TEKA Kom. Mot. Energ. Roln. – OL PAN, 2007, 7A, 11–16

AN ANALYSIS OF POWER EFFECTIVENESS OF SPEED PROFILE IN VIEW OF DRIVING ACCELERATION IN URBAN MEANS OF TRANSPORT, USING SAS SYSTEM

Zbigniew Burski

Department of Vehicles and Engines, Agricultural University of Lublin, Poland

Summary. In this thesis there are introduced basics of analysis of power-intensivity of single traction parameters of a vehicle, using computer system SAS. In the assumed methodology the object of speculations was, via direct researches, a unit of successive modules of transit of urban means of transport with construction convergent with the module, appearing in theoretical speculations. Five transportation routes were taken into account, while making statistical calculations of significant variances in traction parameters of the transit, concerning consumption of energy of the consumed fuel. While making direct statistical calculations using the method of multiple comparisons, there were taken into account modules of each of these lines which make up transits backwards and forwards. There were proven no significant differences between these modules concerning power efficiency in view of acceleration and breaking of a vehicle on accepted level of statistical significance.

Key words: vehicle exploitation, power effectivenes, tachographs, public transport, urban area.

INTRODUCTION

Power effectiveness in traffic and efficiency of vehicles' drive are values deciding of fuel consumption. Its value is a basic measure of quality of energetic construction and exploitation. Factors influencing a value of particular components of energetic balance are not only specified characteristics of a vehicle, engine and road, but also realized speed profiles in view of acceleration and breaking [5, 6].

A characteristic feature of vehicle traffic in urban area is, connected with that, cyclic change of speed [1]. Its frequency, scope and intensity depend on outer factors, dynamic features of the vehicle and subjective driver's behavior. Outer factors are features of the road (especially elevations), traffic conditions (time of the day) and atmospheric factors (especially direction and strength of the wind and falls).

Complex and labile character of interaction of afore-mentioned factors results in the fact that the varied fuel consumption is decided on mainly by the realized speed profile, shown as tachograph's dial [2, 3]. It represents a basic legislative document of UE in national and international logistics [4].

PURPOSE OF THE THESIS

The purpose of this thesis is statistical assessment of severity of speed profile changes in urban means of transport MPK in view of acceleration and breaking. Time of transit and speed of driving were conditioned by legal standards of road traffic in urban area and by ruling timetables. However, value of acceleration and delay (breaking) depend to a great extent on the driver's personality.

OBJECT AND SUBJECT OF RESEARCH

The objects of research were buses Neoplan used in public transport MPK in Lublin.

The subject of research and statistical calculations were tachographs' records (dials) of driving profiles of buses on selected communication lines in Lublin in view of acceleration and breaking.

METHODOLOGY OF RESEARCH AND STATISTICAL CALCULATIONS

In the assumed methodology of research there were analysed values of acceleration on the basis of speed profiles in module apprehension, in accordance with recommendations of Mannesmann Kienzle Company. A single module of a profile was a course of communication route between terminuses.

Speed profiles take into account both directions on the particular communication route and triple-shift system of drivers' work.

In statistical calculations there were used a method of multiple comparisons Tukey-Kramer and Tukey's test of standardized scope HSD.

RESULTS OF STATISTICAL CALCULATIONS AND THEIR ANALYSIS

Results of statistical calculations of differences' severity of acceleration and breaking of speed in particular module's profiles are presented in the table on an example of a bus Neoplan 233 (Tab. 1-3). In Tables 4-5 there are correlated the data concerning the assessment of changes in statistical severity of correlation, using method 0,95 HSD (Tukey), generated by SAS system.

Table 1. Information about level of variables' classification Neoplan 233

Class	Levels	Values
Direction 233	2	direction 1 direction 2
Course 233	12	1 2 3 4 5 6 7 8 9 10 11 12
Number of read observations	1030	
Number of used observations	330	

Table 2. Linear models. The GLM Procedure Dependent variable: a_Neo233

Source General characteristics	**N**	**Total squares**	**Average squares**	**F value**	**Pr > F**
Model	22	0,00713143	0,00032	0,02	1
Error	307	6,43153847	0,02095		
Total corrected	329	6,4386699			
R-square	**Factor**	**Root MSE**	**Average a_Neo233**		
0,001108	801,4122	0,14474	0,01806		
Source Directional characteristics	**N**	**Type III Total squares**	**Average squares**	**F value**	**Pr > F**
Direction233	1	0,00173498	0,00173	0,08	0,7737
Course233	11	0,00249523	0,00023	0,01	1
Direction233*Course233	10	0,00263085	0,00026	0,01	1

Table 3. Characteristics of basic traction parameters of vehicle Neo 233.

Level	**Average**	**N**	**V_Neo233**		**a_Neo233**	
Direc-tion233	**Course233**		**Average**	**Standard deviation**	**Average**	**Standard deviation**
Direction1	1	12	30,75	13,68	0,0166	0,135
Direction1	2	15	34,06	11,93	0,0253	0,107
Direction1	3	13	32,46	11,01	0,0189	0,121
Direction1	4	13	35,53	8,88	0,0220	0,073
Direction1	5	16	30	15,21	0,0208	0,143
Direction1	6	15	26,93	15,54	0,0133	0,161
Direction1	7	13	30,61	20,86	0,0271	0,224
Direction1	8	14	32,71	16,16	0,0195	0,150
Direction1	9	12	31,08	19,92	0,0205	0,154
Direction1	10	12	39,16	10,47	0,0183	0,117
Direction1	11	12	42,08	8,27	0,0233	0,098
Direction1	12	17	43,58	10,81	0,0196	0,087
Direction2	1	16	28,56	12,24	0,0095	0,120
Direction2	2	15	30,60	12,68	0,0195	0,134
Direction2	3	16	27,56	16,54	0,0158	0,187
Direction2	4	15	32,13	12,93	0,0191	0,139
Direction2	5	16	23,50	16,71	0,02	0,144
Direction2	6	16	34,18	15,37	0,0166	0,165
Direction2	7	17	24,47	17,87	0,0078	0,138
Direction2	8	14	31,85	14,88	0,0190	0,147
Direction2	9	14	25,35	19,72	0,02	0,165
Direction2	10	14	30,71	16,33	0,01047	0,194
Direction2	11	13	35,23	9,28	0,0158	0,120

Table 4. Summary juxtaposition of severity of traction parameters of vehicles Neoplan in urban transport (MPK) according to SAS system (Local, XP_PRO).

Lp.	Specification	Traction parameter				
		Source of changes	Extent of discretion	F value	Pr > F	Severity of changes on a level 0.05
1	Neoplan 194	Direction	1	0,03	0,86	not
		Course	8	0,19	0,99	not
		Direction*Course	7	0,06	0,99	not
2	Neoplan 197	Direction	1	0,00	0,936	not
		Course	8	0,03	0,09	not
		Direction*Course	8	0,01	0,0851	not
3	Neoplan 204	Direction	1	0	0,99	not
		Course	11	0,03	1,0	not
		Direction*Course	10	0,02	1,0	not
4	Neoplan 227	Direction	1	0,00	0,65	not
		Course	5	0,04	0,99	not
		Direction*Course	4	0,02	0,1791	not
5	Neoplan 233	Direction	1	0,08	0,77	not
		Course	11	0,01	1,00	not
		Direction*Course	10	0,01	1,00	not

* "direction" – means a designation of the sort of the route
* "course" – means a number of a particular time of covered route
* "direction* course" – means difference between course and direction
* "Severity of changes on a level 0,05" – means changes on a significant level within a direction and between directions

Least Squares Means for effect Direction233*Course233 Pr>|t| for H0: LSMean(i)=LSMean(j) Dependent Variable: a_Neo233. Correlation rate (r = 1,0).

In the Table 4., there are presented exemplary dependences between module profiles of particular parts of the route, which were covered by buses of public transport in various conditions of urban traffic, various time of the day and various staff of drivers. On the basis of an analysis of the preceding data, it was stated that tachographs' dials in view of acceleration and breaking speed, were interpreted by SAS system in view of acceleration and breaking as statistically not diverging from the parameters compatible with exploitation standards.

Table 5. Calculations of statistical severity using method HSD Tukey-Kramer for acceleration with the aid of test standardized scope, according to SAS system.

Lp.	Specification	Tukey's grouping (a)			
		Differences of grouping	Average	N (extents of discretion)	Direction
1	Neoplan 194	A	0,056	95	2
		A	0,055	114	1
2	Neoplan 197	A	0,013	150	2
		A	0,012	130	1
3	Neoplan 204	A	0,0129	168	1
		A	0,0138	165	2
4	Neoplan 227	A	0,003	113	1
		A	0,002	92	2
5	Neoplan 233	A	34,104	164	1
		A	29,319	166	2

* "grouping differences" – averages with the same letter are not significantly various.

CONCLUSIONS

1. In the face of a great amount of acquired results of research, enabling their credibility, in assessment of statistical severity there were used calculations according to the computer programme SAS.

2. The carried out calculations of values of correlation rate and statistical severity using the method HSD Tukey-Kramer of acknowledged traction parameters affecting power-effectiveness of driving showed no statistically significant differences in module record of tachographs. It means that the circumstances of driving, especially mental predispositions of drivers did not significantly affect the values of acceleration or breaking speed.

3. On account of significance of research topic in scope of power-intensivity of vehicles' drive, researches should be continued using tests of increased "power" of statistical dependence. In scope of estimation of speed values it was proved in the previously published researches that there are significant differences between particular speed profiles.

REFERENCES

Burski Z., Kuczyński M. 2007: Próba standaryzacji parametrów trakcyjnych pojazdu w zależności od infrastruktury komunikacyjnej. Wyd. KMiER. PAN o/Lublin.

Burski Z. 2007: A computer analysis of vehicles exploitation in a carrying practise of company. International Scientific and Practical Forum. Lviv State Agrarian University Dublyany.

Burski Z. 2007: The exploitation of Internet reading and analysis of tachograph's dials using TIS-WEB programme in international transport logistics (UA-PL-GB). International Scientific and Practical Forum. Lviv State Agrarian University Dublyany.

Niziński S., Kolator B. 2007: Problemy współczesnej logistyki w aspekcie utrzymania ruchu obiektów technicznych. TEKA KMiER. PAN o/Lublin.

Siłka W. 1997: Energochłonność ruchu samochodu. WNT, Warszawa.

Siłka W. 1998: Analiza wpływu parametrów cyklu jezdnego na energochłonność ruchu samochodu. Zeszyt 14. Monografia 2. Teka KN-PM, Kraków.