Technology White Paper

Battery Technology Trends and Maintenance Practices in Heavy Trucking Industry

A major trend in the industry in regards to batteries is the increasing acceptance of AGM battery technology. Trucking fleets are quickly realizing that a well-designed AGM battery can provide a broad array of advantages over flooded technologies such as longer life, more run-time and less maintenance, which all add up to more time on the road and less time in the shop to replace inferior batteries. Slowly but surely, trucking companies are changing their thinking on AGM technology.

Another trend in the market that is gaining traction is the understanding of the "total cost of ownership" when implementing AGM battery technology. While the upfront cost may be slightly higher, trucks using high-quality AGM batteries will spend less time in the shop to replace sub-par batteries. Bottom-line profits are the primary goal for any company, so investing in quality AGM batteries and properly maintaining them equates to more time on the road and less time in the shop for repairs.

This is a maturation process for the industry, but it is slowly moving in the direction of AGM technology.

Educating the Market

The main challenge Trojan is seeing in the industry relates to the question of "quality" of the AGM batteries that are available on the market today. Unfortunately, truck OEMs continue to deliver their trucks with sub-par batteries which is not helping address the quality problem. The good news is that Trojan is changing this thinking and directly addressing the question of battery quality with its OverDrive AGM battery. Based on feedback Trojan is receiving from customers, Trojan's OverDrive AGM battery is providing the most consistent, reliable performance the trucking market has ever experienced, so minds are beginning to change and the industry is looking more favorably on AGM battery technology.

The other challenge Trojan runs into is in educating the trucking market. AGM is a different than flooded because it uses sealed technology and requires different charging parameters. Therefore, educating shop personnel and drivers is a must to ensure AGM batteries reach their optimum life with proper maintenance.

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Increased Use of Onboard and Anti-Idling Technologies Straining Batteries

As onboard technology changes and electrical advances in heavy-duty trucking applications are introduced, it is now more important than ever to select the correct technology to fit a specific trucking application. Both flooded and AGM batteries are used in the trucking industry, however, the latter is becoming the technology of choice to meet the demands of today's heavy trucking vehicles. Flooded batteries are acceptable for applications where batteries are not exhausted by long-term use of advanced electrical operations or onboard vehicles with minimal technology. However, AGM batteries are best for over-the-road trucking applications which typically put more demands on the vehicle's electrical systems.

Added on-board OEM electronics and driver comforts whether DC powered or powered through an inverter, in addition to more advanced satellite technology can quickly drain and destroy traditional flooded batteries. However, AGM batteries are specifically engineered for these increased technological demands, and can withstand the rigorous electrical loads required which flooded technology can't handle.

Procedures fleets (and drivers) Can Implement to Extend Battery Life

The other challenge we run into is in educating the trucking market. Selecting the correct, application specific battery will also translate to longer life. Class 7 and day cab battery applications can be met with a thin plate, high porosity pasted battery. However, over the road, sleeper equipped tractors require thick plates with cast grids as opposed to stamped grids which are pasted with high density, low porosity paste (HDLP).

A battery, regardless of technology, is designed to deliver a finite number of amp hours over its life. The positive plates degrade over time and once positive grid corrosion has fully set in, the battery has reached its end of life. Additionally, the deeper a battery is discharged or cycled, the more amp hours are consumed during that cycle.

Once the right AGM technology is selected, reducing or managing the use of inverters will lower the depth of discharge, thus prolong the life of the battery. Products are available on the market that will disable an inverter at a preset voltage level whereas others will become disabled based on a pre-programmed timer that doesn't reset until completing full charge cycle.

AGM is a different animal because it uses sealed technology and requires different charging parameters, so educating shop personnel, and drivers is a must to ensure batteries reach their optimum life with proper maintenance.

In addition, whenever adding a device that needs connectivity at the batteries, never connect the positive and negative leads of the device to only one battery in the bank. This will cause

discharge imbalance. Always connect the positive battery lead to battery 1 and the negative to battery 4; 4 being furthest from battery 1. This will ensure equal discharge as a battery bank.

Should Fleets Examine and Update Battery Specs and Update To Meet Changing Power Needs?

Battery charging issues are the result of having an alternator that is not the right size to properly charge the high-capacity batteries needed to effectively operate hotel loads, lift gates and electric APU systems. If an alternator does not provide enough power to charge an AGM battery, that battery will prematurely fail. To avoid this, a trucking company must ensure that the alternators used on their trucks are the proper capacity to effectively charge the batteries that power these added loads. Also, trucking companies must ensure that their trucks are outfitted with a battery that has the proper capacity to handle the combined electrical loads of an APU system. This is a simple fix to effectively prolong battery life, but unfortunately is not being done which results in premature battery failure.

Truck OEM's select an alternator based on design and electrical requirements of the vehicle. When other devices are added, the increase in depth of discharge of the starting batteries or additional batteries, charge capacity must be increased. Trojan recommends increasing alternator capacity by 20 amps per battery added in excess of the truck's 4 starting batteries. For example, when adding 1 battery for a medical device such as a CPAP, and the truck has a standard 160 amp alternator, the alternator must be increased to a minimum rating of 180 amps. Or, if an electric APU is being added with an auxiliary bank of 4 batteries, the alternator must be increased by 80 amps, so in the case of a standard alternator capacity of 160 amps, it must be replaced with an alternator with a minimum rating of 240 amps. Finally, for over the road trucks where inverters are being used on a regular basis, Trojan recommends increasing alternator capacity by 20 amps for every 1,000 watts being consumed during a driver's rest period.

The fact that many trucking companies have gone away from long haul to more regional operations, the lengths of haul are shorter, and the truck's alternator is unable to fully recharge the batteries. This forces a truck to come off the road to replace a discharged battery which, in turn, results in lost revenue. The mindset is that these discharged batteries have failed, when in reality, they're simply discharged due to lack of recharge capacity. Many battery manufacturers are strengthening their positions on warrantying discharged batteries.

Spec'ing Long Life or Heavy-Duty Batteries Opposed to "Regular" Batteries

Today's economy is forcing companies to watch their expenses very closely and cut costs where necessary. In the trucking industry, it's important to understand that unless a truck is outfitted with the right-sized alternator to effectively charge the APU battery system, their expenses will continue to increase because of the frequent battery replacements that will continue to occur. By upgrading a truck's alternator and using a high-performance 500-cycle vs. 250-cycle battery, a company will extend the amount of time between battery replacements.

While high-quality batteries may require a slightly larger up-front investment cost, they will pay for themselves in the long run with fewer premature battery failures that require battery replacements. Using lower cycle life batteries may seem a more cost-effective strategy, it actually will cost the trucking company more in the long run due to frequent battery replacements, not to mention the need to pull trucks off the road in order to replace the batteries.

Availability of Power Management Systems to Manage Today's Class 8 Power Requirements

While nothing exists that is available at the OEM level today, several OEMs are working to develop battery management systems. Some users have chosen to install pulse type chargers that claim to de-sulphate batteries. These devices, while charging, will send high current pulses through the battery in an attempt to shed any sulfation that has built up on the positive plates. The challenge is that while the sulphation will in fact detach from the plate, it takes with it positive active material. The loss of this active material translates to reduced battery capacity and advanced deterioration of the positive plate. While these types of devices may offer very short term positive results, they actually contribute to premature battery failure due to the loss of active material.

Impact of Extreme Weather Condition on Battery Life

Owners of heavy duty trucks expect that a battery should be able to handle subzero winter temperatures as well a hot summer temperatures without performance degradation. While AGM technologies perform better in extreme temperatures than flooded technology, it is difficult to engineer batteries that are resistant to both extreme cold and hot weather. Extreme temperatures can accelerate aging and it is unclear how fast batteries will age across a range of temperature conditions. This remains a challenge for battery engineers. Batteries with thicker plates that employ cast grids pasted with high density, low porosity HDPL paste, will delivery greater life, provided they are afforded adequate charging and with managed discharging. The lower the daily depth of discharge, the longer it will take to consume the battery's total amp hours.

By selecting a properly designed AGM battery, a trucking company nor its driver should be affected by a battery's performance in any extreme weather condition, either heat or cold. Heavy-duty trucking batteries must provide consistent, reliable performance. In rigid cold or sweltering heat drivers must rely on a starting battery that can deliver both the cranking power to start and engine as well as power to operate their hotel loads in any extreme environment. Theoretically, a battery that has been charged all day while the truck is driving, will be a warm battery, even if ambient temperatures are subzero.

Common Maintenance Mistakes by Fleets and Drivers

The trucking industry's prevailing mindset has been that if one battery was bad, or even questionable in a set of four, they would just replace the entire set. In addition, diagnosis is too

simplistic and if a handheld tester show too low a CCA, the assumption is that the battery has failed. Further determining this failure is where greater education is needed. If all 4 batteries in a bank show equally low CCA and the truck has a no-start, more likely than not, the batteries are simply discharged, or have been undercharged. Again, with battery manufacturers better managing warrantable failures, autopsies of batteries will tell the story of the battery's life and its failure mode.

By understanding how to identify a battery that has truly failed; i.e. suffered a manufacturing defect limiting a single battery's performance; in a set enables maintenance crews to simply replace the battery that is near end-of-life. In another instance, the problem may not be a failed battery at all, but rather an issue of under- or over-charging the batteries. These are things the maintenance crews must be aware of to ensure the best course of action when evaluating an AGM battery's performance. For example, assume 4 one-year-old batteries with a CCA rating of 730 are tested with a Midtronics or equivalent tester. 3 batteries read 700 CCA and 1 battery reads 300 CCA, then clearly, there is some sort of defect that has caused the 1 battery to read low. Conversely, if the same 4 one-year-old batteries are tested and all read 300 CCA, then the batteries are discharged or have not adequately been recharged.

Changing Current Battery Specifications or Brand – Is it Beneficial

Maintenance free AGM batteries offer the easiest solution. Because they are sealed batteries, there is no need to add water to maintain battery life as there is with flooded batteries. Though they may have a higher upfront cost, AGM batteries offer the lowest total cost of ownership over the life of a commercial truck. If a battery is not lasting a minimum of 2 years in an over-the-road truck with managed inverter practices, then the wrong technology is being used. In such cases, fleets need to consider cast, thick plate, HDLP pasted AGM technology.

Signs When a Battery is Nearing End of Life

Trucking fleets are quickly realizing that a well-designed AGM battery can provide a broad array of advantages over flooded technologies, including longer life, more run-time and less maintenance. These advantages add up to more time on the road and less time in the shop to replace inferior batteries. While today's economy is forcing companies to watch their expenses closely and cut costs where necessary, the industry is quickly realizing the "total cost of ownership" benefits of AGM battery technology. Implementing battery testing during preventative maintenance cycles allows the fleet to monitor battery health. When the batteries fail to equally test at 60% of their rated capacity and the battery is beyond 2 years old, then the battery is nearing end of life. Battery Council International (BCI) determines that a battery has reached end of life when it fails to delivery 50% of its rated capacity.