

# LiTHIUM BALANCE

## BATTERY MANAGEMENT SYSTEMS

Case Study

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### **LiTHIUM BALANCE's lithium ion Battery Solution for Toyota Material Handling Applications**

Toyota BT have trialled a battery driven reach truck capable of around-the-clock operation in a cold-store (-25°C). No battery maintenance or swapping was needed. The state-of-the-art lithium ion battery solution was developed and supplied by LiTHIUM BALANCE.

#### **Introduction**

Toyota Material Handling Europe (TMHE), the global leader in material handling solutions, presented their newest product range and services at CeMAT 2011. Among these was the lithium ion powered BT Reach Truck for use in cold stores.

The state-of-the-art lithium ion battery solution was supplied by LiTHIUM BALANCE. The lithium ion battery solution provides cost and energy savings, extended operation and improved performance.

Cold store is by far the most demanding sector of the supply chain as both operators and machines face extremely cold temperatures. TMHE is a major supplier to the European "cold chain", supplying some of the largest cold store distribution companies. One of these companies is SuperGros (SG), the largest wholesaler in the Danish, grocery retail, market, supplying everyday goods to a the large proportion of the Danish, foodware retailers.

SG has a total turnover of approx. EUR 2,3 billion/year and currently employs 1150 employees.

SG has a large inventory of counterbalanced trucks, stackers, reach trucks, order picking trucks and other types of materials handling vehicles. Their focus is efficiency and cost of operations. The low temperatures have a negative effect on truck performance as Lead/Acid (L/A) batteries have reduced performance at low temperatures. The batteries have to be changed frequently and the cost of maintenance is high.

Significant investment is bound up in the replacement battery packs including: personnel, servicing equipment and extra battery packs. Switching to lithium ion was meant to address these issues and improve operational efficiency.



#### **Huge benefit to the Customer**

Sune Kristiansen, "Logistic & Operations Manager" at SuperGros, is a happy man. The new lithium ion battery technology is revolutionising his distribution centre's efforts to optimise operations and reduce costs.

*"There is no doubt in my mind, the economical benefits are huge. With lithium, only for the battery change (i.e. the absence of it), we are saving 36 minutes per truck per day (6 changes of 6 minutes). Moreover, we do not need to purchase replacement battery packs. In this way we can save extra 50% on the initial battery investment."*

The significantly longer cycle life of a lithium ion battery pack allows for even more savings. Li-ion can outlive the L/A battery by 3-5 times. Every reach truck is equipped with 2 L/A packs - one in operation the other at charging. Considering that Li-ion pack can deliver 3-5 more cycles than an L/A, a single lithium ion pack delivers energy corresponding to multiple L/A packs during its long life. This, multiplied by the total number of trucks in a huge distribution centre like SuperGros makes the potential savings very impressive.

The list of benefits does not stop here. Shah Mahmood Mirzad is an experienced truck operator at SuperGros, selected to be the test driver of the Toyota BT lithium ion truck.

*"What I like about it is the ease of use.",* says Mahmood. *"I do not need to change battery, which takes lots of pressure off my shoulders. With the new battery – when fully charged – I can drive almost 9 hours, whereas with the L/A the range was between 4-5h. We also introduced the routine to opportunity charge the battery during breaks and now we are able to operate the machine non-stop", (i.e. for 3 shifts).* In terms of measurable benefits, Mahmood highlights improved operational performance through reduced downtime for battery changes and maintenance and saving the cost of a second battery pack.

*"Companies are looking to reduce costs and find flexible solutions for their business. Environmental concerns are also a key factor. Delivering cold store solutions that minimise the impact on the environment is one of our major objectives"*

*Jonas Tornerfelt, VP Product Planning, Toyota  
Material Handling Europe  
Supply Chain Exec (TMHE magazine, Jan 09)*

Jakob Arvidson from TMHE Product Management and Innovation sees great promise for the new battery technology. *"We constantly look for possibilities to increase productivity of our machines. To do that, we must apply new batteries. Therefore, we are currently testing lithium ion in a cold store facility in Denmark. The cold store is the heaviest application for us."* According to Jakob, the current experience with the lithium truck in Denmark shows that Toyota can increase the productivity of their machines significantly while preserving constant performance throughout the whole shift. Another important benefit is the energy savings. *"With lithium solution we can reduce energy costs by 20% which is also good news for the environment."*

### The Solution

The objective of the lithium ion cold store initiative; was to design a battery pack for a Toyota BT Reach Truck that would allow multi shift operation and avoid battery changes. The overall objective was to realize cost savings related to operations, reduce battery cost (no maintenance, no replacement packs), and to optimize the fleet usage (one-pack-per-truck policy, opportunity charging possible).



The designed solution was based on the s-BMS *Battery Management System* from LiTHIUM BALANCE as the reach truck's battery interface. One of key advantages of the LiTHIUM BALANCE s-BMS is that it is cell-agnostic. In other words, the battery interface allows for full flexibility in terms of choice of lithium ion chemistries, types of cells and battery suppliers. In this way, the battery becomes a commodity. The flexibility gives independence and security to truck manufacturer and to end-customer as they both can choose the best battery solution for their application (i.e. the best technical and economical fit).



**Figure 2 LiTHIUM BALANCE Type 100160**

Considering the longevity and better performance of the lithium ion batteries, it has become possible for the truck manufacturers to supply total solutions, i.e. trucks equipped with a native battery pack.

By doing this, the OEMs have an opportunity increase turnover and revenue.

LiTHIUM BALANCE designed, manufactured and supplied a complete battery pack - the so called Black Box, with a standard battery-truck interface to Toyota Material Handling Europe. The interface is based on *Battery Management System* type 100160 from LiTHIUM BALANCE.



**Figure 1 Toyota BT Reachtruck lithium ion battery mock up with LiTHIUM BALANCE s-BMS included**