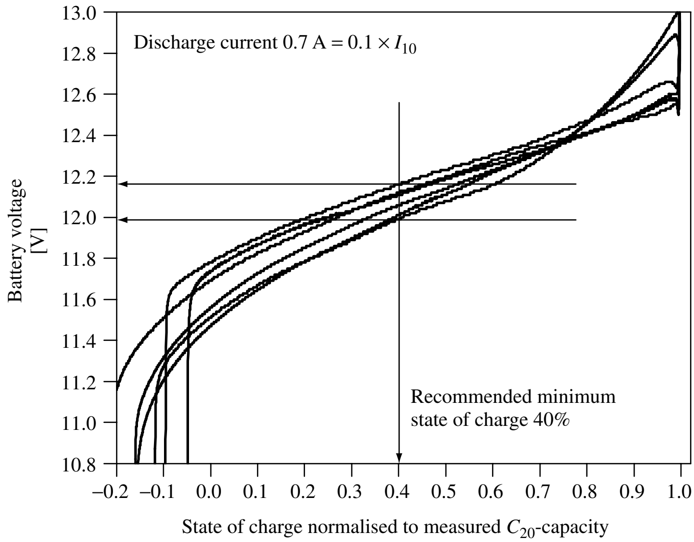

Figure 18.25 Discharge curves of six batteries rated for the same capacity, with the same technology (flat plate, flooded lead acid and all batteries new). The voltage is shown as a function of the state of charge of the batteries. The state of charge is calculated on the basis of the discharge ampere-hour and the nominal (not measured) capacity. Capacity tests were performed with $0.1 \times I_{10}$. The voltage is given for a 12-V block battery made from 6 cells connected in series (a typical design as used for SLI batteries for cars)

in SOC for the same voltage limit could be as high as 25%. Taking into account different battery technologies, the differences in SOC are even higher. In autonomous power supply systems, low and high currents occur (Figure 18.5, [9]).

Two solutions for the problem are available. One is a current-compensated end-of-discharge voltage threshold and the other is the use of state-of-charge determination. The latter solution is the most appropriate for autonomous power supply systems. There are various methods for state-of-charge determination in lead acid batteries, which are appropriate for autonomous power supply systems [26].

18.5 SECONDARY ELECTROCHEMICAL BATTERY SYSTEMS WITH EXTERNAL STORAGE

The secondary batteries described in Section 18.4 use electrodes both as part of the electron-transfer process and to store the energy via electrode solid-state reactions. Consequently, both energy storage capacity and the power rating are intimately related to the electrodes' size and shape.

Electrochemical batteries with external storage overcome this drawback. The reaction occurs within an electrochemical cell and the energy is stored in two tanks separated from the electrochemical cell. The electrochemical cell has two compartments, one for each storage medium, physically separated by an ion-exchange membrane. This allows the designing of the battery power and the energy content separately.