enveloped polyethylene separators. For almost a decade, Evanite has marketed Submicro® polyethylene separators, with a backweb of 0.25 mm, to meet this need. These separators offer the benefits of: (i) extremely low electrical resistance; (ii) low acid displacement; (iii) very high resistance to oxidation; (iv) very high resistance to dendrite growth; (v) high corrosive puncture strength. With regard to the two most important criteria, namely, electrical resistance and acid displacement, the Submicro separator is comparable with the 10-G Plus type.

Within the last few years, battery manufacturers have developed new designs in order to improve product performance. These designs have included the concepts of thinner plates and a greater number of plates. Thus, the distance between plates has been decreased which, in turn, has required the development of thinner separator material. In some automotive batteries, separator material is now required with a total thickness, including ribs, of 0.6 mm. Traditional Submicro separator material (with a 0.25 mm backweb) has proved to be successful in thicknesses ranging from 0.75 to 1.3 mm. In order to meet the needs of battery manufacturers for thinner material with the same, or better, performance characteristics, Evanite developed 007 Submicro with a backweb of 0.19 mm (0.0075 in.). Like Ian Fleming's fictional James Bond, the material has been created to handle a tough problem. It has further reduced separator electrical resistance and acid displacement, both very critical in new, high-performance batteries. In order to allow for proper acid flow and gas release, extra ribs have been incorporated at about 7 mm pitch, as opposed to an average pitch of 11.5 mm in the 0.25 mm backweb material. These extra ribs insure that the requisite space will be achieved

between the backweb and the positive plate. The 007 Submicro battery separator is available in widths of 158, 159.5 or 165 mm and with thicknesses ranging from 0.6 to 0.75 mm.

Compared with a Submicro separator having a 0.25 mm backweb, the 007 Submicro separator has ~25% less electrical resistance and displaces ~20% less acid. This can lead to ~5% more CCAs and ~42 s more reserve capacity in a standard battery.

Absorptive glassmat technology

A rapidly growing technology is that of sealed lead/acid batteries. Since 1983, Evanite has offered to the manufacturers of such batteries an absorptive glassmat separator material, marketed under the brand name: AGM. The material is a very pure, binderless, non-compressed paper and is produced from very fine glass microfibres that are manufactured at a sister company, Evanite Glass Fiber, Inc. The major attributes of AGM are: (i) high acid absorption; (ii) very low electrical resistance; (iii) good recombination of hydrogen and oxygen into water within a sealed cell by allowing diffusion of oxygen to the negative plate; (iv) extreme chemical cleanliness.

The high surface area of AGM and the very high volume porosity (90 - 95%) allow AGM to absorb electrolyte and provide conductivity between the positive and negative plates, while permitting oxygen diffusion and thus recombination. The recombination feature enables the battery to be completely sealed, and this prevents any possibility of acid leakage. The batteries may be placed in virtually any position without any danger of spillage.

AGM is available in several basic weights, ranging from 85 to 365 g m^{-2} and in thicknesses from 0.5 to 3.0 mm (measured at 4.6 kPa). The separator material is being used extensively in batteries designed for uninterruptible power supplies, standby power, and other similar applications where low maintenance, good high-rate discharge, and spill-free batteries are required. The safety and recombination features are creating new and innovative uses for batteries which heretofore were not practical.