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Experimental studies of the size contact area of a summer tire as a function of pressure and the load

Jakub Polasik^{*}, Konrad J. Waluś, Łukasz Warguła

Chair of Basics of Machine Design, Poznan University of Technology ul. Piotrowo 3, 60-965 Poznań

Abstract

Vehicles in depending on the segment and destination vary in size, type and power drive unit. These factors directly affect the total weight of the car and thus the type and size of tires. The choice of tire size depends on the power generated by the drive unit, which through the interaction of tire-pavement is to be transferred to the surface. The parameters affecting the field of contact with the ground is the value of the tire pressure and load on each wheel unit. Depending on the size of the rim, tire size and the number of people transported and / or goods manufacturer gives the recommended pressures for front and rear axle of the car. The effect of changes in pressure and load on the size of the surface area of contact selected summer tires with the road.

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1. Introduction

Depending on the segment the automotive vehicles can differ in essential technical data such as type of drive unit, vehicle size or finish. These factors have a direct impact on vehicle mass and thus the type and size of tire. Tyre size selection depends on the power generated by drive unit which must be transferred to the surface by the interaction between tyre and pavement. The values of tyre pressure and unit load of individual wheels are the parameters which have an impact on the contact area between the tyre and pavement [1-4]. Depending on the rim size, tyres size, number of transported persons and/or cargo the tyre manufacturer gives the recommended tyre pressures for front and back vehicle axles – loaded and unloaded. The lower the tyre pressure, the larger the contact area becomes - this leads to the effect of “tyre spilling”. During the driving high frictional resistance exists and this

^{*} Corresponding author.

E-mail address: polasik@interia.eu

fact is the reason of heating and wear of the tyre [5]. High pressure in tyre causes too excessive wear of the central section of the tyre [6]. Meanwhile low pressure in the tyre is the reason of wear of tread shoulder and temperature growth [5, 7] – in extreme conditions it can lead to tyre delamination or even to secondary vulcanization. The paper presents the effect of changes of tyre pressure and load on the size of contact area between the tyre and pavement.

2. Measuring methodology

The aim of investigations was the measurement of contact area between summer tyres and pavement in function of tyre pressure and load. The measurements were done for the following tyre pressures: 0,5 bar; 1,0 bar; 1,5 bar; 2,0 bar; 2,5 bar and 3,0 bar and for the following tyre loads: 50kg, 100kg, 150kg, 200kg, 250kg, 300kg, 350kg, 400kg, 450kg and 500kg. All impressions were digitalized and this fact allowed to model the geometry of trace surface.

3. Measuring results

The results of laboratory tests and geometry modelling of contact surface between the tyre and pavement are presented in Tables 1, 2 and 3.

Table 1. The results of measurements of tire contact with the ground Barum Brillantis . in size 165/80 R14

Barum 165/80 R14											
surface area of contact with the ground [cm ²]		load [kg]									
		50	100	150	200	250	300	350	400	450	500
pressure [bar]	1,0	-	45,89	-	70,50	-	108,19	-	133,75	-	159,55
	1,5	14,81	34,46	42,67	66,05	71,02	100,02	108,85	109,93	122,80	135,95
	2,0	12,96	23,40	40,43	47,71	59,84	73,96	94,10	103,48	112,34	120,11
	2,5	11,07	25,41	31,11	38,91	47,28	56,10	66,66	89,98	100,99	110,23
	3,0	10,37	18,31	26,12	37,17	46,04	54,38	71,27	74,32	79,97	94,17

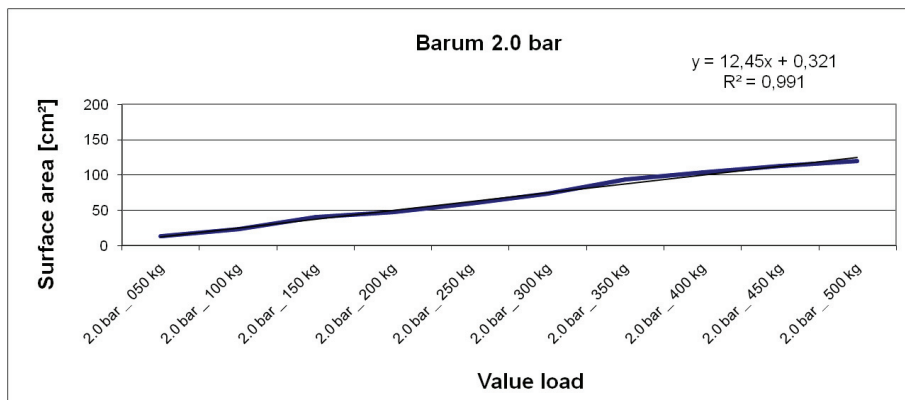


Fig. 1. Contact area of the tire Barum 165/80 R14 with the ground as a function of load and pressure.

Table 2. The results of measurements of tire contact with the ground Continental ContiEco Contact 3 . in size 195/65 R15

Continental 195/65 R15											
surface area of contact with the ground [cm ²]		load [kg]									
		50	100	150	200	250	300	350	400	450	500
pressure [bar]	1,0	20,60	38,10	58,85	86,78	95,30	116,15	133,15	143,86	159,56	171,56
	1,5	17,02	30,00	44,82	58,97	72,80	85,44	98,78	111,65	125,73	137,32
	2,0	15,60	26,71	38,31	50,74	62,87	74,18	86,91	96,77	106,81	117,34
	2,5	14,35	24,24	35,22	45,23	55,47	65,15	74,25	85,01	93,47	99,92
	3,0	13,14	22,29	31,46	39,27	48,41	56,95	65,48	76,50	83,41	91,68

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