

Development of a Compressor for PEM Fuel Cells in Mobile Use

REN technical development in the MWMEV

Applicant: Pierburg AG
Alfred-Pierburg-Straße 1
D-41456 Neuss

Project Partner: FEV Motorentchnik GmbH

Contact: Dr. Dirk Hunkel
Tel. +49-2131 / 520-2011



Description of Project:

An important component in fuel cell systems for automobile manufacture will be compressors which supply the reaction air at a pressure of 2-3 bar to the fuel cell. Through the elevated air pressure there is a greater oxygen partial pressure on the cathode side, which means that the current density and hence the power density of the fuel cell is increased. This is also necessary in automobile manufacture in view of the small and compact sizes required.

A compressor for use in a fuel cell system differs from compressors previously used in automobile manufacture in that the fuel cell demands much higher standards with regard to pressure level and the purity of input air than an internal combustion engine. For example, it must be ensured that the air is absolutely free of oil and contaminants, and in addition the compressor must be permanently corrosion-resistant when exposed to the air humidified with high-purity water. Furthermore the compressor should also attain high levels of efficiency in the part-load range. This can be achieved by variable inner compression.

The project is therefore aimed at developing a compressor for the cathode-side air stream of a fuel cell which is up to the requirements of mobile application. The aim is to use the principle of the inside axle, rotary piston supercharger. As a first step design data is determined on the basis of kinetic and thermodynamic simulations. This includes a variable internal compression with respect to length, diameter, eccentricity and gap dimensions. As a second step a compressor will be designed on the basis of the design data. This will then be manufactured as a prototype to validate the simulations and to optimise difficult-to-simulate properties, such as noise emission.

Part of the project is also the development and setting up of a test stand for fuel cell systems. Initially this will be used to test the compressor to be developed. Furthermore an evaluation will be conducted of strategies for charging which make use to a special degree of the capability (variable internal compression) of the compressor described above.

Setting up and operating the test stand requires development of regulation and control electronics for energy and heat management. It must be possible to supply the necessary gas mixtures in the requisite variability and humidity and the high dynamism of the test stand for the simulation of mobile applications must be guaranteed.