ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com
Journal DOI: 10.21474/IJAR01

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

INVISTICATION OF THE RESISTANCE HMA WITH RECYCLED AGGREGATE TO MOISTURE INDUSED DAMAGE.

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Manuscript Info

Manuscript History:

Received: 25 April 2016
Final Accepted: 19 May 2016
Published Online: June 2016

Key words:

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Abstract

HMA made from a specific materials may be need to strength when is subject to water in the pavement layers because of the ability of water to prevent the binder to not adhere to the aggregate and it will not to hold the pavement together which leads to rapid failure of the pavement .This is often referred to as stripping that it makes treatments such as enhance the pavement layers with certain materials from presence of water .

Test methods are study to measure the resistance of different mixturesutilizing recycled aggregate to saturation periods and also to measure the significance of using theanti-stripping as additives.

This research was in exposing the three types of asphalt, one 60% of recycled aggregate from asphalt mixture and the other 60% recycled aggregate from the concrete mix and third mix using 10% from wax as additive by weight of asphalt, to merging in water with different durations represented as (3, 7, 15, 28) days . Different experimental tests were also conducted and compared the results with virgin asphalt mixture for the same conditions. The tests used was (Marshall stability and flow), bulk density, indirect tensile strength, compressive strength, sensitivity to temperature, resilient modulus.

The investigation was successful so it gave valuable results showing improved asphalt resistance to moisture damage when using recycled aggregate from previous mixes and provingthe wax effectiveness in increasing these resistance and improve HMA properties

Introduction:-

The premature failure of flexible asphalt pavements may be achieved from the presence water atsurfacecourse which leads to segregate the gel contents . Binder course saturation results build up the flexural strains in the wearing asphaltic layer while deteriorated rutting leading to cracking of the surface layer. Laboratory testing equipment be required to get a physical and quantitative understanding of the deformation characteristics for saturated surface course materials and the associated failure mechanisms of the pavement structure, the laboratory testing equipment was developed including Marshall stability and flow, bulk density, indirect tensile strength, compressive strength, sensitivity to temperature, resilient moduluswhichbe carried out on 250 mm diameter compacted samples of a recycled aggregate having a maximum particle size of 19.5 mm. All tests were performed on both unsaturated and saturated samples.

Comparative analyses were demonstrated in order to assess the response of varies saturated periodswith different conditioned mixtures using the results from the utilizing test methods.

Materials and Methodology:-

Recycled aggregates employed in this research were provided by collecting concrete and flexible pavement from the construction and highways debris of Al-Najaf city , transferring them to the crushing and breaking them into the size of natural aggregates. Firstly the characteristics of the aggregates were evaluated Al Najaf city which is located at south of Iraq . 5% asphalt cement has gradation of 40-50 penetration from Al-Nasiriya factory. Wax and limestone filler was bring from the local market in Al-Najaf city.

Virgin aggregate is heated to a temperature of (175 – 190)˚C while the compaction mold assembly and hammer are kept pre-heated to a temperature of(100- 145)˚C. The bitumen is heated to a temperature of (121- 138)˚C.

In case of preparation the mixture used recycled asphalt pavement RAP, the RAP is heated before mixing with virgin aggregate and new asphalt cement,in special oven at 120˚C for 60 minutes and the total mix then be placed in mixing bowl and mix rapidly until the virgin aggregates are thoroughly coated to be later placed in the standard mold and compacted at Marshall compactor instrument .

The prepared samples divided into two groups, the first group was submerged in water at 25 ˚C while the othersamples were submerged in water at 40 ˚C . Both of grouped were subjected to different days (3, 7, 15, 28) to present saturation condition as it was in the field without accelerated vacuum condition.

Indirect tensile strength test:-

According to ASTM (D 4123) [ASTM,2003 ,specimens are prepared by Marshall Method and tested for Indirect tensile strength]. The prepared specimens are cooled at room temperature (25 ^{o}C for 24 hours) then immersed in a water bath at different testing temperatures (25, and 40 ˚C) for 30 minutes, employing a stainless steel loading strip on both the top and bottom of lateral surface of tested specimen , running parallel to the axis of the cylindrical specimen which are loaded diametrically at a constant rate of 2 in/min. (50.8 mm/min.) until reaching the ultimate loading resistance.

Three specimens for each mix combination are tested and the average results are recorded. The indirect tensile strength (IDT) is calculated, as follows:

$IDT = 2 P_{ult} / \pi t D$...

Where:
$P_{ult}$is the Ultimate load up to failure (N).
t is the Thickness of specimen (mm), and
D is the Diameter of specimen (mm).
The temperature sensitivity is calculated, as below:

$IDT = [(IDT)_{to} - (IDT)_{t1}] / (t_1 – t_o)$……….…………………………………….

Where:
(IDT) $_{to}$is the Indirect tensile strength at t_o (˚C),t_0 = 25˚C
(IDT) $_{t1}$ is the Indirect tensile strength at t_1 (˚C), t_1 = 40 ˚C
.

Ultrasonic Device:-

Non-Contact Ultrasound, the predominant method of introducing wave propagation into a sample, is by placing the transducer onto the material using a coupling medium such as a gel. This technique is a contact mode for which the use in construction inspection or testing is very tedious. Non-contact modes of transducer placement are more practical and the method employed in this research.(Dunning et al, 2004)

The Ultrasonic pulse velocity method was used to measure the travel time of an ultrasonic pulse passing through the tested specimens. Two modes of wave travel were detected, compressional or longitudinal wave and plate wave. The latter is a type of surface waves ; when a surface wave is launched on a plate and if the thickness of the plate is reduced until it approaches the wave length or if the wave length is increased[Elvery ,1971].

Results and Discussion:-

The results of Stability recorded unaffected for merging in water for each modified mixtures is while the mixture with recycled asphalt has made improvement in resistance to water as shown in Figure (1).

In Figure (2) the best results appeared when the mixture of recycled asphalt, followed by recycled concrete mix that showing improved tensile strength inspite of their sensitivityduration imposed to water compared to the virgin mixture and this modified with wax.

So the results of Marshall Flow and Marshall Stiffness have been no variation values, but their were generally realized US Specification which demonstrated in Figures (3) and (4) respectively .

Figure (5) appeared another steady case obvious in sensitivity to temperature for mixtures have recycled asphalt and concrete compared with the both of virgin and this which modified with wax.
The period of merging has a significant effect on the surface layer strength at all mixtures, elsehigh resistance to moisture in the mixture withrecycled concrete followed by these modified with wax, either with regard to the mixture of recycled asphalt is still good resistance to limit to 14 days whichobvious in Figure (6)

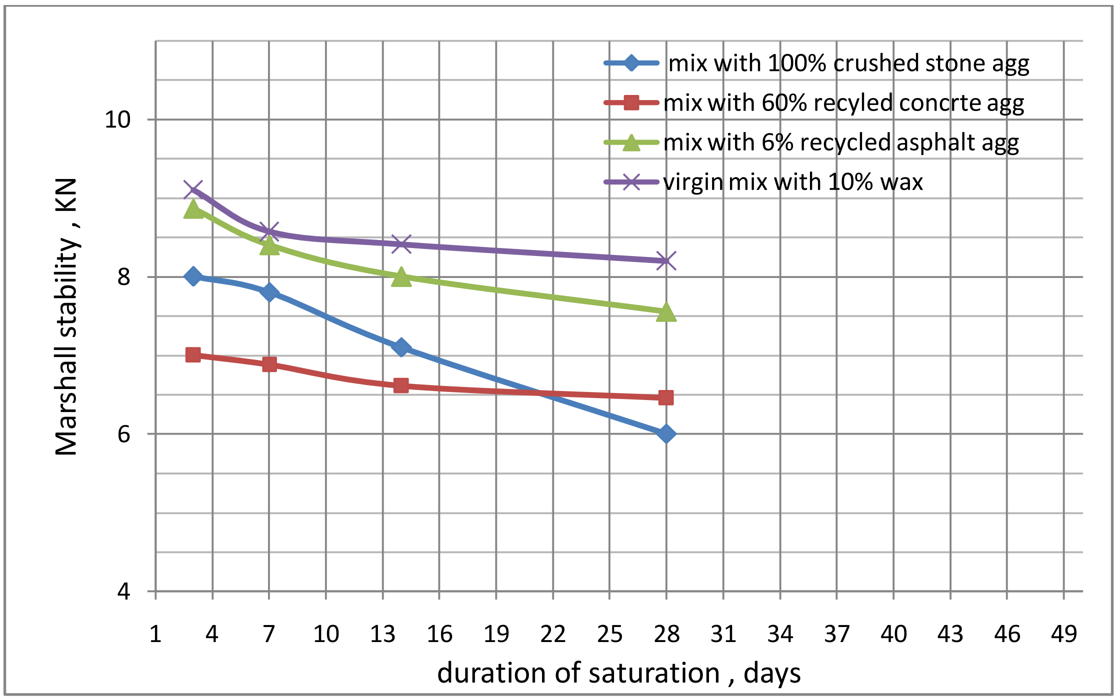

Figure 1:- Marshall stability test.

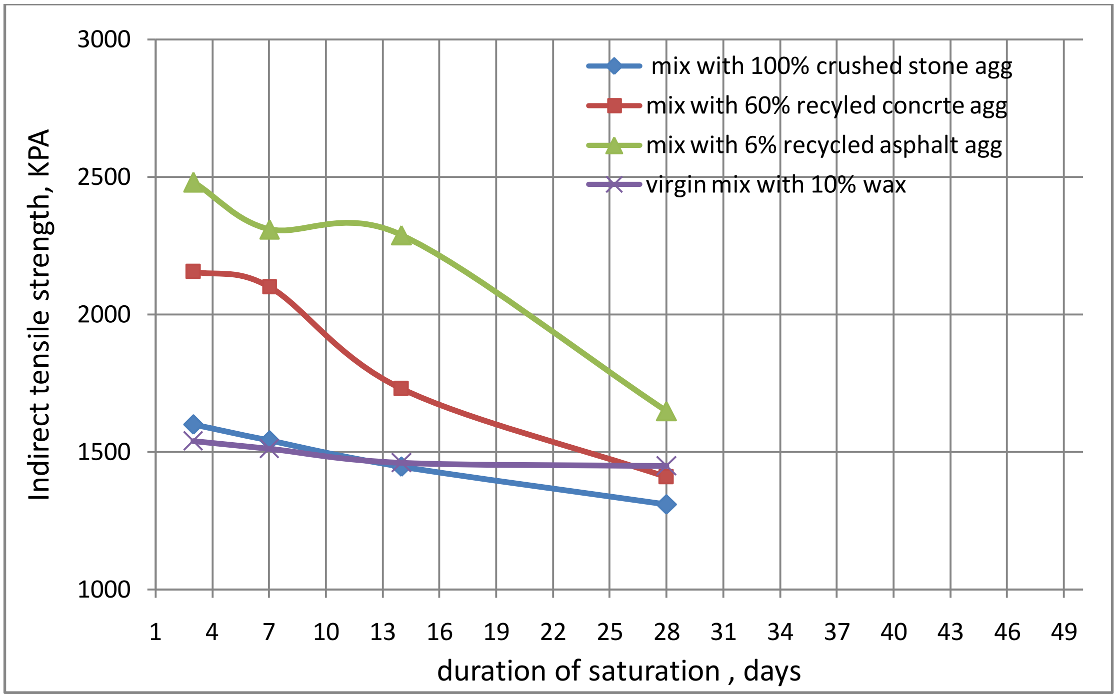

Figure 2:- In-direct tensile strength test.

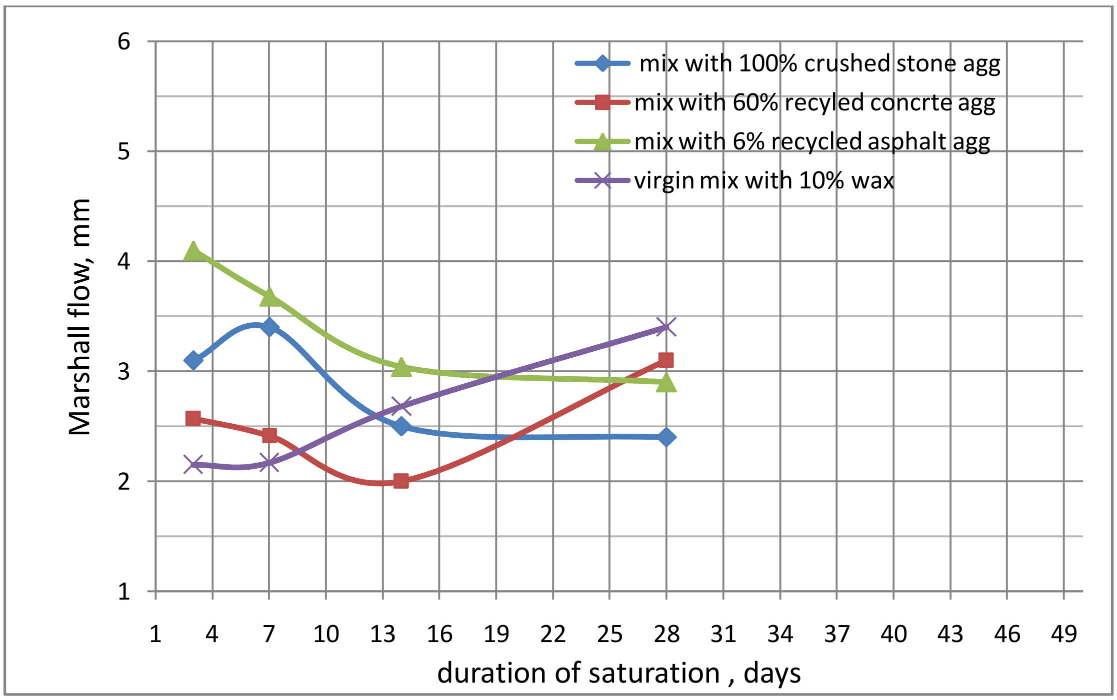

Figure 3:- Marshall Flow test.

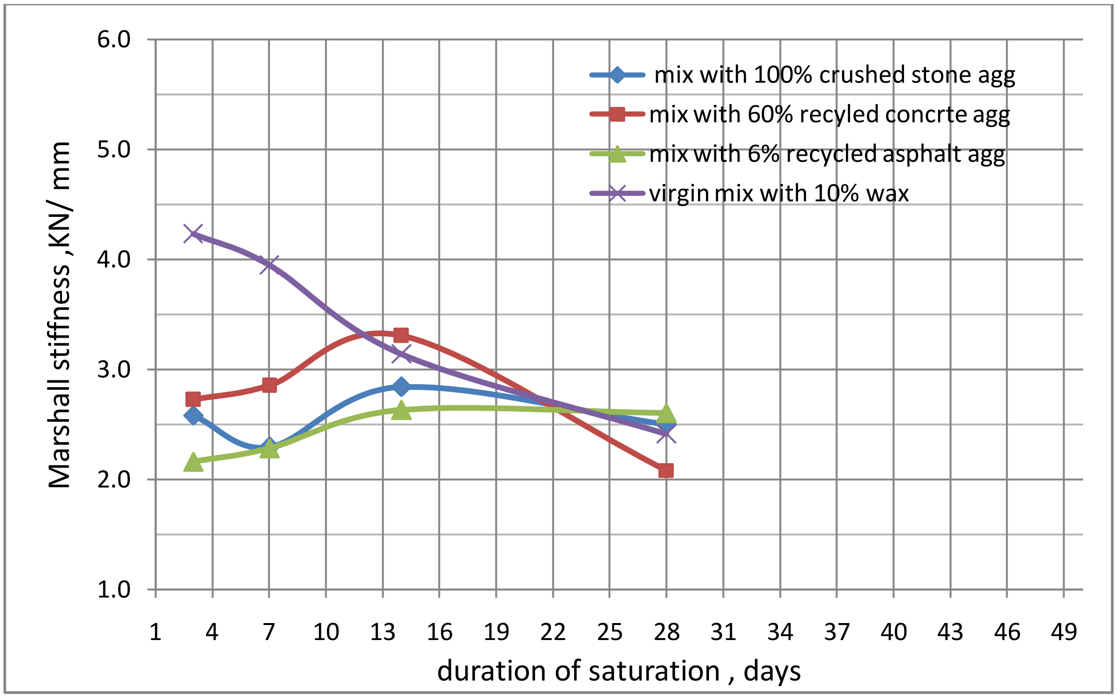

Figure 4:- Marshall Stiffness test.

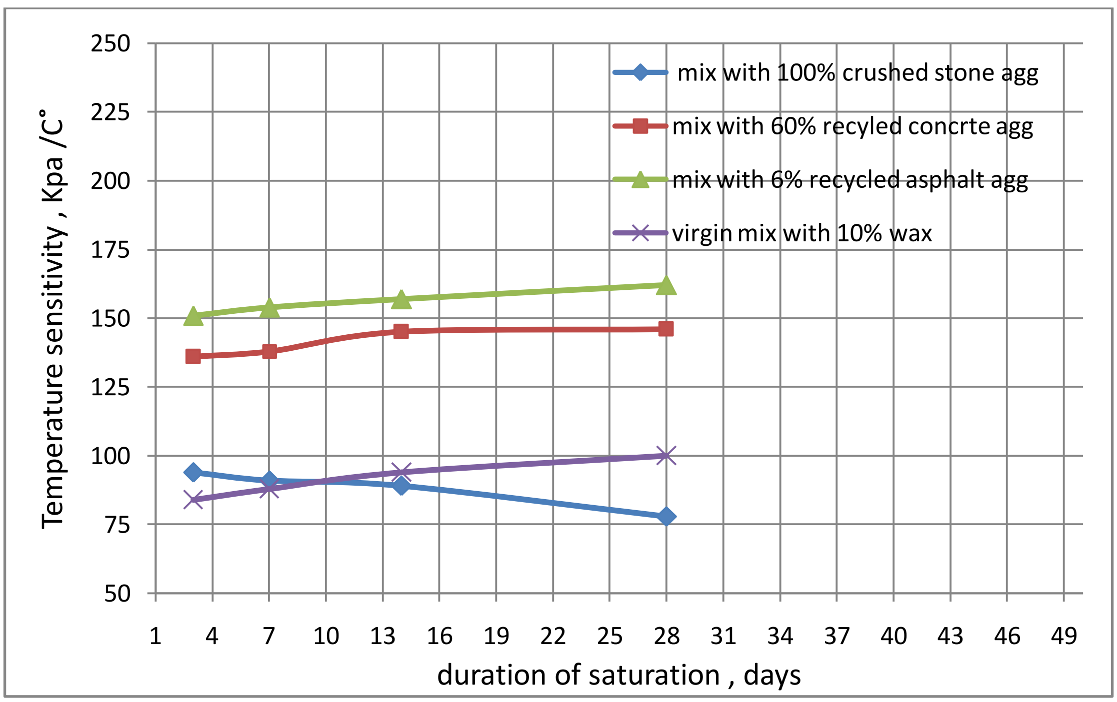

Figure 5:- Temperature sensitivity test.

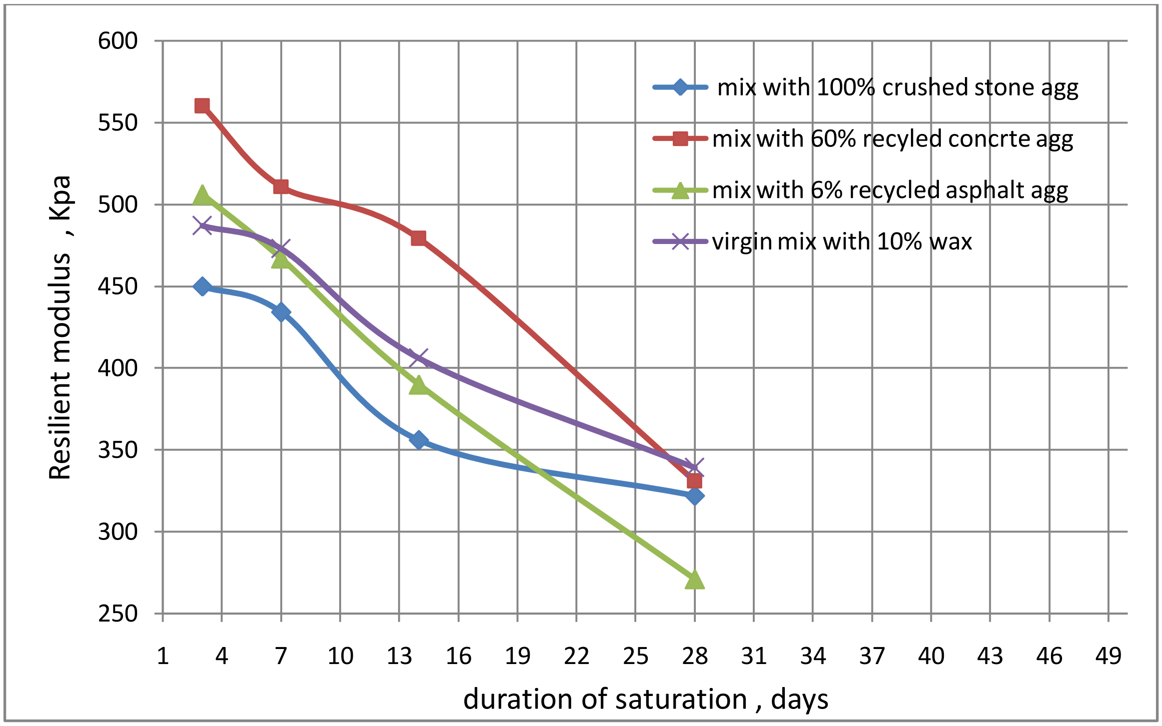

Figure 6:- Ultrasonic test.

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