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Recycling Asphalt Concrete

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Abstract: *This study was conducted to evaluate the re-use of asphalt concrete waste in the surface layer. The reason for choosing this layer is because the surface layer of most parts of the road network is always the most exposed to maintenance processes that often include scraping and re-spreading of the surface layer. It is expected that there would be an increasing demand for this type of asphalt mixtures.recycled asphalt can be used in building and maintenance of paved roads as a substituting material of aggregates and binding materials in hot asphalt mixture. Recycling asphalt would save a huge amount of money in building and maintaining roads. It would also help in protecting the environment and reduce the demand for aggregates and binding materials.*

In this study, a sample was collected from one damaged road in Sirte. Aggregates were obtained after extracting asphalt from the used concrete asphalt. Mixtures of used materials with the addition of new un-used aggregates as per Marshall Method were prepared and their properties were defined. Also, a mixture of new material was studied as a reference for comparison. The proprieties of the both mixtures were evaluated. The results showed that the properties of the mixture of recycled elements with new elements achieve the required qualities of asphalt mixture used in surface layer, and they also archive significance increase in Marshall's stability.

1. Introduction

Libya has one of the biggest highway network in Africa and the Arab World. 90% of the roads in Libya are paved with asphalt to the surface layer. The length of this network is estimated to be about 34000 Km; 1600 Km of main roads and 18000 Km of secondary and agricultural roads.

As a result of the different factors that affect the roads such as the heavy loads, high rates of traffic and bad climate conditions. That leads to the damage of the surface layer which requires the re-paving of the surface layer and disposing the remains. This leads to an increase in the demand for Aggregates and binding materials which pollutes the environment.

It is stated that secondary and agricultural roads need a strengthening asphalt concrete layer of 4Cm thickness every 6 years. To decrease the cost of maintaining the above mentioned roads, recycling the remains of surface layer of main roads is needed.

2. Research Discussion

The components of the asphalt sample were isolated using the isolation machine. Tests and experiments on the components of the mixture to define their properties were conducted.

❖ First: Asphalt tests:

The following table shows the results of the asphalt that was extracted from the sample and compares them to 70/60 asphalt which is used in asphalt mixtures in Libya.

TABLE: (1) Results of tested the properties of extracted and 60/70 bitumen

Test	Unit	Test result extracted	Test result 60/70	Specification limits
Penetration 25C°	0.1mm	39	64	60-70
Ring and Ball softening point	C°	32	51	40-60
Specific gravity at 25C°	_	0.85	1.035	1.01-1.06
Flash point	C°	193	295	245-335
Ductility at 25C°	cm	88	105	≥100

As the target of the study is to decrease the percentage of the new asphalt in the mixture and substitute it with the recycled asphalt. The combination should have the same properties with the mixture used in Libya which is 60/70.

Different proportions were used; they were as follows (Recycled/New)

(0/100) , (10/90) , (20/80) , …….. (0/100)

Tests shown in the above mentioned table were conducted on each proportion as to accomplish two conditions;

1. The properties of the asphalt used in Libya.
2. Reduce the usage of new asphalt.

The best proportion is (20/80) as it accomplishes both conditions.

Results of composition 20% extracted +80% bitumen 60/70 in Table (2)

Test	Unit	Test result	Specification limits
Penetration 25C°	**0.1mm**	**63**	**60-70**
Ring and Ball softening point	**C°**	**50**	**40-60**
Specific gravity at 25C°	**_**	**1.02**	**1.01-1.06**
Flash point	**C°**	**255**	**245-335**

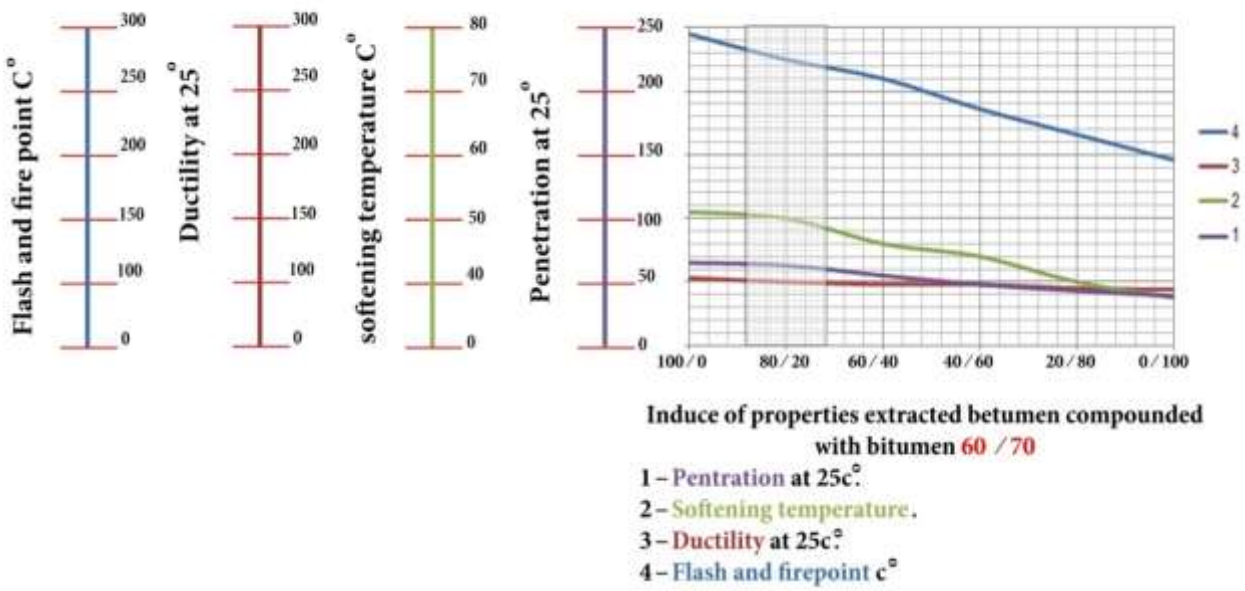


Fig. 1: Induce of properties extracted bitumen compounded with bitumen 60 /70

❖ Second: Aggregate Tests:

Quality weight test was conducted as well as shattering test (Los Angeles) on the recycled aggregate and Basalt aggregate. The results achieved matched the standards.

Fig. 2: Combining old aggregate (extracted) and new aggregate

- **Mixture composition using Marshall Method:**

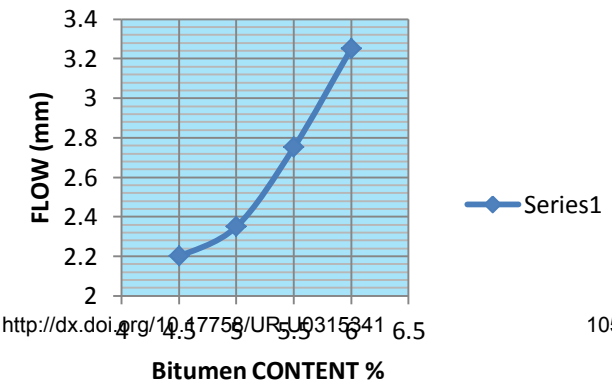
Samples of asphalt mixtures were prepared by increasing the percentage of asphalt content by about 0.5%, starting from 4.5% up to 6%.. Three samples of each percentage were used. The following table shows the percentage of each element in the mixture.

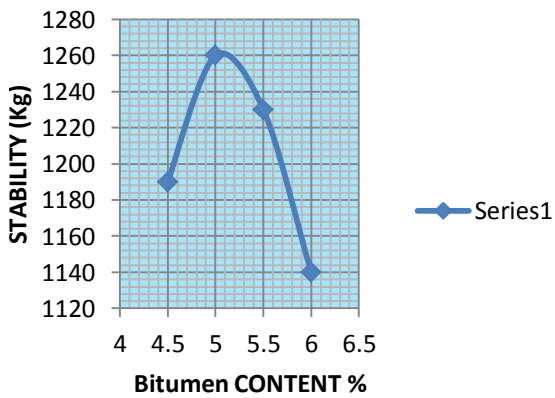
TABLE: (3) The result of analysis of compacted mixture base on the weight of total mixture

Elements of Mixture	Mix compositing %by WT of total Mix			
	Mix or trial number			
	1	2	3	4
New Aggregate	66.85	66.5	66.15	65.8
Old Aggregate	28.65	28.5	28.35	28.2
Total Aggregate	95.5	95	94.5	94
Asphalt content %	4.5	5	5.5	6
Total	100%	100%	100%	100%

- **Best Asphalt content selection**

After composing the mixtures, Marshall test was conducted on each to find out the best asphalt content, as shown in the following charts.





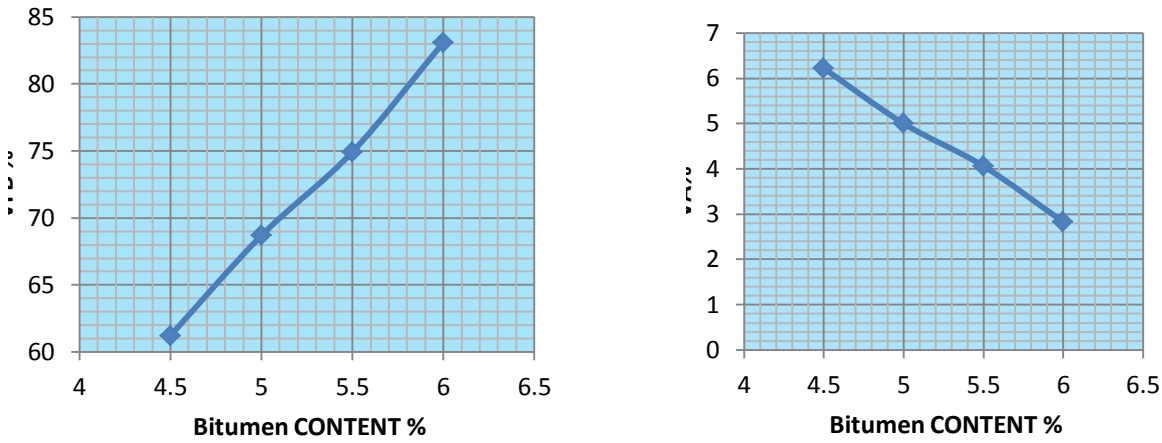


Fig. 3: The relationships between binder content and the properties of mixtures such as stability, flow, VA, VMA, VFB and bulk density

From fig (3) test property curves for hot-mix data by the Marshall method :-

1. The optimum bitumen contents corresponding to maximum values of stability = 5.1%
2. Bitumen content corresponding to maximum unit weight =5.505%
3. Bitumen content corresponding to 4% air voids = 5.49 %

The optimum bitumen content for final mix final is the average of the value

$$\frac{5.1 + 5.505 + 5.49}{3} = \mathbf{5.365}\%$$

Based on the a above mentioned results the final JMF was summarized as follows

Table No(4). final mix design for asphalt concrete without additives

Mix content	Percent %	Weight in (gm)
New aggregate	66.224	794.694
Old aggregate	28.3905	340.686
Bitumen content	5.365	64.38

Comprassion and evaluation :-

The result were summarized in table (4-8)shows the comparison between the testing results obtained in the this research and the design criteria for Marshall Method

TABLE (5) Mixtures specification

Mix properties	Final design res	design criteria	
		Minimum	Maximum
Stability (kg)	1244	600	-
Flow (0.25mm)	10.4	8	16
VMA %	16.1	15	-
Air void VA%	4.3	3	5
VFB %	73	65	75

3. Conclusion

1. To reduce the cost of building and maintenance of roads as well as the demand on asphalt and aggregate and to protect the environment.
2. The properties of the mixture achieved by the study are as required by AASHTO.

Recommendation

- We recommend that the process of recycling asphalt is to be done in summer, to minimize the deformation of the surface layer after compaction.

4. References

[1] Ministry Of Communication Libya 2003

[2] Ahmed A. Othman Roffa . The evaluation of pavement in Desert Region in Libya 2000, Barcelona . Spain .

[3] "Industry statement on the recycling of asphalt mixes and use of waste of asphalt pavements "EAPA May .2004

[4] Asphalt institute manual series NO 2 (MS-2) sixth edition .

[5] Paul H.Wright Highway engineering sixth Eddition , 1996.

[6] Asphalt institute . Mix design method for asphalt concrete and other hot mix types 2 sixth edition , USA 2010.

[7] Highway Engineering . Clarkson . H . Oglesby R.Gary Hicks 4th edition New Yourk 2009 .

[8] Association of state highway and transportation officials (AASHTO) standard specifications for transportations for transportation materials and methods of sampling and testing AASHTO 245-1993 Washington DC

[9] Khanna S.K and Justo C.E.G."HIGHWAY Material Testing " (laboratory manual) Nemchand and bros .Roorkee 2000.

[10] BSI . Method for sampling and testing of mineral aggregate , sands and fillers , BS:82 British standards institution .

[11] AL-sabbagh .N. "Utilization of recycled aggregates in concrete mixes",Ms.c.project report, debarment of Civil Eng. Kuwait University .2002.

[12] Hansen T."Recycling of demolished concrete and masonry", London UK.1992.