Improved electrodes and gas impurity investigations on alkaline electrolysers

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Motivation
Alkaline water electrolysis for hydrogen production is a well-established technique but some technological issues regarding the coupling of alkaline water electrolysis and Renewable Energy Sources (RES) remain to be improved.

Targets:
• fluctuating power operation
• decrease of system costs
• higher operating pressure
• high efficiency, high current density
• ability to tolerate periods of non-operation

by
• electrodes with low cost coatings
• improved gas purity at low current density with new separator design

Methods and Results
Electrodes

Electrodes were plasma-spray coated with low cost Ni alloy coatings (AlNi and AlNiMo). After activation (Raney-Nickel) high porosity is achieved and electrodes show overpotential reduction of 330 mV overelectrode reduction of 330 mV.

Gas Impurity

Using a new cell concept with double layer separator (e-bypass separator) different flow concepts were tested. The primary purpose of this concept is to reduce the amount of H₂ impurities in O₂ and O₂ impurities in H₂ and at low current density due to diffusion of gases dissolved in KOH. It was found that there are further influences on gas quality by:

• single/double layer separator, permeability
• flows of KOH with microbubbles between gas separators
• quality of gas separators

Further measurements and simulations necessary to understand and improve gas quality even with single separator.

Summary and Conclusions

• Electrodes with Raney-nickel-alloy coatings (low cost material) → overpotential reduction of 330 mV
• Electrodes show excellent stability: 1100 on-off cycles, 98% of initial efficiency retained
• Hydrogen in oxygen impurity reduced by factor of 4 due to e-bypass-separator (double layer separator)
• Cell can be operated at higher pressure and/or lower current density before reaching the limiting gas concentration
• Gas impurity in an electrolyser depends on many more factors than only which type of separator is used
• For further improvement of electrolyzers study of internal problems using current density distribution measurements has been started

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