A cleaner sweep

Tennant UK, part of the Tennant Company have launched the world's first li ion battery powered street sweeper.

Tennant UK, part of the Tennant Company have recently launched the world's first li Ion battery powered, fully electric, street sweeper under their Green Machines brand. At the heart of this vehicle lies an innovative, dual battery pack with integrated battery management from LiTHIUM BALANCE.
Street sweepers are being used increasingly to keep our streets, pavements and parks clean. Compact and strange looking, these vehicles are sophisticated devices full of technology. Street sweepers work using remotely controlled front mounted brushes that sweep dirt and debris to the front of the vehicle where a vacuum intake sucks the dirt and debris up into a hopper. The debris are sorted out via separation stages and a dust suppression system is also incorporated.

Sweeping cleaner

Tennant UK have always focused on environmentally friendly solutions, starting with their adoption of turbo diesel drivetrains in the late 90s to reduce CO_2 emissions when most of the market was still using less efficient normally aspirated petrol engines.
Program Manager, Vipin Pillai tells the story of how the next generation came about.
"Back in 2005 we found that we were being approached by customers to provide a fully electric sweeper because of emissions, both noise and tailpipe. A street sweeper needs to be a real workhorse running 8 hours a day and there simply wasn't a battery solution with sufficient energy density for the job at that time. In 2008 we decided that suitable Li Ion batteries were finally available and mature enough".
Ivan Loncarevic, LiTHIUM BALANCE's Business Development Manager made contact with Tennant UK at this time and the cooperation was born. Over the course of several visits to the Tennant UK factory in Falkirk Scotland and several visits to LiTHIUM BALANCE in Denmark, the battery solution was evolved. This was followed by an extensive test period to validate performance, safety and reliability.

Figure 1 500ZE in action sweeping a pedestrian zone

Technology

The project aimed at achieving class leading results in all aspects of operation, aiming for an efficient, maneuverable and light weight vehicle, the light weight being of significance when cleaning pedestrian areas without damaging the pavement.
Much focus was put on finding the optimum arrangement for electrification. The ICE powered machines used hydraulic motors for all activities from driving the brushes and vacuum, suction system to driving the vehicle wheels. With the switch to a battery driven system came the opportunity to look for efficiency gains. The drivetrain and the vacuum, suction system were both switched to electric and the brushes and other functions were equipped with an electro hydraulic drive. Lighting was switched to LEDs to further improve efficiency.
The dust control system was designed to operate in three stages with initial dust suppression around the brush heads being achieved using the highly efficient "CloudMaker" water spray system that uses up to 70% less water than other techniques. The dust and debris are then sucked through a cyclone and filter to remove particulates before being put through a final cyclone and exhausted at the rear of the vehicle as clean air. The dirt and debris are held in a 0.75m^3 hopper in the rear of the vehicle.
Precise control is a high priority both for the vehicle as a whole and the ancillaries such as the brushes. This allows safe operation close to pedestrians and in tight spaces. The IQAN data bus is used for chassis and drivetrain control systems providing reliable and precise control. Further to this, the driver is placed in a comfortable air-conditioned cabin with good all round vision.
The final product ended up with a 60kWh battery developed as twin powerpacks capable of being run together or independently with integral battery management from LiTHIUM BALANCE meaning that they can be charged on or off the vehicle, individually. Key to this feature was the innovative "balancing switch" developed by LiTHIUM BALANCE that intelligently balances the power usage between the two packs. Recharge times are 4 hours using a 3-phase outlet.

Awards in Europe and North America
The Tennant Company received the prestigious Ruban d'Honneur in the European Business Awards (2010) for the 500 EZ as well as the Tekne Cleantech award (2010) from the Minnesota High Tech Association (MHTA)

The large battery pack capacity achieved at a safe 72volts meant using high capacity large format Li Ion batteries. The BMS is charged with managing these batteries, providing real-time State of Charge (SoC - remaining energy in the pack) information, ensuring that the batteries are neither over charged or over discharged and operated within their thermal boundaries. With cells of this type, keeping the pack balanced (keeping all series connected cells at the same SoC) is an important challenge which the LiTHIUM BALANCE s-BMS is very good at mastering, maximizing pack capacity.
A 15kW peak traction motor ensures a transit speed of 25km/h.
The practical requirements for this type of vehicle meant achieving IP69 enclosure sealing on various parts of the vehicle and IP 69K for the hopper.

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Conclusions

The benefits of such a vehicle design speak for themselves with the ability to operate outside of normal working hours without disturbing the local residents, the saving of up to 5 tonnes of CO_2 /year in localised emissions (estimated to be the equivalent of taking 40 passenger cars off the road) and financial savings of the order of £2500/year.
With customers having already taken delivery of these Sweepers and running them, Tennant UK can rightly be proud of pioneering this solution and making road sweeping, even cleaner than before. Follow the link
http://www.tennantco.com/company/press-room/2010-news/500ze-electric-sweeper-from-tennant-green-machines for more information.

Working with LiTHIUM BALANCE
"LiTHIUM BALANCE know their technology and are very responsive. These two characteristics make them extremely good to work with".

– Vilpin Pillai Program Manager Tennant UK

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