Analysis Of Air Effect On Tire For Vehicle Car

Kisman H. Mahmud, Moh Sukron Ilyas, Anwar Ilmar Ramadhan

Abstract: this study aims to find out information about the use of fuel. These research and planning steps include several steps that must be done gradually and sequentially. In conducting the research and making of these tools it takes about three months to be conducted at the vehicle inspection. The research of analysis is done by finding relevant facts in the context of deflated and conducting research methods in 5 steps. Based on the results of the study it was found that in terms of prohibition specifications (68 psi and 85 psi) shifted the smallest style resistance compared to the prohibition under the specification. The lower, this tire has a great rolling resistance style. In this research revolved the greatest resistance style that is in the lowest prohibition condition (45 psi and 65 psi). The magnitude of the rolling resistance style affects the effort and energy that to resist these obstacles.

Index Terms: tire pressure, coast down, rolling resistance, fuel consumption

1 Introduction

The tire pressure of this tire is one of the main factors for capability, comfort and safety when driving. Each tire must have a standard air pressure (specification), and if the tire pressure on the tire is not in accordance with the recommended standard it can cause harm to the vehicle and driver and passengers [1-4]. And this is the result if air pressure on the tire is less than its specifications 1) Friction between the tires and the road increases, thus requiring more power to drive vehicles and fuel more wastefully. 2) The steering wheel becomes heavier, making it so tiresome for the driver. 3) The tire wear is also uneven, the edges are worn faster. 4) The tire becomes too flexible so that the temperature inside it increases. When the tire pressure is low and the high speed of the tire can break, it can be a threat to the driver [5-10]. Problems often experienced by motorists are reduced or excessive air pressure on tires. When experiencing this the rider performs the addition or reduction of air pressure on the tire regardless of the air pressure value in accordance with the standard tire specifications used [11-12]. Because of the fact that vehicle tires are still speculative, where tires are filled with air using a compressor without knowing how much air pressure is appropriate to the tire specification standard. This causes the comfort of driving to be reduced and in the long run will be able to shorten the life of the tire. In addition to shortening tire life, tire pressure on the tire will also affect the speed of the vehicle. Standard tire pressure conditions in addition to affecting vehicle speeds, also affect the efficiency of fuel use. In this study focused on the problem of the relationship of the analysis of the influence of air pressure in the tire on 4 passenger vehicles.

2 Research Method

The following is a flow of research conducted in accordance with Figure 1.

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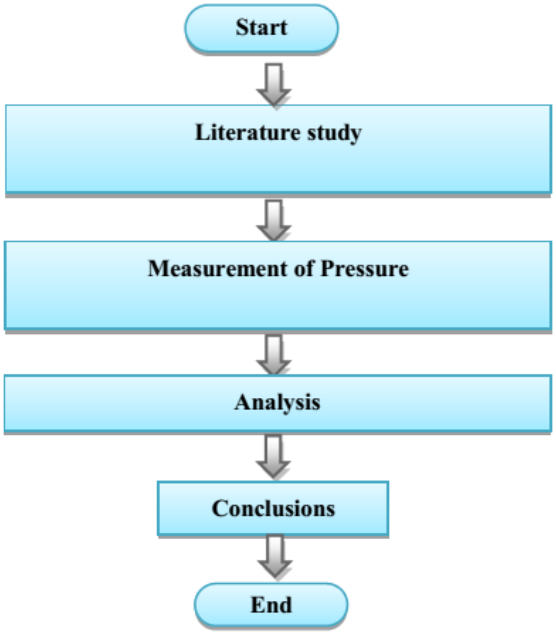

Figure 1. Flowchart of this research

3 Results and Discussion

Vehicle specification

The vehicle used in this research is the type of bus that has 4 wheels with the specifications of the dimensions of the vehicle as follows.
Vehicle Empty Weight: 3030 kg
Vehicle Length: 4950 mm
Vehicle width: 1670 mm
Vehicle height: 2300 mm

Coast Down Method

Coast down method is done to find the magnitude of Rolling Resistance (Rr). As explained in Automotive Technology [12], to find the specified quantities, running vehicles that only experience wind resistance and rolling barriers. Two of the above experiments can meet the numbers required in calculations in accordance with the equations used in the coast down method, namely:

$$\left(\frac{p}{2} x\ a.{V_1}^2\right)\ \ CD + (m.g) f r = m.a_1 \quad (1)$$

$$\left(\frac{p}{2} x\ a.V_2^{\,2}\right)\quad CD + (m.g)f\,r = m.a_2 \qquad (2)$$

Where:

$$V_1 = \frac{Va1 + Va2}{2}(m/dt) \qquad (3)$$

$$V_2 = \frac{Va1 + Va2}{2}(m/dt) \qquad (4)$$

This Coast Down method was used to find the Rolling Resistance coefficient (fr) on each tire pressure variation. So, the above two experiments will be repeated up to 5 times with different tire pressure variations. From the results of the experiment that has been done, obtained the following results. Experimental results with initial velocity of 30 km / h can be seen in Table 1.

Table 1. Experimental Result with Speed 30 km/h

No	Tire Pressure		Va_1 (km/h)	Va_2 (km/h)	t (sec)
	Forward	Backward			
1	88	105	30	20	31.20
2	78	95	30	20	28.70
3	68	85	30	20	25.70
4	58	75	30	20	23.20
5	48	65	30	20	20.20

After an experiment with a speed of at least 30 km / h, it was then experimented with a speed of at least 25 km / h. The results obtained are as follows, see Table 2.

Table 2. Experiment Results with Speed 25 km/h

No	Tire Pressure		Va_1 (km/h)	Va_2 (km/h)	t (sec)
	Forward	Backward			
1	88	105	25	15	17.80
2	78	95	25	15	15.65
3	68	85	25	15	15.40
4	58	75	25	15	11.95
5	48	65	25	15	10.25

Data Va_1, Va_2, a_1, and a_2 can be seen in Table 3 below.

Table 3. Data for Va_1, Va_2, a_1, and a_2

No	Tire Pressure		Va_1 (km/h)	Va_2 (km/h)	a_1 (m/s^2)	a_2 (m/s^2)
	Forward	Backward				
1	88	105	25	20	0.089	0.156
2	78	95	25	20	0.098	0.177
3	68	85	25	20	0.108	0.180
4	58	75	25	20	0.119	0.232
5	48	65	25	20	0.137	0.271

From the above experimental data then the equation of both motion can be written like equations (1) and (2). By completing these two equations, then the average value of fr is known.

Table 4. Equations for Both Experiments

No	Tire Pressure		Use equation (1) and (2)
	Forward	Backward	
1	88	105	52.986 + 41.454 fr = 376.47 33.914 + 41.454 fr = 659.88
2	78	95	52.986 + 41.454 fr = 414.54 33.914 + 41.454 fr = 748.71
3	68	85	52.986 + 41.454 fr = 456.84 33.914 + 41.454 fr = 761.40
4	58	75	52.986 + 41.454 fr = 503.37 33.914 + 41.454 fr = 981.36
5	48	65	52.986 + 41.454 fr = 579.5 33.914 + 41.454 fr = 1146.3

Thus the fr value can be known to each tire pressure as shown in Table 5 below.

Table 5. The fr value for each tire pressure

No	Tire Pressure		Use equation		
	Forward	Backward	fr(a)	fr(b)	fr
1	88	105	0.007	0.015	0.011
2	78	95	0.008	0.016	0.012
3	68	85	0.009	0.017	0.013
4	58	75	0.010	0.022	0.016
5	48	65	0.012	0.026	0.019

After the Coast Down method, the rolling resistance (fr) coefficient on each tire pressure variation is known. The experimental results show that the lower the tire pressure the greater the coefficient of rolling resistance. The tire pressure relation to the rolling resistance coefficient is shown in Figure 2.

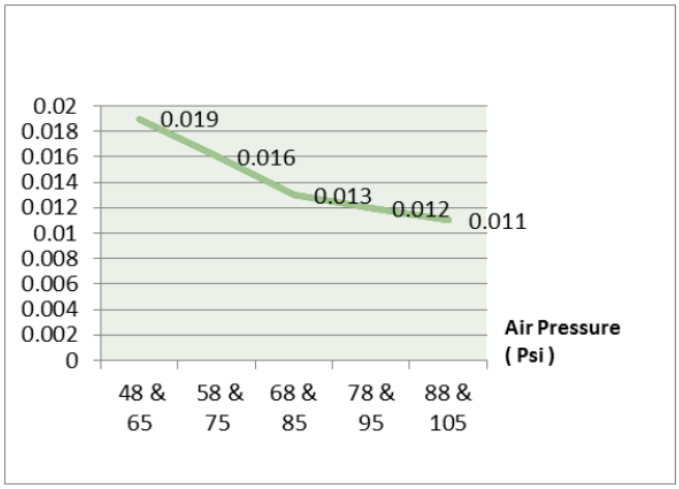

Figure 2. Tension Pressure Relations and fr

Thus the Rr value can be known on each tire pressure as shown in Table 6 below.

Table 6. Value of Rolling Resistance

No	Tire Pressure		Rolling Resistance (N)
	Forward	Backward	
1	88	105	455.994
2	78	95	497.448
3	68	85	538.902
4	58	75	663.264
5	48	65	787.626

If illustrated by the graph, the rolling resistance relationship with tire pressure as Figure 3.

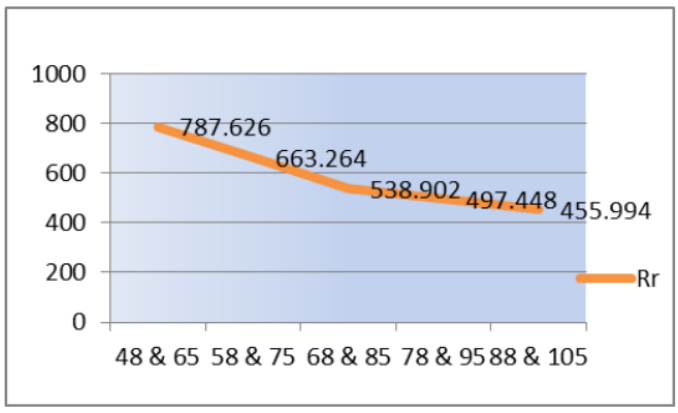

Figure 3. Tension Pressure Relations and Rr

4 CONCLUSION

Based on the above study obtained conclusion that is: Tire pressure specifications (68 psi and 85 psi) produce the smallest rolling resistance force compared to tire pressure under specification. The lower the tire pressure the rolling resistance force is getting bigger. In this research, the biggest rolling resistance force is the lowest tire pressure variation (48 psi and 65 psi). The size of the rolling resistance force affects the effort and energy used to resist the barrier. So the greater the rolling resistance style, the greater the effort and the energy required, the greater the fuel consumption being used.

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