times, the upper part can reach a very high state of charge while the lower part is by far not completely charged. This means, that the lower part of the electrode is cycled in lower states of charge than from the average state of charge of the electrode. Further, the lower part is cycled without a full charge for extended periods.

These findings are confirmed twofold by experimental results. On one hand, it was possible to show experimentally the effect of inhomogeneous current distribution and the state of charge within the electrode as a function of the charge/discharge currents [20]. On the other hand, almost all physicochemical analysis of lead acid batteries from PV systems at the end of their lifetime shows a high degree of sulphation in the lower part of the electrodes [21, 22].

Another problem related to acid stratification in batteries with liquid electrolytes is that a measurement of the acid density, made at the only accessible position above the electrodes, does not give any direct information on the battery's state of charge.

As an example, Figure 18.17 shows the correlation between the acid density above the electrodes in a flooded battery and the battery's state of charge for a battery from a PV system, with a large number of partial cycles.[12] Without acid stratification, a measured acid density of, for example, 1.18 g/cm^3 corresponds to a real state of charge of approximately

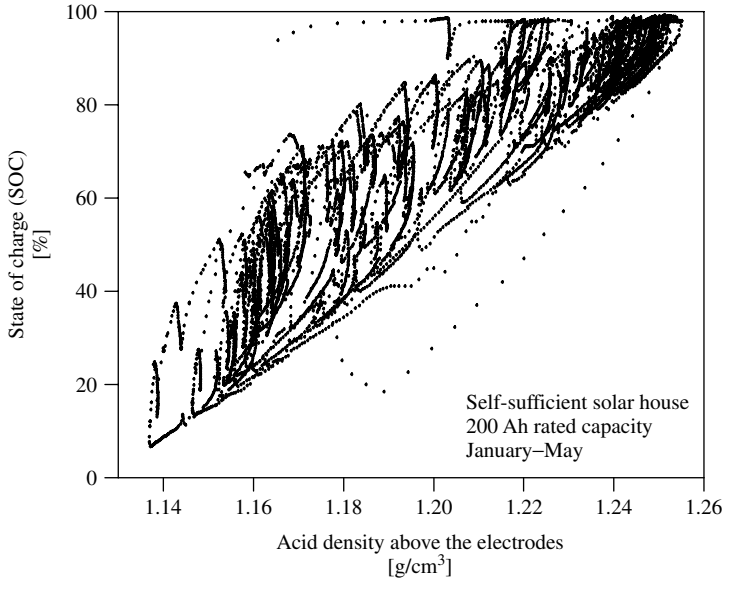

Figure 18.17 Acid density above the electrodes versus the actual state of charge, measured over five months for a battery from a photovoltaic system (200 Ah cells, simulated acid densities based on measured initial data 10-minute average values)

[12] Figure 18.17 is based on a detailed battery model including modelling of the vertical acid-density distribution. The model was verified by measurements in a battery. The model and verification are described in [19]. Therefore, the state of charge and the acid density above the electrode displayed in Figure 18.18 are calculated by the model. The calculations are based on detailed measurements of the battery current, voltage and temperature in the system.