have a bad image due to the cadmium content, which is, known to be environmentally incompatible.

Several different types of NiCd batteries are in the market with differences in the plate technologies and the handling of evolved gases.

The basic reaction is the same for all construction types of NiCd batteries.

$$2NiOOH + 2H_2O + Cd \rightleftarrows 2Ni(OH)_2 + Cd(OH)_2 \quad (18.1)$$

During discharge, trivalent NiOOH is reduced under consumption of water to divalent $Ni(OH)_2$. Metallic cadmium is oxidised to $Cd(OH)_2$. The reversible backward reactions proceed during charging.

The potassium hydroxide electrolyte (KOH) does not undergo a significant change in its concentration or density during charging or discharging. Only water, which is present in high concentrations, participates in the reaction. The electrolyte density is about 1.2 g/cm^3.

NiCd batteries are available with liquid electrolyte and as sealed, maintenance-free types [3].

The rated voltage of NiCd cells is 1.2 V. Although the discharge rate and the temperature significantly affect the discharging behaviour of all electrochemical cells, the effect is noticeably less pronounced in NiCd batteries than in lead acid batteries. As a result, NiCd batteries can be discharged at higher rates, without the accessible capacity falling much below the rated capacity. Even for discharge rates of $5 \times C_5$ a high-performance NiCd battery can supply 60 to 80% of the rated capacity. Also, the influence of the temperature on the capacity is comparatively small which is due to the fact that diffusion processes have less impact on the reaction kinetics compared with lead acid batteries.

High temperatures in the range of 40°C and more should be avoided as the charging efficiency is getting very low and the self-discharge rate is increasing significantly. Self-discharge rates at 20°C are in the range of 20%/month. The energy efficiency is in the range of 60 to 70%, which is significantly less compared to lead acid batteries.

A NiCd battery can withstand occasional deep discharge, inverse charging and also freezing of the cells without direct damage.

NiCd cells have a low internal resistance. Typical values for the DC resistance are between 0.4 and 2 mΩ for a fully charged 100 Ah cell. The internal resistance is largely inversely proportional to the cell size for all cell types. Falling temperatures and a decrease in the SOC increase the internal resistance, but the internal resistance remains essentially constant up to a DOD of 60 to 80%, and only increases significantly at higher DODs. Thus, the internal resistance is not a suitable indicator to determine the state of charge.

Under normal operating conditions, a NiCd battery can reach up to 2000 100% DOD cycles even under severe operating conditions. Depending on the application and the operating conditions, the lifetime can be between 8 and 25 years. Starter batteries for diesel generators reach lifetimes of about 15 years, batteries for train lighting achieve 10 to 15 years and stationary batteries have lifetimes of 15 to 25 years. Good charging