MEMBRANE ELECTROLYZER FOR HYDROGEN PRODUCTION

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ABSTRACT

The article is concerned with a production of hydrogen and oxygen through by the help of electrolytic process in a device called electrolyzer. The basis of the work is assurance of the best efficiency of this process by testing a variety of materials and surfaces of electrodes, and testing different types of alkalic electrolytes.

1. INTRODUCTION

Hydrogen is at the present time spoken as fuel of the future. Production of hydrogen by the help of electrolytic process is revealing as the most profitable method, because traditional methods of hydrogen production result from elaboration of earthy gas, where rising toxic and greenhouse gases during the reaction. Two laboratory electrolyzers, a big and a small, were proposed for these demands, where all measurings were proceeded. The basis of the work is assurance of the best efficiency of electrolytic process in electrolyzer. We are trying to achieve this, mainly, by testing on a variety of materials for electrodes and by making of new surfaces of electrodes with galvanic metallization. Different types of alkalic electrolytes of a various molarity are also examined.

2. ANALYSIS

At the beginning of the work we will measure which electrolyte will be best for next use in elektrolyzer. We will use solution of KOH, because electrolyzér is designed for alkaline electrolytes. From the graph no. 1 it is apparent that the best electrolyte for use in elektrolyzer is 6 Mol KOH, because with higher molar concentrations of electrolytes is conductivity of electrolytes lower and thereby electrolyzer voltage is also lower. For next measurements with electrolyzer we will use especially higher molarity electrolytes.

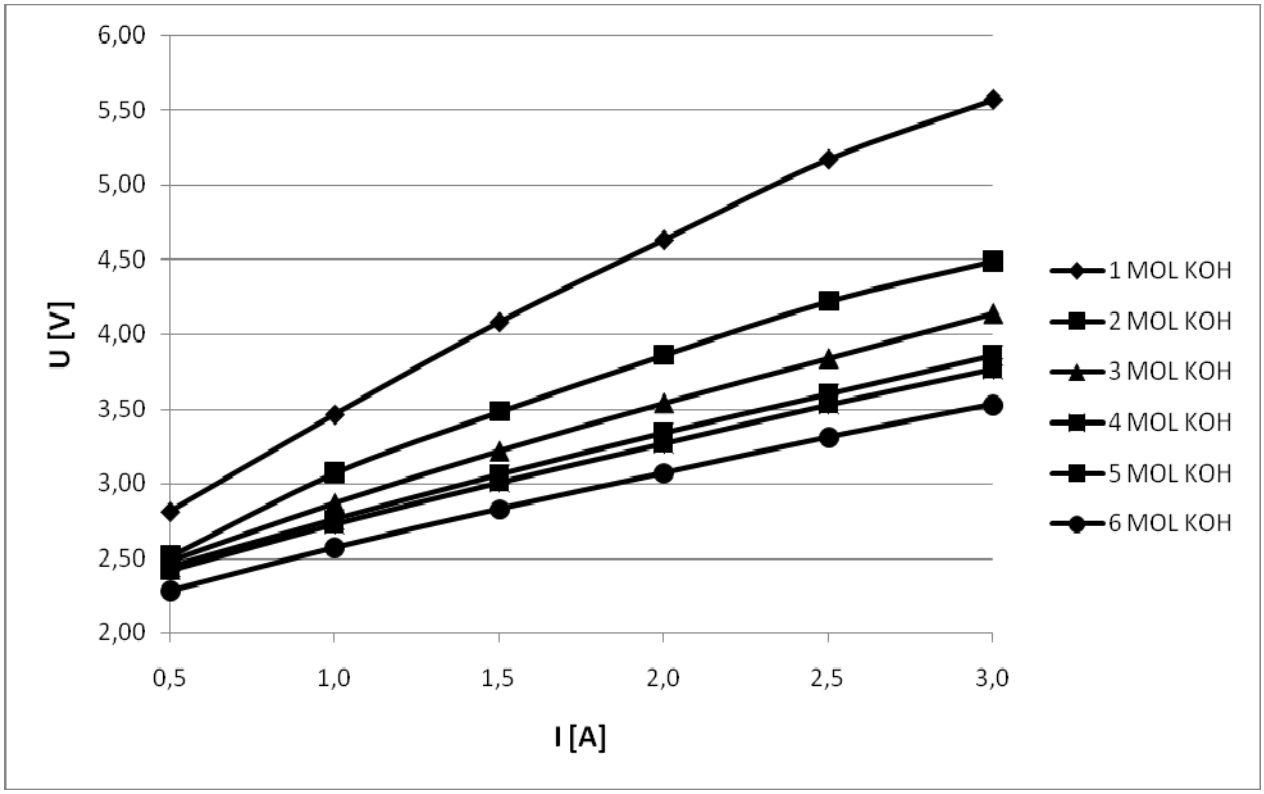

Fig. 1 - Measurements on elektrolyzer with different KOH solutions

Other way to incrase efficiency of electrolyzer is extension of active surface of electrodes by the help of patent no. 125479 [2]. On surface of nickel or brass material we built-up Zn-Ni surface and sequentially we ate away redundant zinc. Four samples of electrodes was created for this experiment. Individual samples was differ in used basic material and manufacturing process. By the help of Voltametry was chosen sample with the best parameters. From the graph no. 2 is apparented that the best characteristics have the samples number 3 and 4. Extension of active surface of electrodes for electrolyzer was implemented by the same manufacturing process, which the sample with best parameters was created. In terms of economical was chosen samplne number 4.

sample	basic material	created surface	comment
1	brass	Zn - Ni	Hull's cellule - 0,8 až 4 A/dm^2
2	nickel	Zn - Ni	Hull's cellule - 0,8 až 4 A/dm^2
3	nickel	Zn - Ni	Equable surface, 2,5 A/dm^2
4	brass	Ni + Zn - Ni	Equable surface, 1 A/dm^2 + 2,5 A/dm^2

Tab. 1 - Materials of electrodes, surfaces and manufacturing processes

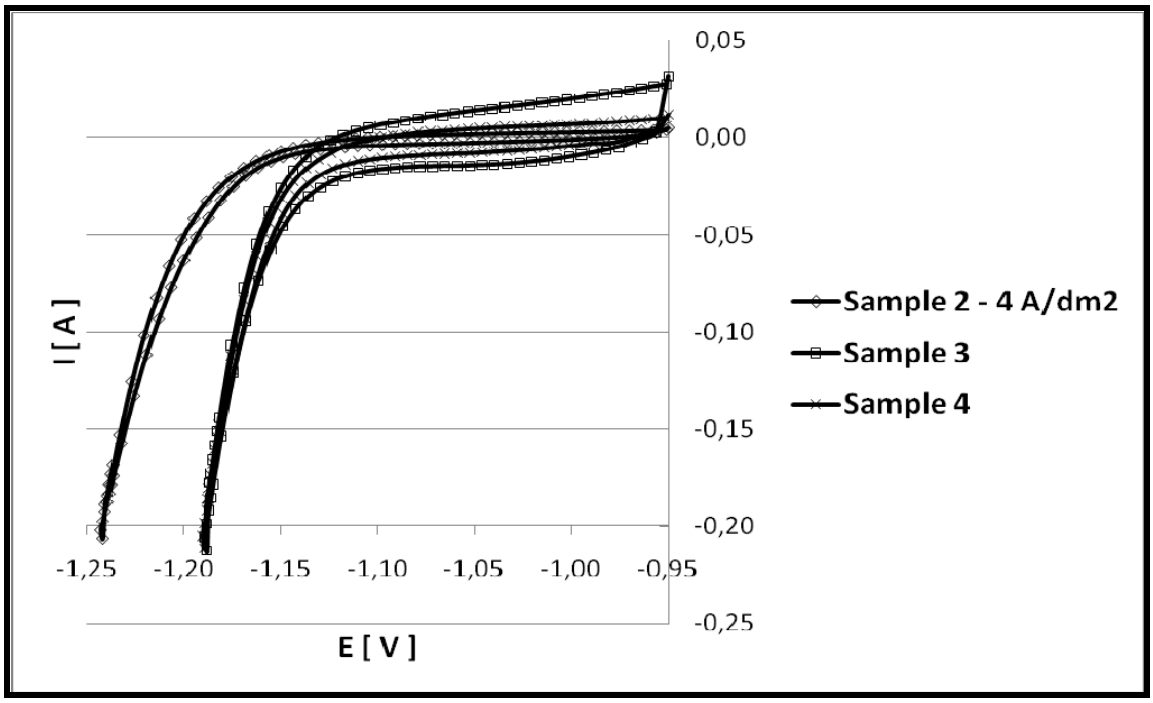

Fig. 2 - Polarization curves of 3 best samples, measured by voltametry

Measurements were performed on a small electrolyzer with only two electrodes. To avoid mixing the resulting gases and creation of explosive mixtures we separate electrode spaces using membrane. We use membranes Ralex from MEGA company from Stráž pod Ralskem, particular type AMH5E-HD. It was first measured with the original electrodes, then with the new electrodes with extension of active surface. With using electrodes with extension of active surface supervened downtrend of electrolyzer voltage against original (only nickel) electrodes about 0,2 - 0,4V.

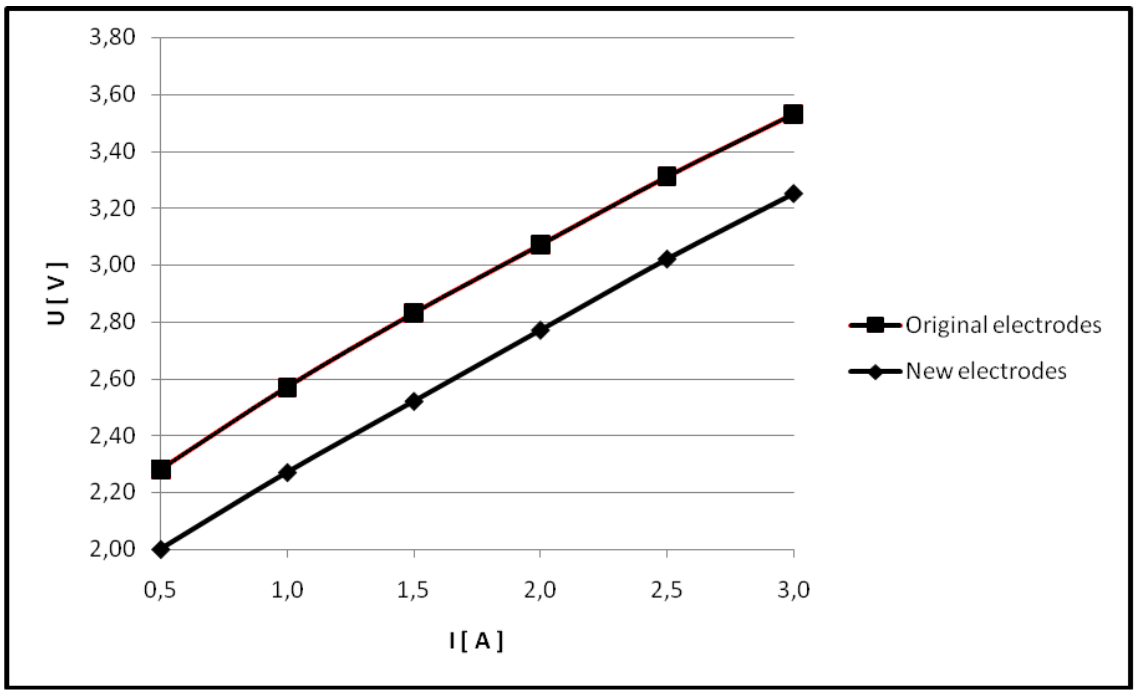

Fig. 3: Electrolyzer voltage: confrontation of original and new electrodes with 6 mol KOH electrolyte

Efficiency of electrolyzer determine as rate of theoretically used energy and really used energy. By using new electrodes with extended active surface in electrolyzer was his efficiency with identical conditions of measuring extended about 8,68% (counted for 6 mol KOH electrolyte, 0,5A). On this account, this method is proving as very perspective.

Electrodes	I [A]	U [V]	t (10 cm^3) [s]	t (1 m^3) [h]	W_s [Wh]	W_t [Wh]	η_{el} [%]
Original	0,5	2,28	150	4166,7	4750,0	2943,2	**61,96%**
New	0,5	2,00	150	4166,7	4166,7		**70,64%**
efficiency difference							**8,68%**

Tab. 2 - Efficiency of small electrolyzer - 6 mol KOH - 2 electrodes

3. CONCLUSIONS

Purpose of this work was to create galvanic deposition of metals with electrocatalytic properties. This galvanic deposition will be used to prepare the high efficient electrodes for electrolysis cell for hydrogen production. It is clear, that we can create suitable surface for electrodes. Hence, the reduction of energy by their use is possible. Increased efficiency of elektrolyzer of 8.68% means in the case of large-scale use of elektrolyzer significant energy savings. Continuation of the work will be another increase of efficiency of electrolyzer and optimization of electrode processes.

ACKNOWLEDGEMENTS

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REFERENCES

[1] VONDRÁK, J., BALEJ, J.: Influence of Mercury on Hydrogen Overvoltage on Solid Metal Electrodes I. Stationary Polarization Curves of Hydrogen Deposition on Pure and Poisoned Electrodes. Electrochim. Acta 15,1653(1970)

[2] VONDRÁK, J., BALEJ, J., PASEKA, I.: Způsob výroby aktivních elektrod s nízkým přepětím. čs. pat. c. 125479, 15.12.1967

[3] KNOTEK, T.: Diplomová práce, Ústav elektrotechnologie VUT, Brno 2007

[4] KAŇA, O.: Tvorba elektrod pro elektrolyzér [Semestrální projekt]. Vysoké učení technické v Brně, FEKT, Rok obhajoby: 2008

[5] VONDRÁK, J., SEDLAŘÍKOVÁ, M., BARATH, P.: Optimalizace a vývoj nového elektrolyzéru vody, Brno: Vysoké učení technické v Brně, zpráva grantu VaV SN/171/05 – příloha č. 4

[6] BĚHAL, Ž.: Slitinová lázeň zinek/nikl SLOTOLOY ZN 80. Pokyny pro práci s lázní. Rok 2006