Application of Alternative Fuels in Engines of Internal Combustion

Ph.D. Dissertation – György Budik

Theses

1. I have proved that a carburettor type, four stroke, constant speed gasoline engine of internal combustion can be modified without structural changes so as to operate with E85 fuel without combustion problems, maintaining its original 8:1 compression ratio and its ability to operate with gasoline. I have determined the optimum set parameters for E85 operation: modifying spark advance from 25° BTDC to 40° BTDC and changing the carburettor nozzle from hydraulic diameter of 0.92mm to 1.08mm. With these settings the engine became capable of larger maximum output and its efficiency exceeded that of gasoline operation in the whole investigated power range. Based on the thermodynamic calculation of gasoline operation, I elaborated the thermodynamic calculation method of the engine for E85 fuel. I determined the air/fuel ratio of the optimum E85 operation (α=1.1 relative to stoichiometric) and the thermodynamic characteristics of the engine. [Chapters 5.4, 5.5, 6.2, 7.1, 8.2]

2. I have proved that a carburettor type, four stroke, constant speed gasoline engine of internal combustion can be modified without structural changes so as to operate with hydrogen fuel without combustion problems, maintaining its original 8:1 compression ratio and its ability to operate with gasoline, with the application of a standard state hydrogen supply system. I have determined the optimum set parameters for hydrogen operation: modifying spark advance from 25° BTDC to 20° BTDC and applying a hydrogen nozzle of D=4.8mm diameter. With these settings the efficiency of the engine during hydrogen operation exceeded that of gasoline operation in the whole comparable power range. Based on the thermodynamic calculation of gasoline operation, I elaborated the thermodynamic calculation method of the engine for hydrogen fuel. I determined the air/fuel ratio of the optimum hydrogen operation (α=2.466 relative to stoichiometric) and the thermodynamic characteristics of the engine. [Chapters 5.4, 5.5, 6.3, 7.1, 8.3]

3. I have proved that if a carburettor type, four stroke, constant speed gasoline engine of internal combustion is modified for hydrogen operation without structural changes so as to operate with optimum set parameters for hydrogen fuel, maintaining its original 8:1 compression ratio and its ability to operate with gasoline, the limit of achievable maximum engine output during hydrogen operation is imposed by the peak combustion pressure of the original gasoline engine design. [Chapters 5.4, 5.5, 6.3, 7.1]

4. I have proved that if modifying and optimizing a carburettor type, four stroke, constant speed gasoline engine of internal combustion for E85 or hydrogen operation without structural changes, maintaining its original 8:1 compression ratio and its ability to operate with gasoline, operating with the respective optimum set parameters, the efficiency curves of the engine for E85 and hydrogen operation are close to congruent in the whole comparable power range. [Chapters 6.2, 6.3, 7.1]

5. I have proved that if a carburettor type, four stroke, constant speed gasoline engine of internal combustion is modified for hydrogen operation without structural changes so as to operate with optimum set parameters for hydrogen fuel, maintaining its original 8:1 compression ratio and its ability to operate with gasoline or E85 fuel, the engine operates satisfactory with gasoline or E85 at the spark advance optimum for hydrogen operation (20° BTDC), with the respective optimum air/fuel ratios of gasoline or E85. [Chapters 6.1, 6.2, 6.3, 7.2, 7.3, 8.1, 8.2]