Feature Article

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80V Electric Lifts – Smaller Carbon Footprint, Improved Performance and Lower Costs

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80V electric lift-trucks have been in service in a variety of industries around the world for many years. These trucks have more recently replaced many higher load capacity, internal combustion I.C. engine powered units operating exclusively indoors. The advantage is obvious in terms of the ecological benefit derived from running zero-emissions equipment indoors, but there is much, much more to talk about beyond this important fact.

Here in N. America there's a buzz in the air. For the first time many lift-truck users are taking a serious look at upgrading their existing electric truck fleets to higher voltage designs or even more interesting, converting their primarily LP fueled truck fleets to high-voltage powered electrics. There are additional reasons for this interest including:

- Potential cost-savings accrued the user over the life-time of the equipment.
- Longer life-cycles for electric powered trucks in comparison to I.C. models.
- Performance specifications matching and exceeding those commonly found on today's I.C. engine truck designs.

Even though electrics are more expensive in terms of acquisition cost for truck, battery and charger, this cost typically only represents approx. 10%-15% of the total funds spent on the equipment during its service life. Far greater expenses are represented by the fixed costs associated with the use of the truck[s] such as operator wages, benefits, insurance and especially variable costs such as equipment maintenance, fuel, down-time and the cost of rental equipment required when trucks are out of service for repairs.

With fossil-fuel prices spiking to record highs on an almost daily basis it is easy to understand why electric trucks are generating such interest. Simple math quickly puts into perspective the tremendous fuel savings accrued by a typical 5000 lb. capacity electric powered truck in comparison to its L.P. liquid propane fueled counterpart. Based on a simple single shift environment totaling 2000 operating hours/year we can point to the following fuel-cost calculation.

- 8 hours/day x 250 days/year = 2000 operating hours/year.
- 35 KWH of electricity consumed per shift @ .10 cents per KWH = $3.50 per shift.
- 33 lbs./8.0 gallons of LP fuel consumed per shift @ $3.25 per gallon = $26.00 per shift.

This represents savings of $22.50 per shift in favor of the electric truck. Operating just one electric powered unit for a period of one year would generate fuel savings of $5625.00 vs. the L.P. engine truck calculated at today's fuel prices. If we include a fuel cost inflation factor of just 10% per year over five years for both trucks the math reveals a total fuel cost of $5292.50 for the electric truck over the five years compared to $39,680 for the L.P. powered machine. This represents a $34,387.50 savings in favor of the electric truck. The impact in terms of fuel cost savings for fleet users is staggering. It's a simple proposition. The more trucks you use and the more hours you run them the greater the fuel cost savings with electrics.

The first electric powered lift trucks pre-date I.C. engine models. Here in the USA, where the first ever lift trucks were designed and built, electric truck designs first appeared during World War I. At this time the War Department approached the manufacturers of electric automobiles and electric motors such as the Baker Rau-Lang Company as well as Elwell Parker, both of Cleveland Ohio, and asked them to apply their proprietary technologies to design and build mobile electric powered shell-handling cranes. These trucks were used in munitions depots on the East Coast, transporting large caliber artillery shells destined for Europe (see image at left).

Electric powered counterbalanced trucks soon followed with the common industrial voltage ultimately being established as 36V. Between 1920 and 1960 electric powered lift trucks of all types became common fixtures in thousands upon thousands of factories and warehouses from coast-to-coast in the USA and Canada. In the early 1960's the first 48V counterbalanced trucks appeared in combination with higher levels of electronic controller technology such as the GE EV-100 SCR control system. This was due in large part to market demand for faster more productive types of electric trucks, capable of increased product throughput in a rapidly expanding economy while ever larger and larger product distribution centers were being established, especially in the grocery industry. To this day 36/48V power represents the standard for all counterbalanced electric lift trucks designed and built in North America.

In Europe established electric truck voltages are 24/48/80/96/120V. Almost all counterbalanced trucks with capacities exceeding 4500 lb., approx. 2.0 metric tons, are designed as 80V or 96V machines. Higher voltage design pays great dividends in terms of reducing heat while increasing truck efficiency. This is illustrated by referring to Joule's Law, named after the English physicist James Joule (1818-1889). In resistive circuits, electric power is calculated using Joule's Law. (cont'd)

P = I x V where…

1. P = The amount of work done by an electric current or electric power measured in watts.
2. I = The flow of an electric current or current measured in amperes.
3. V = The difference of electrical potential between two points of an electronic circuit or electric charge measured in volts.

Whenever system amperage can be reduced by increasing system voltage, the result is a more powerful, more efficient and cooler operating lift truck. Electric utilities have used this principle for years taking advantage of high-voltage, low amperage power transmission lines to bring electricity over great distances to substations. Step-down voltage converters then generate commercial, industrial and residential power at common voltages such as 110/220V.

Today's modern 80V units utilizing 3-phase AC motors with lifting/carrying capacities from 5,000 to 10,000 lb. / 2.5 to 4.5 metric tons and beyond are rapidly establishing new standards for performance, reliability, durability and energy efficiency. However it has only been recently that this advanced technology has made a mark in North America. Old habits die hard and established standards persist even though resistance to new and highly beneficial technology has often resulted in the demise of entire industries. For many years it has been quite common for I.C. engine lift truck users to attempt conversion to electric powered units. A higher voltage electric truck alternative now makes such a conversion quite attractive.

In the past many conversion attempts designed to capture the best of both worlds in terms of utilizing zero-emission vehicles along with the performance of I.C. truck technology failed due to limited battery capacity, marginal performance and unacceptable truck shift-life. These symptoms can often be traced directly back to the truck and battery voltage utilized. Lower voltage designs must rely on higher amperage in order to generate the electric power required. It all goes back to Joule's Law. Higher amp draw through the truck wiring, controllers and electric motors, as well as through the battery will produce higher operating temperatures. Especially in low battery voltage conditions these operating temperatures can quickly become excessive leading to automatic thermal performance cutback, component overheating and worse. The higher amp-draws typically generated by 36/48V trucks require larger controllers, motors and conductor cable diameters all requiring more copper for

heat dissipation. In addition larger heat-sink plates must be installed in order to quickly draw heat away from key electrical components. Excessive heat build-up in key components has historically led to the failure of many an attempt to replace I.C. engine trucks with electrics. Today's modern 80V electric lift truck technology now offers a clear solution to this problem along with a very attractive package of incentives to make the conversion:

- ***Higher voltage designs offer additional advantages.*** These are critical to making them more suitable to replace existing I.C. engine powered trucks in many applications.
- ***Very high KWH capacity battery compartments.*** KWH capacity is the key to realizing longer shift life, as KWH capacity can be equated to fuel tank capacity in engine powered trucks.
- **Superior performance** in terms of travel and lifting speeds as well as excellent grade performance where truck are required to regularly negotiate ramps.
- ***Total indoor-outdoor application flexibility.*** These designs are equally at home inside and outside in all weather conditions. Many of these trucks are fitted with operator cabs for exclusive outdoor use.
- ***Pneumatic or SE (Super-elastic) tire specifications.*** These tires allow the trucks to operate in a wide variety of environments while at the same time reducing impact shock and the effects of poor surface conditions on the truck, battery and operator.
- ***Superior heat management.*** Truck components such as motors, controllers and conductors are all built to much more compact specifications and utilize counterweight mass to dissipate accumulated heat. In addition the truck battery benefits as well from higher voltage/lower amp draw technology.

In terms of specific advantages compared to I.C. engine powered equipment the following can be cited:

- **Zero emissions**.
- **Longer truck life**. Electric trucks typically outlive I.C. engine powered units by up to 6000 operating hours and beyond.
- **Reduced maintenance expense**. Electric trucks typically incorporate 1/3 fewer components than I.C. engine powered units. Electric braking further reduces maintenance expenses by limiting the use of friction brakes.
- **Dramatically reduced fuel consumption** and expenses as outlined previously.
- **Superior ergonomic platform for operators.**

Short of load bulldozing, contemporary 80V truck technology is quite capable of replacing engine powered equipment in a broad spectrum of applications. Advances in battery charger design and technology are also contributing to the increased interest in these trucks. Opportunity chargers, designed to charge truck batteries at break time over the course of a normal shift, are helping to further extend electric truck shift life even in multi-shift

environments. Once again, the newer opportunity and fast-charge technologies which are currently widely applied in the industrial truck market are best suited for use with higher voltage trucks. By nature battery charging tends to generate heat and higher voltage trucks and batteries are less susceptible to heat issues. This is mainly due to the fact that they experience lower levels of amperage rise as battery voltage drops during the typical work cycle. The normal drop in battery voltage inevitably leads to increased amp draws through the electrical system as the truck attempts to compensate in order to maintain established performance specifications. Such amperage rise and the increased heat associated with it, is limited in higher voltage trucks.

Since typical 80V truck designs incorporate chassis dimension footprints very similar to those of pneumatic/SE tire engine powered trucks they also share some major components. Masts, fork-carriages and steering axles used by typical I.C. engine powered “yard trucks” are also found on these electrics trucks. Such assemblies are designed to withstand greater stress and torsion forces than similar components used on “indoor only” equipment. As a result truck reliability and durability are not adversely affected but rather enhanced under all operating conditions.

In today’s highly competitive and cost driven global economy, users of counterbalanced lift trucks should take the time to investigate the advantages associated with conversion to higher voltage electric truck technology. Cost of ownership and cost justification spreadsheet programs, offered by several lift truck manufacturers document an especially compelling case for making the switch from I.C. engine powered units to 80V electrics. Recent developments in the oil markets further serve to reinforce this approach. In terms of total economic, ergonomic, and ecologic impact, these trucks are very rapidly establishing a new standard of excellence.

Linde 80V forklifts can be found in Maryland at Matthai Material Handling. Matthai is a full-service Linde dealership that services and provides parts for all makes and model forklifts, and provides 24 hour emergency service.