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Research article

PREDICTIVE MODEL TO MONITOR THE PERFORMANCE OF PALM KERNEL SHELL ASH FILLER ON LIFE EXPECTANCES OF HOT ASPHALT FOR HEAVY TRAFFIC

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Abstract

Using of asphalt additives in highway construction is known to give conventional bitumen better engineering properties thus helpful to extend the life span of asphalt concrete pavement. In this research an investigation was made on the fundamental studies of modified asphalt mixtures in order to understand the influence of modifiers on the mechanical properties and fatigue resistance with the aim of preventing fatigue cracking in asphalt pavement. The result generated equations that were resolved to produces theoretical values, these results were compared with other measured values for validation, both parameter produces a favourable fits. These conditions express the mechanical properties and fatigue resistance tests for asphalt concrete mixture performed using a marshal test apparatus. In addition, these modification has proof it rate of contribution to the enhancement of the material properties that govern fatigue life of flexible pavement. More so the research findings of the study has express how the tensile strains in the asphalt bound layer were considerably reduced under the influence of palm kernel filler considered at varying frequencies. The reduction in tensile strain was an indication that the fatigue life of the pavement had been enhanced to carry increased number of design traffic loads within the design period before failure occurs.

Keywords: predictive model, palm kernel shell, and hot asphalt

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Introduction

"Asphalt modifier" includes both asphalt cement additives and asphalt cement extenders. An asphalt additive is a material added to the asphalt cement or asphalt aggregate mixture to improve the properties and/or performance of the resulting binder mix. An additive changes the binder properties, improves the bond between the aggregate and asphalt, or changes properties of the mixture. An asphalt cement extender is an additive which replaces a part of the asphalt cement that would normally be used in the mix. Its use may result in performance improvements, but its primary intent is improved economy (Jones 1990). Asphalt additives and extenders have a long but somewhat limited history in pavement construction. Since the first use of lime and sulphur in asphalt mixtures, over 50 years ago, several hundred modifiers have been introduced. Except for some of the mineral fillers, asphalt modifiers have not been widely used in pavina construction. Limited, comprehensive pavement performance data exists, making the comparison of conventional and modified asphalt concrete mixtures difficult (Suham, E.S. Al-maliky, 2008). Stiff hydrocarbons and mineral filler types of antistrip modifiers can, however, improve mixture stiffness at high temperatures. These modifiers were not selected because improved benefits could be obtained with other types of products. Fiber modifiers appear to be most effective for improving the resistance of asphalt concrete overlays to reflection cracking Fibers do not significantly modify the properties of the asphalt binder hut they can increase the tensile strength of the mix. The literature review suggests that fiber modification does not improve the resistance to rutting. Thus, this type of modifier was eliminated from further consideration (Jones 1990).

Asphalt cement modifiers have been used in pavement technology to enhance pavement performance and reduce different types of pavement distress, of which, rutting, low temperature cracking, fatigue cracking, stripping, and hardening are the most common failure. Fibber is one of the additives used for this purpose (Thomas and Haiming, 1999). Using fibbers to improve the behaviour of materials is not a new concept. The use of fibbers to reinforce a brittle material can be traced back to Egyptian times when asbestos fibber was used to reinforce clay pots about 5000 years ago (Mehta, 2006 Rajas, 1999, Roux, et al 1996). Fibbers are widely used as reinforcing agent in concrete, however, the modern ways of fibber reinforcement started in the early 1950s (Saeed and Ali, 2000, brudopandley, 2010). Fibbers are sometime sadded to stabilize the binder during mixing and placement. An additional benefit of using fibbers is that fibbers have been shown to allow increased asphalt binder contents and thus increase film thicknesses thereby increasing durability (Thomas and Haiming, 1999 Aravind and Das, 2007).

Flexible pavements are designed so as to have at least 20 years project life. The current researches include studies that focusing on increasing the performance and lifetime off-road pavements. It is aimed to increase the performance and lifetime of roads by using different additive materials. (Serin *et al*., 2012, Ahmed et al 2014, Dhodapkar, 2008). Steel fibers have been used in concrete since the early 1900s. The early fibers shape was round and smooth and the wire was cut or chopped to the required lengths. The use of straight, smooth fibbers has largely disappeared and modern fibbers have either rough surfaces, hooked ends or are crimped or undulated through their length. Modern commercially available steel fibbers are manufactured from drawn steel wire, from slit sheet steel or by the melt-extraction process which produces fibbers that have a crescent-shaped cross section (Dun-Qiao, 2010Ravindra *et al*, 2011 Ahmed et al 2014).

2. Materials and Methods

The materials used in this research study include 40/50 penetration grade bitumen, river sand free from deleterious materials and crushed granite purchased from a quarry site at mile 3 area of Port Harcourt, while periwinkle shells were obtained in sufficient quantities from mile 3 market, where they were dumped after the removal of the edible portion. Impurities such as soils and other dirt were removed and the shells were sun dried including oven dry at a temperature of 400c and crushed. And sieved with sieve No 200. Table 1 gives a summary of the result of some of the test performed on the bitumen. Also Table 2 gives some properties of coarse and fine aggregates.

3. Results and Discussion

Table: 1 predicted and measured values of palm kernel at various percentage

% Palm Kernel Shell Ash	Measure Values on Number of circle	Predicted Values on Number of circle
0	7.51483512	7.492813
1	7.534839059	7.540493
2	7.546506391	7.549969
3	7.550564042	7.559311
4	7.553687471	7.574638
5	7.68481501	7.675188

Table: 2 predicted and measured values of palm kernel at various percentage

% Palm Kernel Shell Ash	Measure Values on Number of circle	Predicted Values on Number of circle
0	7.495623345	7.445421
1	7.515627156	7.492543
2	7.527294472	7.501952
3	7.531352125	7.511181
4	7.53447553	7.52646
5	7.665603181	7.626118

Table: 3 predicted and measured values of palm kernel at various percentage

% Palm Kernel Shell Ash	Measure Values on Number of circle	Predicted Values on Number of circle
0	7.459364751	7.436208
1	7.479368736	7.483395
2	7.491035935	7.492869
3	7.495093719	7.502116
4	7.498217033	7.517244
5	7.62934465	7.617876

Table: 4 predicted and measured values of palm kernel at various percentage

% Palm Kernel Shell Ash	Measure Values on Number of circle	Predicted Values on Number of circle
0	7.429506478	7.344683
1	7.449510402	7.496053
2	7.461177677	7.497621

3	**7.465235244**	**7.5009**
4	**7.468358717**	**7.507104**
5	**7.599486326**	**7.521928**

Table: 5 predicted and measured values of palm kernel at various percentage

% Palm Kernel Shell Ash	Measure Values on Number of circle	Predicted Values on Number of circle
0	**7.355368982**	**7.332923**
1	**7.375372921**	**7.379427**
2	**7.387040105**	**7.388931**
3	**7.39109786**	**7.398045**
4	**7.394221306**	**7.412874**
5	**7.525348911**	**7.514116**

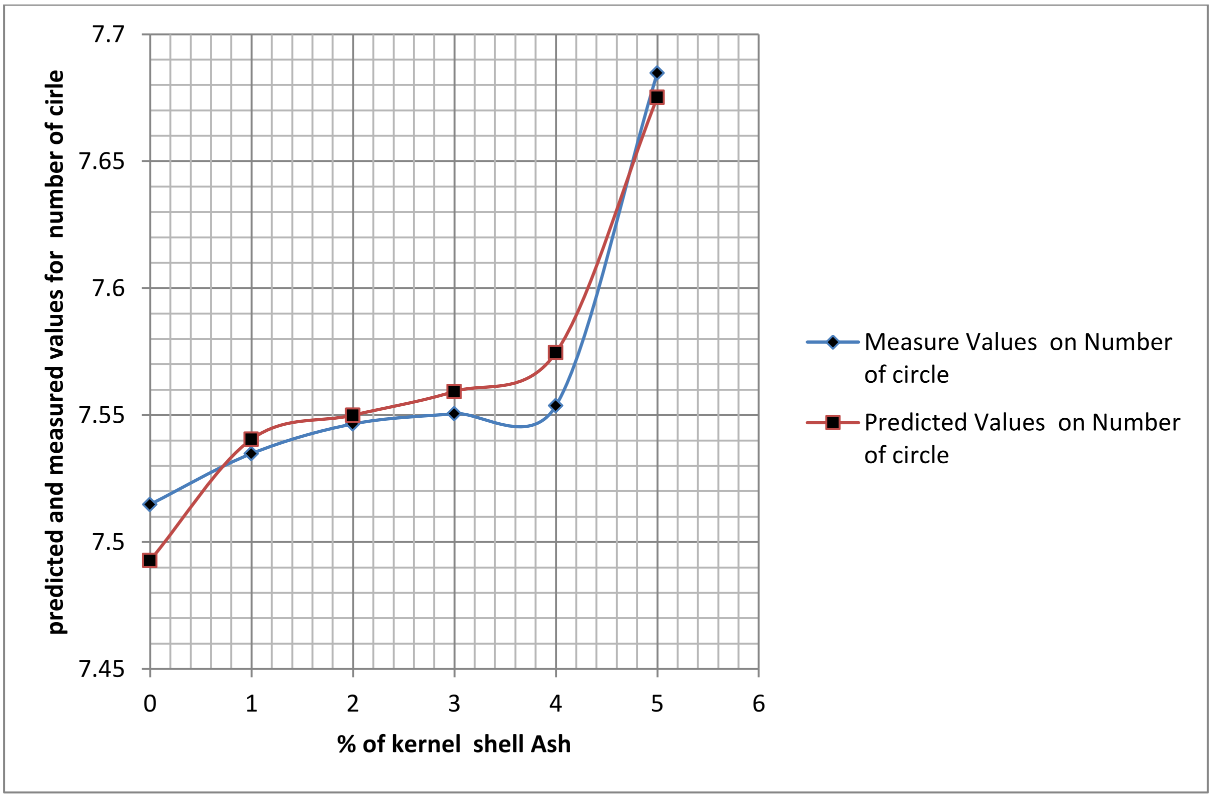

Figure: 1 predicted and measured values of palm kernel at various percentage

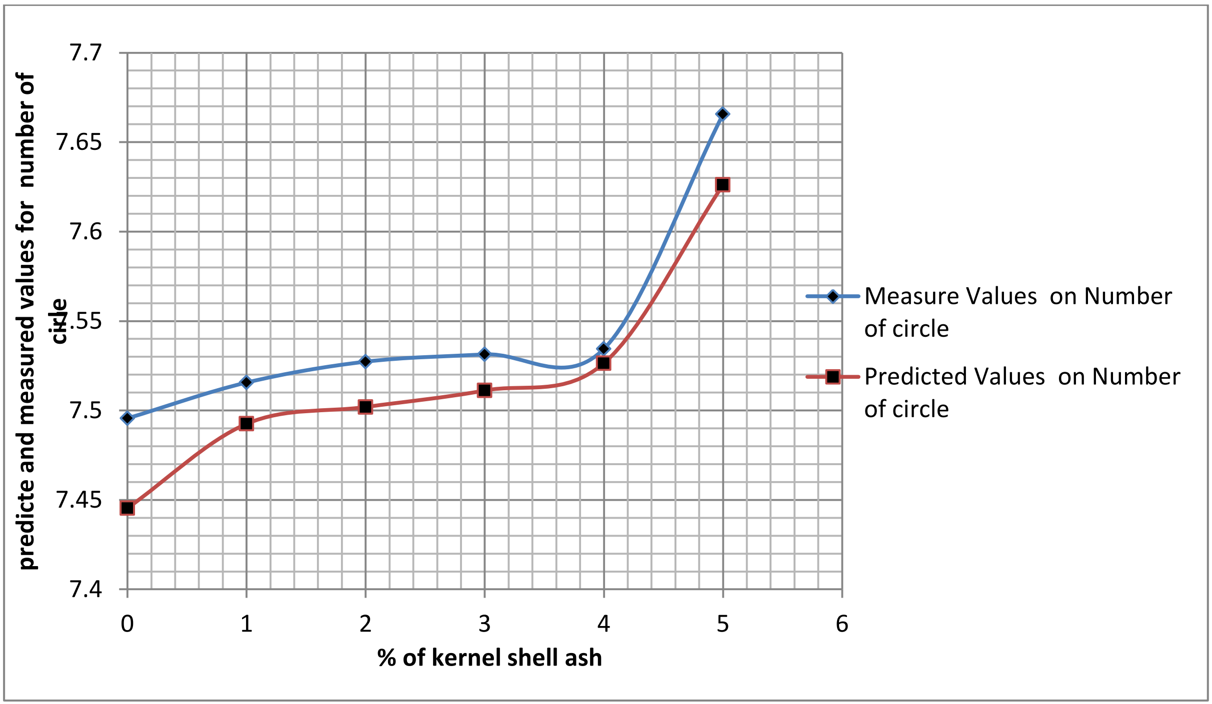

Figure: 2 predicted and measured values of palm kernel at various percentage

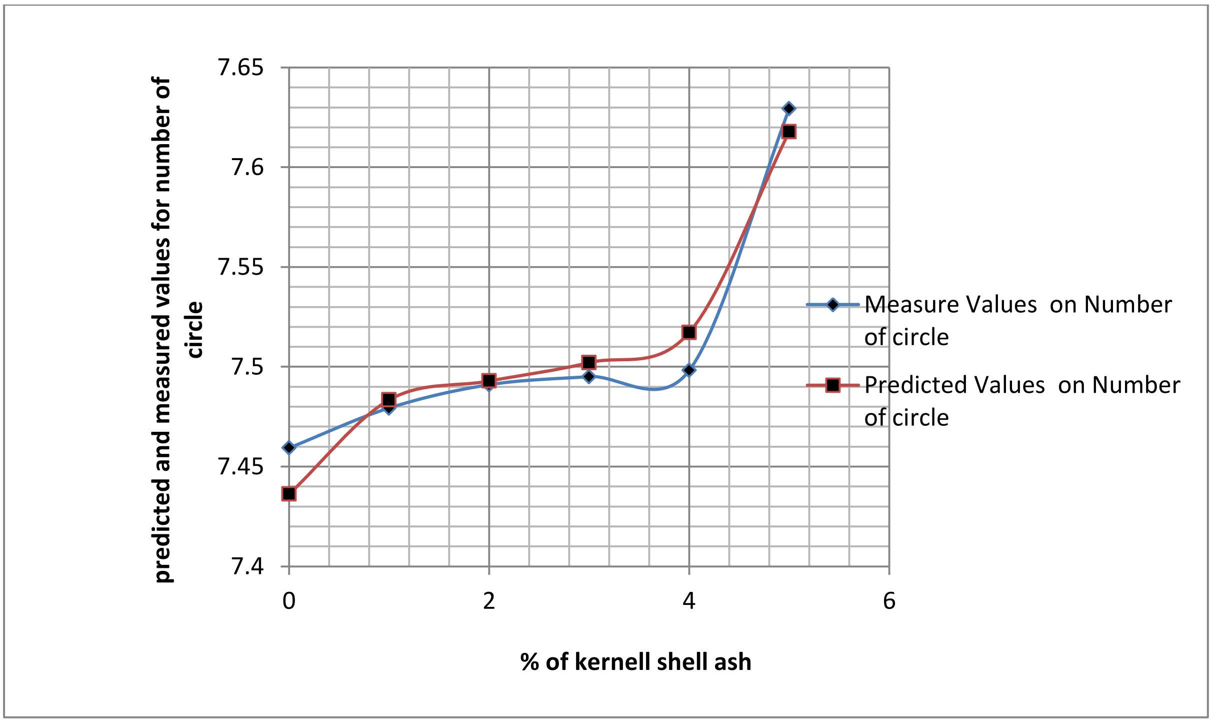

Figure: 3 predicted and measured values of palm kernel at various percentage

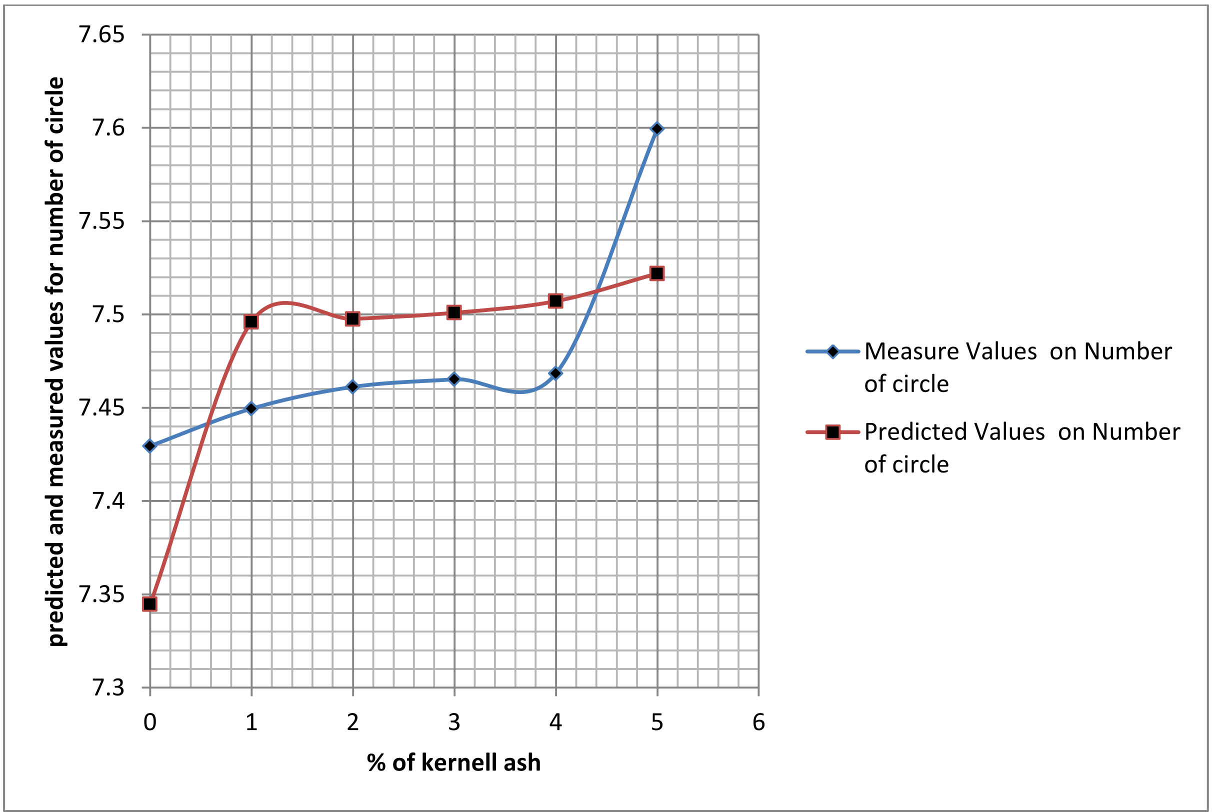

Figure: 4 predicted and measured values of palm kernel at various percentage

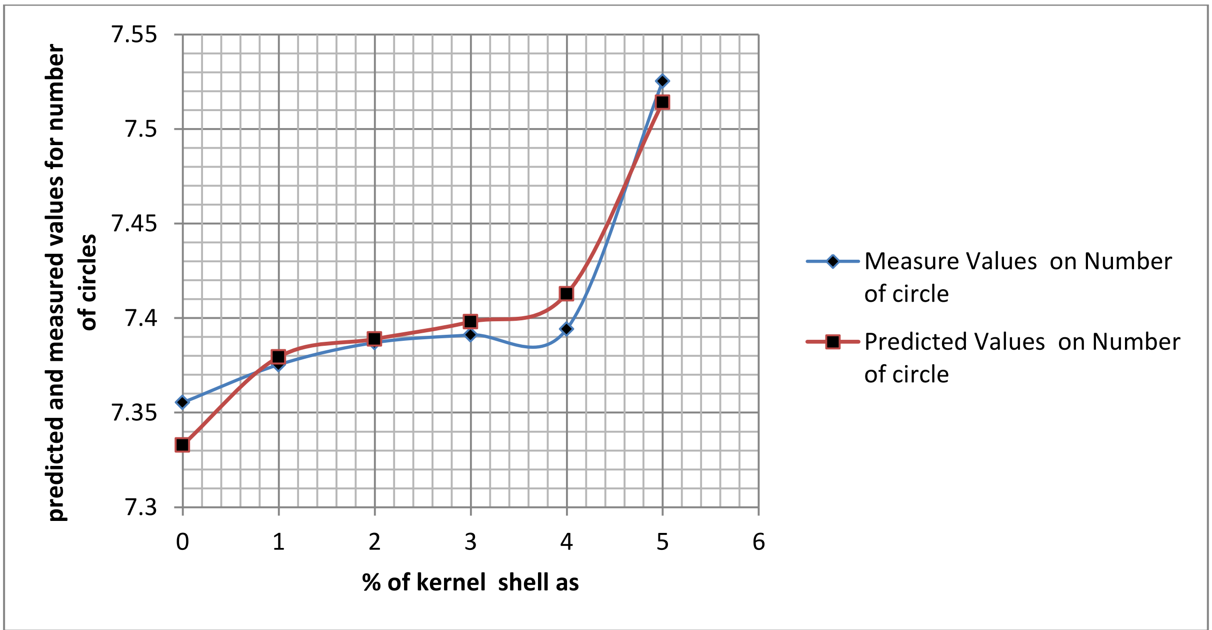

Figure: 5 predicted and measured values of palm kernel at various percentage

From figure 1 express the behaviour of the local content material were observed base it trend as gradual increase were experienced to the optimum level. More so the performances of the local material rapidly increase from 4%. These produces similar trend in flow, From figure 2 predicted and measured value showed vacillation in its increase between 4 and 5% rapid increase were observed, but in trend the predicted values were showing low values thus show similar trend in flow. From fig 3 it also express similarities with other figure above, exponential condition were experiences between 4 and 5% it could be seen that the predicted and measured value showed fluctuation and increased to the optimum value thus show similar trend in flow. While in fig 4 it is observed that the predicted value experienced Sharpe increases at 1% and gradually show linear increase. While that of the measured values showed a gradual increase and fluctuated at 4% content. Both values show similar trend in increase. From fig 5 it could be seen that the predicted and measured value express gradual increase, sudden exponential phase were experienced from 4 and 5% thus show similar trend in flow.

4. Conclusion

Predicting the performance rate of palm kernel shell as filler has definitely establish higher level of stability base on it level of performances on traffic load. To determine the performances rate with palm kernel, the relationship between the Dynamic Modulus and the loading frequencies for the five tested groups (0, 1, 2, 3, 4 and 5% PKA) were expressed. The 5% PKA mixes showed the best performance, followed by the 3%, 1%, 7% and 0% PKA mixes, respectively. The addition of PKA improved the performance of the modified asphaltic concrete and increased resistance to permanent deformation. Furthermore, the dynamic modulus showed a proportional correlation with the horizontal tensile strain properties of the mixes, in simple words; an increase in dynamic modulus properties of the sample is followed by a decrease in horizontal tensile strain, this condition implies that the rate of fatigue in flexible pavement will definitely reduces base on the performances of palm kernel content in hot mix asphalt, the life expectancy on the design for durability of flexible pavement with its application will definitely achieve it expect results.

References

[1] Jones R. 1990, Modifiers for asphalt concrete air force engineering & services center engineering & services laboratory tyndall air force base, Florida 32403.

[2] Ahmed S. D. AL-Ridha, . Atheer Naji Hameed, Sinan Khaleel Ibrahim; 2014 Effect of steel Fiber on the Performance of Hot Mix Asphalt with Different Temperature sand Compaction Australian Journal of Basic and Applied Sciences, Pages: 123-132.

[3] Mehta, P.K. and P.J.M.Monteiro, 2006.Concrete; Microstructure, Properties, and Materials. 3rd ed., New York: McGraw-Hill.

[4] Saeed, G.J. and K.Ali,2000.Carbon Fiber Reinforced Asphalt Concrete. The Arabian Journal for Science and Engineering, 33(2B): 1297-1304.

[5] Suham, E.S. Al-maliky., 2008.Prediction Model of Permanent Deformation Paving Materials. A special edition for engineering and development refereed scientific engineering journal. Comprehensive scientific engineering conference, no.3, parts I.

[6] Ravindra, V.S., C.B. Mishra, F.S. Umrigar and D.A. Sinha, 2011.Use of Steel Fiber in Concrete Pavement: A Review. National Conference on Recent Trends in Engineering & Technology

[7] Serin.,S., N. Morova, M. Saltan and S. Terzi, 2012. Investigation of Usability of Steel Fibers in Asphalt Concrete Mixtures. Construction and Building Materials,36: 238-244.

[8] Rajas,J., S.nazarian, V. Tendon and d.Yaun,1999.Quality Management of Asphalt-Concrete Layer Using Wave Propagation Techniques. Journal of association of asphalt paving technologists, 68.

[9] Roux, N., C. Anreadeand M.A.Sanjuan, 1996. Experimental Study of Durability of Reactive Powder Concretes. Journal of Materials in Civil Engineering, February, pp: 1-6.

[10] Aravind K. , Das Animesh, (2007), "*Pavement design with central plant hot-mix recycled asphalt mixes"*, Construction and Building Materials, Vol. 21, Dept. of Civil Engg., Indian Institute of Technology Kanpur, India, pp 928–936.

[11] Bandopandhyay T. K., (2010*), "Construction of Asphalt Road with Plastic Waste",* Indian Center for Plastic in Environment (ICPE), ENVIS – Eco- Echoes, Vol.11, Issue 1.

[12] Dhodapkar A N., (2008*), "Use of waste plastic in road construction",* Indian Highways, Technical paper, journal, P No.31-32.

[13] Dun Qiao.,(2010), "*Utilization of sulfate-rich solid wastes in rural road construction in the Three Gorges Reservoir*", Resources, Conservation and Recycling, Vol.54, College of Materials Science and Engineering, Chongqing University, China, pp 1368–1376.