

TWO DIFFERENT ENERGY STORAGE SYSTEMS IN THE TRACTION ELECTRIC DRIVE OF LIGHT VEHICLE

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One of the advantages of a traction electric drive (ED) compared to internal combustion engines is the possibility of regenerative braking, which reduces energy consumption and increases the range of driving on a single charge in urban driving conditions characterized by frequent accelerations and decelerations. This study examines the feasibility of using electric double-layer capacitor batteries (EDLC) in addition to conventional chemical batteries (CB).

The purpose of this work is to compare the energy effect of regenerative braking using ED with two different configurations as described below and to evaluate energy consumption in various standard urban and mixed driving cycles for light vehicle.

EDLC has a low energy density of 10...20 kJ/kg, which is orders of magnitude lower than the capacity of CB. Therefore, it is necessary to maintain the CB as the primary energy storage. However, EDLC has significantly higher tolerance for overcharging and much lower energy losses, which is a significant advantage over CB. This work explores ED configurations with EDLC and CB without pulse-width modulation converters (PWMC) between them.

At the first configuration (fig. 1 a) EDLC is always connected to the PWMC supplying the electric machine (EM), and CB is connected to EDLC through a diode to prevent CB from charging during regenerative braking. At the second configuration (fig. 2 b) CB and EDLC are connected to the converter through a power switch K depending on the ED's operating mode. For light vehicle computer modeling of seven different standard urban (ECE-15 and Japan 10 Mode Cycle) and mixed (NEDC, CADC, Japan 10-15 Mode Cycle, JC08, and US FTP 72) driving cycles showed:

- regenerative braking with the use of EDLC can reduce energy consumption by 11...23%;
- the use of EDLC can reduce the root mean square current of CB by 3...18%, reducing CB wear and extending its service life;
- the second configuration with switching (fig. 2 b) results in up to 0.4% lower energy consumption, but the root mean square currents of CB and EDLC are less than 2% in the configuration with a diode (fig. 1 a), making this configuration preferable to switching between energy storage systems.

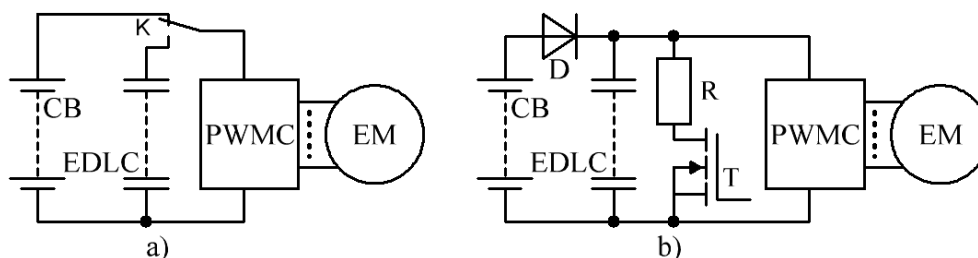


Fig. 1 – The diagrams of CB and EDLC connections in the traction ED

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