International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 06 | June 2019 www.irjet.net p-ISSN: 2395-0072

Relationship between Asphalt Concrete and Accident a Case Study of Libya

Meutaz Almahdi[1], Hüseyin GÖKÇEKUŞ[2], Youssef Kassem[3]

[1,2]Faculty of Civil and Environmental Engineering, Civil Engineering Department, Near East University, 99138 Nicosia, Cyprus
[3]Faculty of Engineering, Mechanical Engineering Department, Near East University, 99138 Nicosia, Cyprus

---

Abstract - *In this paper, a detailed review has been conducted to highlight the effect of various asphalt concrete mixtures on slip resistance. In addition, in order to reduce traffic accidents in Libya, the slip resistance of five various asphalt mixture collected from the previous scientific research is compared with type of asphalt used in Libya. The properties of asphalt concrete in terms of slip resistance are discussed. Traffic accidents data over various periods to show the main reasons for raising the traffic accidents in Libya is due to the low slippage resistance of highway surfaces. The results concluded that asphalt mixture will help to improve and build the road with higher resistance to sliding, one of the objectives of sustainable development especially in Libya.*

Key Words: *Asphalt concrete1, Libya; resistance2, Traffic accident3, sustainable developmen4, accident5.*

1. INTRODUCTION

In Libya, traffic accidents are the number one cause of death in the country after the wars, and Libya topped the international list in 2015 of road traffic deaths by 73.4 per 100,000 inhabitants [1]. According to the 'WHO' report, road traffic accidents lead to death More than 1.3 million inhabitants each year and another 50 million people are Injuries the numbers are increasing in many countries. If appropriate measures are not taken by 2030, road traffic accidents will be listed as the fourth- most important cause at the end of the lives of many people in the world.

It isprospectivethat it will death about 2.6 million people annually a number of previous studies have shown that rainfall generally leads to more accidents compared to dry conditions [2]. One of the main reasons for the increase in the number of traffic accidents is the reduction of slippage resistance to highway surfaces in order the type of asphalt used, as the type of asphalt used in Libya mentioned above is not effective for the weather conditions in the country and especially in the winter season with rain. The objective of this study is to determine the asphalt concrete mix with higher sliding resistance value to be proper for the location or country of study. This is verified by determining the slip resistance value of the different asphalt concrete mixture after analyzing some previous studies in order to determine the value with high slip resistance. The slip resistance of the pavement surface is affected by many factors including total polishing, weather (wet or dry), temperature, microtexture, pavement surface and macrotexture. In this research, slip resistance will be considered as a factor in the asphalt concrete mix, which deals only with microscopic texture, and microtexture of the pavement [3,4].

Libya

Libya (Figure1) is an Arab country located in the North African continent and on the southern coast of the Mediterranean Sea. Egypt is bordered to the east, Sudan to the southeast, Chad to the south, Niger to the southwest, Algeria to the west and Tunisia to the northwest. , Three major cities were selected in terms of congestion, area, population density and the highest percentage of traffic accidents. The cities are Tripoli, Benghazi and Misrata. Figure 2 shows the number of traffic accident in Libya over a period 2008-2017. It is observed that in the last three years (2015-2017), the number of injure due the traffic accident reached about 7000 injures per year, According to World Health Organization.

Figure -1: Map of Libya

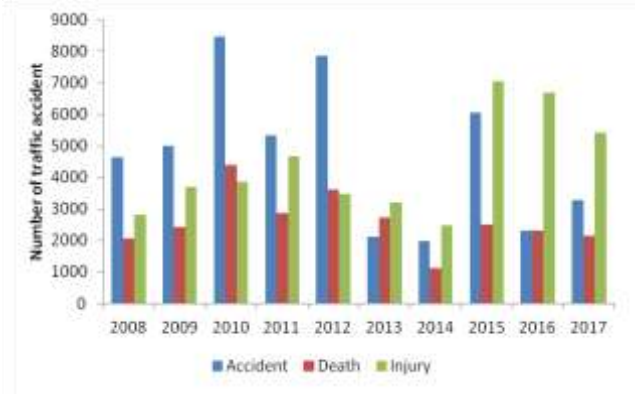

Figure -2: Traffic accident in Libya over the period 2008-2017

Based on the report of the Libyan Ministry of Health, the number of populations is annually increased by 2% as shown

Figure 3:

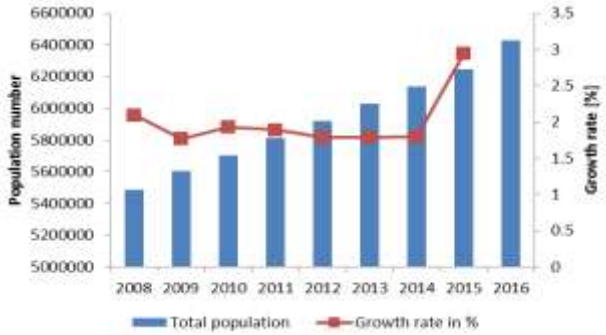

Figure -3: Population number and growth rate in Libya during the investigation period (2008-2016)

Most of Libya's area (1.7 million kilometerssquare) consists of desert terraces: grazing with slavery or veins. The highlands cover a large area, and the plains are confined to the Mediterranean coast, narrowing in the east and widening in the middle. Climatically, the coastline is affected by Mediterranean influences, while the desert influences include most of the country, 95% of the total area, which makes all rivers run seasonally.

Libya can be divided into five different climatic zones, but the prevailing climates are the Mediterranean climate, hot summer, and desert climate in most of the coastal lowlands. The climate is Mediterranean, with a hot or very hot summer and mild winters. Rain is relatively low. The weather is cooler in the highlands, and frosts occur at the highest elevations in the desert interior, although they are relatively high, and their summers are very hot because of the clear sky and dry air. Previously recorded the highest temperature ever on 13 September 1922 in Azizia, Libya has reached (58°C).

1.1 Tripoli

Tripoli is the capital of Libya and its largest city. It has a population of 2,200,000 people in 2016. It is the most crowded Libyan city, located in north-western Libya. The city is built on a rocky peak overlooking the Mediterranean Sea off the southern tip of Sicily. It is bordered by the Tajoura area, west of Janzur, south of El Sawani, and the Mediterranean Sea to the north. The centre of the city is Martyrs Square and Red Seragal. The city of Tripoli is described as "the bride of the Mediterranean", for the beauty of orchards and white buildings. Tripoli is also called "West Tripoli" to distinguish it from "Tripoli Sham" in northern Lebanon.

1.2 Benghazi

Benghazi is the second largest city in Libya, with a population of 1,001,000 and is considered the economic capital of 2012, overlooking the Mediterranean coast. The city's radiation is concentrated in the Benghazi Lake in the city center. Major Benghazi includes cities and towns in the south, such as Gummins, Slough, Abyear and Tukra.

1.3 Misrata

Misurata is a city in Libya and some statistics place it among the third largest population density in Libya after the cities of Tripoli and Benghazi. Misurata includes 350,000 people in 2016 and is located on the Mediterranean Sea on the western tip of Cedar Bay, located about 208 km east of Tripoli, Characterized by their fertility and economic importance. It is the only steel and iron factory in Libya, a Libyan state-owned company and a huge conglomerate of more than 6,000 workers.

1.4 Asphalt use on Libya

The current asphalt binder specifications in Libya are based on the penetration grade which is based on simple empirical tests such as penetration test and softening point test. These specifications are based on experience and observations and they are not considering the theory of pavement performance and the Long term aging of the binder. Asphalt cement grade 60/70 is the sole binder used in construction of asphalt pavements in Libya. Pavement performance in the north coastal regions is different from pavement performance in the central and southern regions of Libya. Pavement performance in the north coastal regions was satisfactory in most of the cases while pavements performance in the desert region were unsatisfactory. Premature Thermal cracks appeared on all roads in the central and southern regions due to fast binder aging and due to wide temperature.

Asphalt is high-viscosity oil with black color, extracted through the distillation of crude oil under pressure and high

temperatures up to 300 ° C. It has many different types of liquidity and concentration, as well as the temperature of melting and freezing.

It is used as an adhesive between the particles of small building stones (aggregate) to become a good and effective material for pavement of the streets and the ground of airports and is called (asphalt mix)There are many types of asphalt mixtures used in road construction such as:

1) Cold Bituminous Mix.
2) Penetration Macadam.
3) Mastic Asphalt.
4) Sheet Asphalt or Rolled Asphalt.
5) Sand Asphalt.
6) Hot Mix Asphaltic Concrete.

Type of asphalt mixtures use in Libya:
Hot asphalt mixtures…
Hot asphalt mixtures are used for paving the surface layers of important highways, whether inside cities or cellular roads. These mixtures have proved to bear the heaviest traffic types if they are designed, well prepared, and placed on an appropriate foundation layer.
Components of hot asphalt mixtures:

The hot asphalt mixture consists of a homogeneous gradient of crushed mix (a mixture of crushed stone, sand and powder) coated with a layer of solid asphalt and for drying the aggregates and obtaining sufficient liquidity for the solid asphalt. Mixing and operation, hence the label (Hot Mix).
Mixing of aggregates and solid asphalt is done at the mixing plants as shown in the picture, where the aggregates in the dryer and the asphalt are heated to the appropriate temperatures to complete the mixing process in the mixer, Transfer the mixture to the paving site where it is laid on a layer of regular and flat thickness by the finisher and then crushed by the equipment of the stamp to obtain a smooth surface level and fixed.

-The disadvantages of hot asphalt mixtures:

There are a number of disadvantages that lead to the rejection of the hot asphalt mixture summarized in the following:

-Heat the mixture
Increasing the heating of the mixture leads to the oxidation or hardening of the asphalt, which causes the weakness of the hot asphalt mixture. This is shown by the rise of blue smoke from the mixture. If the temperature is measured above the prescribed, the mixture is rejected and necessary to repair the condition in the mixing plant.

-Cooler mixture
Cold mixtures cause disintegration of the brushing and settling machines and reduce their portability and should be rejected if the temperature is less than the prescribed and the cold mixture can be inferred from the appearance where it looks frozen and notes the irregularity of covering coarse solid materials in asphalt and this is one of the problems experienced by Libya.

- Increase asphalt ratio
This can be easily observed. The mixing surface of transport vehicles is level or horizontal rather than pyramid-shaped, as appears behind the Fischer, and it must be tested immediately.

-Shortfall in asphalt
The mixture shows a rough appearance with irregularity of coarse material coverage and the disappearance of gloss in the mix and after the brushes appear from the dry shape and brown color that appears on the surface with difficulty data studies.

-Irregularity of mixing
This is evidenced by the presence of weak dry patches of mixed brown color in shiny parts with excess asphalt content.

-Increase the percentage of aggregates
It looks rough, not easy to operate and appears as if it contains a high percentage of asphalt for the small surface area of rough aggregates.

-Increase the proportion of soft materials
The mixture is brown in color, such as mixtures with low asphalt content, which can be distinguished from the clear difference between them and the gradual mixture, as well as from the behavior of the mixture during the brushes and mashed down the terraces.

2. Previous study

Mayora & Piña (2009) studied the effect of the skid resistance on the traffic safety under wet-pavement conditions. They found that the importance of maintaining adequate levels of pavement friction to safeguard traffic safety as well as the potential of pavement friction improvement schemes to achieve significant crash reductions [5].

Do et al., (2009) analyzed the surface profiles of different polishing stages in order to better understanding of the evolution of the road-surface [6].

Kogbara et al. (2016) discussed the impact of skid resistance measurements on asphalt pavements. They concluded that frictional performance of asphalt pavements largely depends on coarse aggregates [7].

Andriejauskas et al. (2014) studied experimentally the parameters influencing skid resistance by using different methods and devices [8,9].

Musey & Park (2016) reviewed the crash data to identify the correlation between pavement skid number, roadway curvature degree, crash rate, and crash severity[10].

Moore & Humphreys (2015) proposed the correlation between skid resistance, which is measured as skid resistance trailer, and mean [11].In addition, the effect of asphalt content and asphalt concrete of the skid resistance properties of roads was studied by Asi (2007) [12]. The experiment, which done by Asi (2007) [12] can be described as follow: a sample of 15cm diameter and 7cm height were compacted using Super pave Gyratory. The gyratory compactor was used because it can simulate field compaction, and compact samples of 15 cm diameter, the sample height was controlled. 15 cm samples were used since the recommended contact path for the British Pendulum shoe on the asphalt concrete surface is between 124 and 127mm. The British Pendulum was designed to test field asphalt concrete surfaces and not designed to test asphalt concrete laboratory samples, therefore its base was adjusted to accept 15 cm samples as by constructing a special fixture to hold the samples firmly in place. In addition, longer ones to accept the 7 cm height samples replaced the height of the adjusting screws of the pendulum[12, 13]. Moreover, the skid resistances of the six different mixes were evaluated in accordance of ASTM E303-93 test procedure. The first mix is of an asphalt concrete mix using local limestone aggregate compacted at the required optimum Marshall asphalt content, mixes with 0.5% and 1.0% asphalt contents higher than Marshall optimum asphalt content, a mix designed using Superpave design procedure, a mix with steel slag to replace 30% of limestone aggregate, and a mix with stone matrix aggregate gradation. Three samples from each mix were tested for skid resistance evaluation. On each sample, the test was repeated five times[11]. The average value of each mix was considered as skid numbers for that mix. At the end, the result of the skid resistance for different mixture was presented in Figure 4. The results showed the mixture with 30% slag has the highest skid resistance number and least value for standard deviation than all the mixture types. The is due to the 30% replacement of the coarse aggregate with steel slag which have more friction than the aggregates. Increasing bitumen content above the optimum value was found to be a factor decreasing the skid resistance of the pavement as can be seen that the skid number is decreasing from **87.2** for optimum content to 81.3 for 0.5 increase and finally down **73.9** which about 12.8% decrease [14].

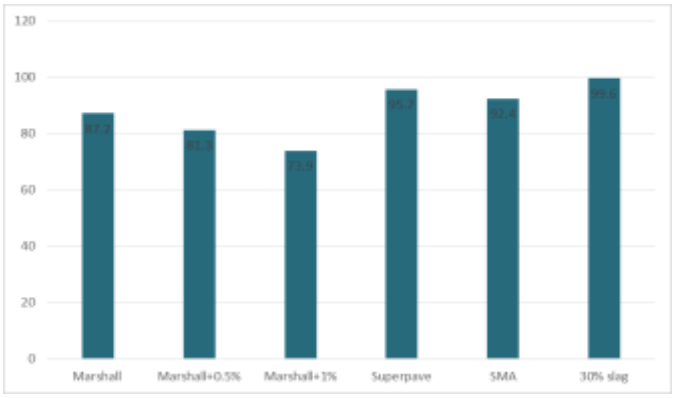

Figure -4: Average Skid Resistance for Different Mixes 12

3. CONCLUSIONS

Main objective of the study is to find the type of asphalt mixture based on the skid resistance to reduce the number of traffic accidents in Libya. Based on the results, the following modifications can be made:

- The slip resistance of asphalt concrete surfaces shall be verified on the Libyan roads during the service period of the road.
- The addition of steel slag can be applied to asphalt concrete mixtures and the use of SMA in Libya to improve the resistance of road surfaces, especially at highway intersections.
- The group designed according to the Superpave design procedures is characterized by slippery numbers better than those designed using the Marshall Mix design procedure.

References

1. World health organisation. Global Status Report on Road Safety: Time for Action. 2009.

2. Persson B N J, Tartaglino U, Tosatti, E., et al. Rubber friction on wet rough substrates at low sliding velocity: the sealing effect. *Kautschuk Gummi Kunststoffe*. 2004 October57 (10), pp. 532-537.

3. Ueckermann A, Wang D, Oeser M, Steinauer B. Calculation of skid resistance from texture measurements.*Journal of traffic and transportation engineering. 2015*, 2 (1), pp. 3-16.

4. 4. Zhang X, Liu T, Liu C, Chen Z. Research on skid resistance of asphalt pavement based on three-dimensional laser-scanning technology and pressure-sensitive film.*Construction and Building Materials*. 2014 October, 69 (1), pp.49–59.

5. 5. Mayora J M, Piña R J. An assessment of the skid resistance effect on traffic safety under wet-pavement conditions. *Accident Analysis & Prevention*, 2009 May, 41(4), pp. 881-886.

6. 6. Do M , Tang Z, Kane M, Larrard F D. Evolution of road-surface skid-resistance and texture due to polishing. *Wear*, 2008 Apr, 266(5-6),pp. 574-577.

7. 7. Kogbara R B, Masad E A, Kassem E , Scarpas A , Anupam K. A state-of-the-art review of parameters influencing measurement and modeling of skid resistance of asphalt pavements. *Construction and Building Materials*, 2016 Apr, 114(1),pp. 602-617.

8. 8. Andriejauskas T, Vorobjovas V, Mielonas V. Evaluation of skid resistance characteristics and measurement methods-141. The 9th International Conference, Lithuania, 2014 May,pp. 22-23.

9. 9. Romanoschi S, Metcalf J. Evaluation of probability distribution function for the life of pavement structures. *Journal of the Transportation Research Board*. 2000, 1730(1), pp. 91-98.

10. 10. Musey K, Park S. Pavement Skid Number and Horizontal Curve Safety. *Procedia Engineering*, 2016 Apr, 145(1), pp.828-835.

11. 11. Moore A, Humphreys J. High Speed Skid Resistance and the Effects of Surface Texture on the Accident Rate. *Skid Resistance of Highway Pavements*. 2015Oct,1520(1),pp.38-40.

12. 12. Asi I M, Evaluating skid resistance of different asphalt concrete mixes, *Building and Environment*.2007, 42 (1), pp. 325–329.

13. 13. Ksaibiti K, Cole M, Farrar M. Evaluation of surface treatment practices in the United States. *Transportation Research Record*. 1996, 1545(1), pp. 26–34.

14. 14. Luce A, Mahmoud E, Masad E, Chowdhury A. Relationship of aggregate micro texture to asphalt pavement skid resistance. *Journal of Testing and Evaluation*. 2007 November,35 (6), pp. 1–12

BIOGRAPHY

Meutaz AL Mahdi-He is master student at Faculty of Civil and environmental engineering, civil engineering department; he was born in july 1987.