A Review of Literature on Analysis of Energy Produced and Distributed in Rigid Pavement

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I. INTRODUCTION

This paper tries to make study of the energy produced when a tire rolls on the surface of rigid pavement and how it gets distributed into the atmosphere and some absorbed by the rolling tire. This paper will more give emphasis on the portion of energy produced because of the textures provided on the pavement; and will not include the loss of energy due to any other cause. Texture provided on the pavement is basically a series of repeating figures drawn transverse to the moving direction in order to attain a desired value of skid resistance and friction so as to avoid skidding in any condition. But in view of this there is an abrupt increase in the amount of energy being produced and this is causing the problem of tire bursting. There has not been a lot of research going on regarding this issue but research paper related to few key problems involved in this study on combining will pave the foundation for the advance research on this issue. Papers related to tire burst, interior temperature distribution of the rolling tire, tire interaction with the pavement will help in concluding my desired purpose of research.

Afzali B(2006)⁹ This paper studied the effect of change in one step of production of tire on the thermal properties and temperature distribution of the rolling tire by performing a finite element modelling of heat transfer and temperature distribution of a steady state rolling tire. It provided the critical points and the maximum temperature in a rolling tire and it helps in choosing best structure and material of the tire. The tire considered is divided into various zones and it says that each zone has its own boundary conditions for heat transfer analysis and its starting assumption will be useful in making our theoretical study.

L.Tighe(2008)¹¹ This paper performed its study to determine the optimum surface friction and the mean texture depth for cement concrete surface and it was found that mean texture depth of about 1.8 mm provided the maximum friction on textured PCC surface. It calculated the British Pendulum Number(BPN) for measuring the skid resistance and the study evaluated the true effect of asphalt concrete surfaces and pozzolanic cement concrete surfaces on different macro texture and its corresponding surface friction. The different combinations of textures used in preparing the specimen are screed finish, burlap, corn broom and plastic turf drag, exposed aggregate.

Woodsider(2011)¹⁰ This paper has done laboratory tests to measure the dynamic vertical, transverse and longitudinal contact forces under tires with varying inflation pressure and loads. It gave a point that longitudinal contact stresses at the trailing edge of the contact patch were on the higher side when the inflation pressure was low. For further research this paper results can be useful and the effect of these forces in the design of pavement can also be incorporated for a better design.

Yuanmang Xia(2012)⁴ An important paper that has developed a new wireless temperature measurement system that aims to measure the interior temperature distribution of the rolling tire. It gave a vital point with respect to the temperature distribution in a rolling tire that at the beginning the tire temperature is in equilibrium with the ambient air temperature and starts absorbing energy and there is an increase in temperature and after much time it attains an equilibrium or steady state when all the heat generated is transferred to the ambient air and road through the tire boundary. Using this technique the measurement of temperature can be possible and this will enable us in finding out the change in temperature inside the rolling tire when moved at a certain velocity and distance.

Zuraiulis(2014)¹¹ This paper made a study on the impact of the road micro profile on the duration and the type tire road contact with the pavement moving at different speed. It provides a precise data on different types of irregularities relation with the contact time of moving tire with the surface. The results will allow us in quantifying other aspects of the moving vehicle like passenger comfort, suspension system, energy production and distribution.

SadokSassi(2015)⁸ This paper gives a model analysis of the vehicle whose one tire is burst and provides result on the stability and geometry of the vehicle and the driver when phenomenon of tire burst occur. Since tire burst is a fatal phenomenon it relates all the changes that occur in a moving vehicle when the tire blows out. The assumptions involved in this study can be helpful in our study. It gave the point that the blast coming from the tyre blowout generates enough energy to excite the wheel structure resonances but has relatively less effect on the stability of the driver.

Grinchuk(2016)⁶ This paper made a study on the heat exchange with air and gave the temperature profile of moving oversize tire. A very important paper regarding the problem which is being considered under this paper as it gave the mathematical model of heat transfer in a tire and its heat exchange with air; The mean temperature profiles are calculated by considering transition to a stationary thermal regime and the influence of the rate of energy dissipation and
of effective thermal conductivity of rubber on the temperature field is investigated; It will help in finding out the portion of energy exchanged with air theoretically and if we get total energy produced in the system we can be able to find the energy produced by other source.

II. CONCLUSION

• Maximum temperature inside a tire increases non-linearly with the rate of energy dissipation and an increase in the thermal conductivity of the tire material reduces the maximum temperature inside the oversize tire.
• The temperature inside the tire increases sharply during the first few hours and then attain a more or less a constant value due to more intense heat exchange with air.
• The energy that comes out of the tire during bursting phenomenon affects the stability of the vehicle and brings about changes in the road tire interaction.
• During vehicle acceleration the impact of road irregularities to the motion of vehicle is observed in case of 10 mm or more and it has been observed that at speed of 80 kmph or more and irregularities of 30 mm or more, the wheel motion increases in vertical direction and the wheel does not come in contact with the road surface.
• There are no temperature gradients in rolling tire in circumferential direction.
• When the load is heavy and inflation pressure is low, the contact force is highly non uniform.
• An increase in Cross Link Density by increasing the curing time, thermal conductivity falls and it causes an increase in maximum temperature when tire rolls.
• The temperature profiles of the change in temperature going inside the rolling tire has been obtained and the critical points with respect to temperature has been concluded from the previous research works.
• The change in skid resistance value with respect to different types of macro textures is concluded in PCC and AC surfaces.

III. REFERENCES

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