AN APPLICATION OF ARTIFICIAL NEURAL NETWORK TO EXHAUST EMISSION MODELLING FROM DIESEL ENGINE

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Abstract

Processes of the combustion of liquid fuels and solid are more complex than combustion of fuel gases. With reference to liquid fuels occur additionally processes of vaporization of the fuel, and with reference to solid fuels - decomposition of the solid phase with processes of melting and vaporization, pyrolysis, or gasification. This simultaneous and also different influence of different parameters is sometimes a reason of incorrect interpretation of experimental results. The study of the theoretical model of the combustion process concerning of liquid and solid fuels and which then the model takes into account also the gas- phase, because combustion processes take place in this phase, and occurs the interaction of the phase gas- and liquid or the solid one. The theoretical model is presented basing on experimental initial researches realized in a model with reference to liquid fuels and solid ones. Researches realized in the constant volume chamber with measurements of the pressure during the process of the combustion with the use of quick photography and with measurement of the distribution of the velocity in the spray of the fuel and droplet measurements by means the laser Doppler equipment LDV and PDPA. There were obtained a good agreement of findings experimental researches with the theoretical model. Generally on the combustion velocity of liquid fuels and solid one significant influence has a kind (laminar, temporary and turbulent) and the thickness of the thermal boundary layer.

Keywords: *transport, road transport, simulation, combustion engines, air pollution, environmental protection*

1. Introduction

The environment can be characterized as material world surrounding living organisms including human beings. It includes the basic natural components and sources – land, air, water, organisms, their communities, ecosystems and countryside including those parts, which are influenced by human beings. The environment thus presents a complex of ecologic systems in which life is developed. Transportation, in fact, influences the environment in two ways:

- in a positive way – thanks to its purposeful displacement of people, raw materials and goods it

realizes needs of society and some services and considerably contributes to the growth of tourism,
- in a negative way – due to its existence, i.e. by means of its operation and equipment it damages and deteriorates the environment.

Tab. 1. Comparison of influence of emissions of different types of transport

	Emissions									
Transport	CO	CO_2	HC	SO_2	NO_x	PM	Pb	Noise	Vibra-tions	Σ
Road – passenger cars	3	1	2		3	1	2	1		13
Road – utility vehicles	1			1	3	3		3	3	14
Railway				1	1	1		2	1	6
Water				1	1	1				3
Air			1		1		1	3		6

This result is very significant when we take into consideration that it has been achieved only due to a better regulation of the engine cylinders filling by means of a variable timed valve gear, without any change of the engine dimensions, compression ratio or maximum value of rotational speed.

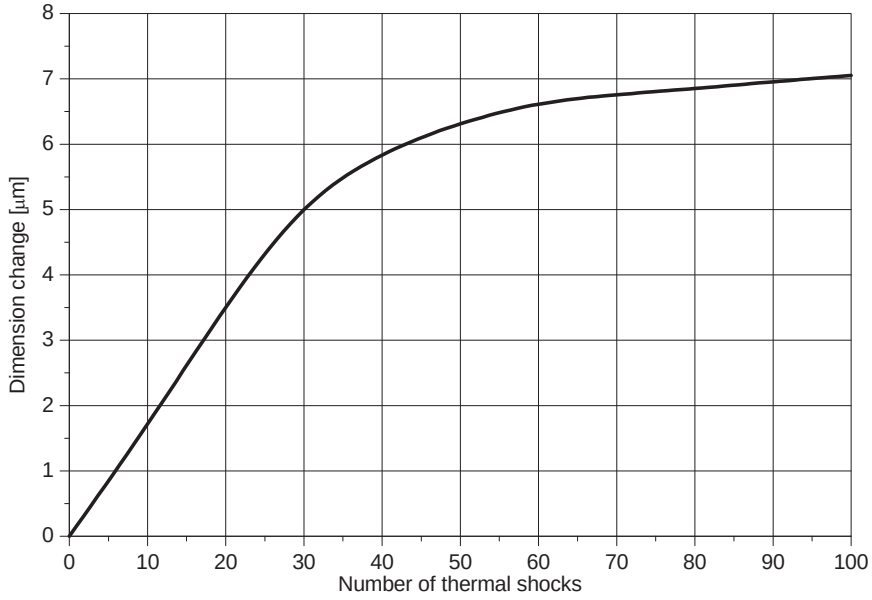

Fig. 1. The example of the influence of the number of thermal shocks on the deformation of the piston sample

2. Simulation of start up of the vehicle with a combustion engine

In this part we examine the influence of a torque curve shape in the speed engine characteristic on some vehicle properties during its start up. This shape change was achieved by an application of the valve gear with variable timing in the vehicle. The evaluation (of dynamic characteristics) is usually expressed in characteristics of the vehicle start up. The mentioned parameters consequently closely relate to economy and pollution of the environment due to operation of the vehicle. The unsteady operational mode of the engine during the vehicle start up is not defined only by increase in its speed and loading. From the point of view of the pollution of the environment caused by exhaust emissions are highly important time intervals between the gear ratio changes. One

criterion for the evaluation can be time needed for achieving the given speed of vehicle or time needed for covering the necessary distance.

The dependence (1) represents the influence of basic parameters on the resistance on thermal shocks:

$$\Theta = \frac{k\,t}{\rho\,c\,h^2}, \tag{1}$$

where:

Θ - undimensional time,
k - coefficient of thermal conductivity,
t - time,
ρ - density,
c - specific heat,
h - half of slab thickness.

The engine operation optimization in a wide range of rotational speed interval may be realized by application of the valve gear with a variable timing. This valve gear allows a direct affecting of the torque curve shape in the engine speed characteristic. A change of the torque curve shape as well as a change of absolute values of the achieved torque has influence on the vehicle driving properties. The present expansion of transportation induces, mostly in large towns, some problems resulting from inability to cope with situations on crowded roads and crossroads. There are more requirements put on a modern vehicle, namely to achieve high accelerations during start-ups at crossroads and, last but not least, during overtaking which is closely related with safety of passengers. One objective is to evaluate – on the basis of a numeric simulation – influence of the torque curve shape change (achieved by means of variable timing of the valve gear) on some chosen parameters during the vehicle start-up. The standard input parameters are similar to those of the 1.3MPI vehicle. The computational model considers resistance of the wheel rolling on the roadway, air drag and elevation resistance.

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