Influence of oxygen content at the PEM fuel cell cathode

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Abstract **The PEM fuel cell represents currently one of the most common types of fuel cells and the analysis of this fuel cell behavior under various operating conditions is essential for provision of optimum performance. This contribution deals with demonstration of great influence of the oxygen content in oxidant which reacts with fuel (hydrogen) on active surfaces in the centre of fuel cell. Two most common options of oxygen inlet are compared for the clear evidence of significance of the solution of oxygen content issues. The first option represents oxidant such as pure oxygen and the second option represents air with about 21 % of oxygen. The measured data are processed as the polarization and performance curves. The measurement is done with a laboratory set which represent the energy unit which is based on fuel cell with closed construction and the simplest possible design.**

Keywords **fuel cell, oxidant, oxygen content, proton exchange membrane, polarization curves, power curves.**

I. Introduction

The issue of Proton exchange membrane (PEM) fuel cell (FC) is nowadays more and more developed due to the possibility of incorporation of fuel cells into the Smart energy network [1]. These networks, which connect a lot of energy sources, can include relatively sophisticated components. These components are designed for optimum operation of the FC and therefore the achievement of maximum operational efficiency and maximum service life of used FC is possible. Thanks to these advantages the operating conditions, which include also the composition of oxidant, can be adjust sufficiently accurately.

The usage of oxygen, which is produced by the electrolyzer or delivered from pressurized containers, is considered as the best option. However, in some cases, is not possible (due to the location of the fuel cell, financial requirements, etc.) to ensure sufficient supply of pure oxygen. In these cases, oxidant may be represented by a surrounding air. When the air is used, the risk of reducing of the FC service life, which is caused by degradation of the active layer due to the presence of CO and CO_2, increases [2]. On the other hand usage of the air greatly simplifies the design of the whole system and may be as the approach to create an autonomous system.

II. Experimental

Laboratory fuel cell Premium 1911 from the H-TEC company was used for measuring. The fuel cell structure includes one MEA (Membrane Electrode Assembly) with active surface of 16 cm^2. A fuel cell is made as a closed structure and operating substances are supplied into the inner space by pipes.

Polarization and power curves were obtained by using a standard measuring apparatus with resistance decade and devices for current and voltage measurement at the output terminals of the fuel cell. Value of actually connected resistor in resistance decades was gradually decreased during a measurement and voltage and current were recorded. Cathode inlet was connected with the output of oxygen from the electrolyzer when a pure oxygen was applied. If was used ambient air as a oxidant, cathode was connected to the compressor inlet with adjustable air flow and with dust filter.

III. Results and discussion

The measurement results are processed in a summary graph, which is shown in Fig. 1. Measurement trends are consistent with theoretical assumptions, e.g. according to [2]. Polarization curve for air shows a significant decrease which is caused by more significant energy losses (particularly activation and concentration). These losses are associated with the speed and intensity of the ongoing chemical reactions.

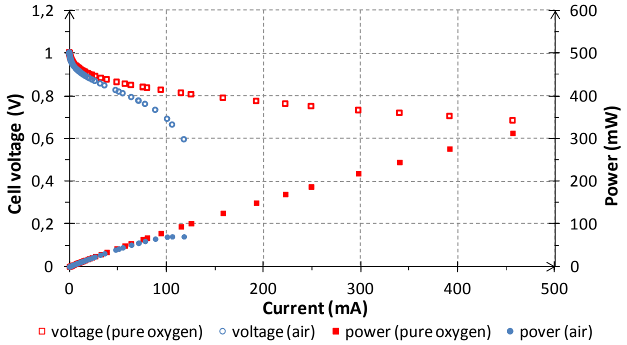

Fig. 1: Polarization and power curves for different types of oxidant.

IV. Conclusion

The obtained results clearly confirm the theoretically expected significant decrease, which is caused by usage of air as the oxidant instead of pure oxygen, in the performance and stability of the system (connected with low-resistance load). Additional measurements allowed determining that the performance and stability of the system increase with increasing of volume flow of oxidant in fuel cell. The next phase of this research will be focused on confirmation of experimental results by equations and function fitting according to [3].

V. References

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