Evaluate the Properties of Hot Mix Asphalt using Recycled Coarse Aggregate

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Abstract- *The studies targets at evaluating the impact of the use of recycled coarse aggregates at the basic of hot mix asphalt made with bitumen grade VG30. First, recycled aggregate properties had been decided and as compared to the ones of regular aggregates. Except for absorption, there had been no sizable differences among everyday aggregates and RCA. Later, recycled aggregates were introduced in asphalt mixes using either bitumen grades. In those mixes, herbal coarse mixture changed into partially (0%,5%,10%,15%,20%,25% & 100%) replaced with the aid of recycled aggregates. Replacement outcomes display that the usage of recycled aggregates expanded the ultimate bitumen content of the asphalt mixes. Properties and overall performance of mixes made from both grades of bitumen were as compared. Although the boom of RCA percentage reduced the resilient modulus of the asphalt mixes, it elevated their skid resistance. However, bitumen elevated the resilient modulus and skid resistance of the asphalt mixes compared to other bitumen grade.*

Keywords- Bitumen VG30, Natural aggregates, recycled aggregates.

I. OBJECTIVES

1.The main aim of this research is to evaluate the potential of recycled coarse aggregates on basic of the properties of HMA (hot mix asphalt) made with bitumen, when used in road construction.
2.Comparative studies of recycled aggregates with natural aggregates
3.To brief the available literature on use of Recycled Coarse Aggregate.
4. To study the outcomes of various research on different test outcomes on recycled coarse aggregate.

II. INTRODUCTION

The construction of the roads and highways requires a large amount of asphalt concrete which consume very amount of aggregate. As we know that there is only one source of the aggregates that is by the natural means, so consuming it in the alarming rate will definitely have a bad impact on the nature or ecology. Then consuming these too much amount would have effects on the atmosphere and environment. Demolishing aggregate concrete structure and making the dump of concrete masses around us would aggravate the problem. So that it will become necessary to the recycle the crushed aggregate concrete and we should use it as coarse aggregate in future new construction of roads, highways and building etc.

From the studies it is clear that the world is using the concrete at an alarming rate, and by the use of more and more roads, the pavement materials are near to the extinction. The material used in the pavement are all natural, and only a little of the material used in the construction agency is artificial. The most of the strength in the pavement id just due to the aggregates present in it. And all the aggregates are nearly natural, and the rest like fillers, fine aggregates and the binder can be replaced up to its full, but the coarse aggregates can't be replaced up to that much.

Figure 1.1 Natural aggregate and aggregate for recycle(waste)

III. BACKGROUND OF STUDY

The average world production of concrete in the rapid developing industrialized world is about 6 billion tons per year which has an adverse impact on the environment. Therefore, recycling construction material plays an important role to preserve the natural resources and helps to promote sustainable development in the protection of natural resources. thus, reduces the disposal of demolition waste from old concrete. Consequently, recycling concrete wastes becomes important in getting rid of the demolished concrete, which accumulates with time. For example, the amounts of demolished buildings in

Europe amount to around180 million tons per year old concrete and masonry that have ‘‘reached the end of the road” can be recycled and used for a number of other applications in construction including roads and concrete structures.

IV. LITERATURE REVIEW

Hisham Qasrawi and Ibrahim Asi (2016):-

This research determined the effect of the bitumen grade when natural coarse aggregate was partly 0%,25%,50%and 75% or totally 100% replaced by recycled aggregates on hot asphalt mix.60/70 and 80/100 was two grades of bitumen used in this research. Different mixes was prepared. The specific gravity and water absorption of coarse aggregate was 2.57 and 1.7%. After the preparation of mixes of these two grades they are compared with each other. 60/70 grade of bitumen improves the skid resistance. Each sample was tested on Marshall Stability machine. The different test was performed to determine the suitableness of recycled coarse aggregates on hot asphalt mix.it was concluded that 25% gives better results on hot mix asphalt when natural coarse aggregates was replaced with recycled aggregates.

A.R. Pasandín and I. Perez (2014)-

The incorporation of recycled concrete aggregates (RCA) in hot-mix asphalt (HMA) could be a way to sell sustainable production. To date, numerous investigations have tested the use of this kind of waste fabric in HMA. Several researchers have discovered that due to the action of water, the usage of this material proved to have inadequate durability. In this research, a laboratory characterization of HMA made with RCA from construction and demolition waste (CDW) for base layers in avenue pavements turned into performed. Percentages of 5%, 10%, 20% and 30% of RCA in region of herbal aggregates were analyzed. To improve the water resistance of the mixes, the RCA were lined with 5% of bitumen emulsion prior to the integration process. The outcomes indicated that the mixes comply with the Spanish water resistance specs required for base layers. The stiffness, everlasting deformation and fatigue of the mixtures had been additionally studied. The outcomes indicated that HMA made with RCA covered with bitumen emulsion exhibited mechanical houses similar to those obtained for traditional combos.

Perez , A. R. Paladin and L. Medina (2012)

This article evaluates the opportunity of designing warm asphalt blend street pavements the usage of Construction and Demolition Waste as coarse recycled aggregates. The probabilities of recycled aggregates used inside the combos have been: 0%, 20%, 40%, 60%. Cement and lime have been used as fillers. The combinations made with coarse recycled aggregates complied with the Marshall technical specifications for low volume roads. The combos also showed suitable resistance to everlasting deformation evaluated by means of wheel monitoring assessments. Nevertheless, the combinations made with RA can also have inadequate sturdiness due to their high susceptibility to water action which changed into evaluated the usage of stripping checks.

Sushanta Bhusal and Haifang Wen (2013):-

Sushant bhusal and Halfang Wen (2013) examined the influence of recycled concrete aggregate on the performance behavior of HMA. The mixes were prepared by blending RCA with aggregate at six various percentages. Many tests were conducted to check the feasibility of the study and to provide a relevant solution to the problem waste generation on site. Tests included flow number test, moister susceptibility test, indirect tensile test (thermal and fatigue cracking) and dynamic modulus test. Graphs were also plotted for different for different test as different percentage of replacement (Six different percentages 0%, 20%,40%,60%,80%, and 100%). Recycled concrete aggregate differs from virgin/natural aggregate because of the cement paste remained on the surface while doing the recycle process. The study indicates that the absorbed asphalt might play a major role at higher temperature which will result the expansion of asphalt. The study also revealed that if the percentage of binder will increase then the cost of HMA will also increase which is also not economical for the construction. Based on the demand and performance substitute of RCA as HMA was not recommended in the study

Xiaoliang Zhang , Ben Zhang , Huaxin Chen , Dongliang Kuang (2018)-

Road creation consumes fantastic amounts of excessive-grade herbal resources. Using low grade herbal some stable wastes as materials is a hot subject matter. Considering this feasibility of the usage of low-grade granite aggregates, solid waste-based filler and binder concurrently in asphalt mixtures has been fully investigated in this research. The commonly used basic asphalt & limestone powder filler were manage groups. Materials traits of uncooked substances specifically which includes micro-morphology, useful group, mineral phase, chemical composition and the thermal stability had been firstly evaluated so that you can understand them. Four asphalt combinations have been then designed through standard Superpave method. Finally, an in-depth investigation into the pavement overall performance of asphalt combos changed into

performed. Moisture damage resistance an and occasional temperature crack resistance had been detected by the converting guidelines of balance, energy and fracture power, and excessive-temperature stability and fatigue overall performances had been decided by means of wheels tracking test and the indirect tensile fatigue check, respectively. Results counseled that RMA and DGR each showed tremendous outcomes on the low-temperature crack resistance and fatigue belongings of the granite asphalt mixture.
DGR also strength moisture ability.

Debora Acosta Alvarez,Anadelys Alonso Aenlle and Antonio JoseTenza Abril (2018)

Recycled Aggregates from construction and demolition waste are a technically viable alternate to manufacture of concrete asphalt (AC). Main objective of this work is to evaluation the hot asphalt mixtures properties that is manufactured with different type of sources of CDW from Cuba. Dense asphalt mixture was manufactured with a maximum aggregate size of 19.2 mm, partially replacing (40%) then natural aggregate fraction measured between 5 mm and 10 mm with three types of RA from Cuba. Marshall specimens were manufactured to determine the main properties of the AC in terms of density, voids, stability and deformation. Additionally, the stiffness modulus of the AC was evaluated at, 26 ◦C. The results corroborate the potential for using these sources of CDW from Cuba as a RA in asphalt concrete, thereby contributing an important environmental and economic benefit.

Ramzi Taha, Okan Sirin and Husam Sadek (2014)-

More than 15 million heaps of aggregates are imported every year to Qatar from neighboring nations. Large portions of waste substances (around 20 million heaps/yr) from excavation waste, demolition rubble and reclaimed asphalt pavement (RAP) are being generated. The predominant goal of this paper is to offer the outcomes on the usage of blended excavation waste (EW) and RAP aggregates within the construction of street bases and sub-bases. Physical and chemical properties were determined. Different mixtures of each substances were subjected to compaction and California Bearing Ratio (CBR) testing in accordance with Qatar Construction Specifications. Results indicated that, for the materials examined, it isn't always possible to apply excavation waste, RAP aggregates or an aggregate of the 2 substances in road bases and sub-bases. The substances did not meet a few Qatari standards such as Los Angeles abrasion, liquid limit, plasticity index and CBR targeted for avenue production.

Alaa Gabr , Sherif El-Badawy, D. El-Tahan, M. Shetawy (2018)

This paper is investigating the feasibility of (RCA) as replacement with natural aggregates the in hot mix asphalt RCA were collected from the two different type of sources to investigate the impact of the material degenerate on the properties of engineering of sample mix. The Basic properties was determined for the both RCA and bitumen for prepare of Hot Mix Asphalt mixes. Different sample designs were using Marshall method with the 100% Performance of sample mixes in terms of the stability, flow, abrasion loss, stability loss, indirect tensile strength was evaluated. So, the investigated sample mix was characterized by image processing & analysis system (IPAS) software to investigate to the aggregate characteristic as contact zone properties, orientation, & segregation. Results showed that the new Recycle Concrete Aggregate coarse aggregates had lower bulk specific gravity, higher liquid limit with the no plasticity, higher pH values and lower Los Angeles Abrasion values compared with the old Recycle Concrete Aggregate.

M. S. Eisa (2018)-

Many researches & studies were done in the field of using the recycled aggregates (RA) in hot mix asphalt (HMA), especially the recycled concrete aggregates (RCA). In this study, we investigated the possibility of using the recycled aggregates from all types of the demolition waste not only the recycled aggregates from concrete RCA. In the previous researches, the RCA were placed as a percentage of the natural aggregates used in HMA, but in this study we examined the possibility of using recycled aggregates from demolition waste (RADW) instead of natural aggregates which means using RADW with 100% of asphalt aggregates. Therefore, we could achieve the full utilization of the demolition waste that represents a big environmental problem especially in Egypt. In this study, three samples of demolition waste aggregates with different components were used in preparing HMA mixtures to produce three types of HMA mixtures (mix 1–mix 2–mix 3) and a mixture with natural aggregates was prepared to produce the control mix. After determining the optimum asphalt content of each mixture, the four mixtures conducted to several performance tests to find the optimum components of demolition waste in HMA mixture and the possibility of using a HMA mixture with 100% RADW. By reviewing the previous studies at that field, we got very important information about coating the RA by bitumen emulsion to present a performance similar to the natural aggregates in HMA.

Amir Kavussi, Abolfazl Hassani , Farbod Kazemian, Mohammad Taghipoor (2018)

Recycled Concrete Aggregate (RCA) is considered to be a potential substitute for natural aggregates in asphalt mixtures. Despite some contradictory results achieved by researchers, it is believed that RCA treatment can improve quality of recycled asphalt mixes considerably. In this research, a two-stage treatment was applied on coarse RCA materials in order to improve their properties. The treatment was consisted of first soaking RCAs in Hydrochloric Acid (HCl); second impregnating the treated RCAs into Calcium Metasilicate (CM). The pores of RCAs were filled with CM particles. Substituting virgin aggregates with different amounts of coarse RCA materials into HMA resulted in increased tensile properties of mixes as tested in indirect tensile fatigue test (ITFT). The treatments resulted in reduced moisture sensitivity of mixes. The improvements were mostly attributed to the reduced water absorption of RCA materials. Moreover, morphological characteristics of the treated coarse RCA materials were determined using Scanning Electron Microscopy (SEM) photography.

F. Moghadas Nejad, A. R. Azarhoosh and Gh. H. Hamedi (2013)-

According to F. Moghadas Nejad, A. R. Azarhoosh and GH. H. Hamedi construction of road and maintenance requirement very large quantities of virgin aggregates (VA). aggregate uses waste as an aggregates and replacement reduce the extraction of the new aggregate, pressing demands on existing landfill areas, and emissions wastes into environment. This study assessed the using of recycled marble aggregates (RMA) as replacement for virgin aggregates in hot mix asphalt (HMA). The aim of this study waste valuate the possible use of hot mix asphalt containing RMA for roads with medium traffic volume for this purpose, VA replaced RMA at rates of 15, 25, 40, and 60% in Hot Mix Asphalt Resilient modulus, indirect tensile fatigue, dynamic creep, indirect tensile strength ratio tests were performed to evaluate the field performance suitability of Hot Mix Asphalt. The results show that, to the mixtures containing RMA, resilient modulus and the fatigue life are slightly lower than those for the control mix, and they decreased when the RMA increased in the mix. In addition, the direct relationship between the percentage of RMA and rutting potential limited the use of RMA in hot weather.

Fidelis O. OKAFOR (2010)

This research examined the performance of recycled asphalt pavement as coarse aggregates in concrete. To determine the mechanical properties of cement for recycled coarse aggregates was investigated in laboratory. Different mixes prepared by using recycled asphalt pavement as coarse aggregates by varying different water cement ratio 0.50, 0.60 and 0.70. In this research Type 1 cement, coarse aggregate was prepared with crushing waste asphalt pavement. According to BIS different test was performed on concrete to determine the slump value and workability. after the preparation of sample, they cover with jute bags for 24 hours and then curing was done. At different age of curing the hardened properties of concrete was determined such as compressive strength .it was concluded that recycled coarse aggregates was absorbed lower water absorption as compared to natural coarse aggregates.

Mary Vancura, Lev Khazanovich, and Derek Tompkins (2009)-

According to Mary Vancura, Lev Khazanovich, and Derek Tompkins State departments of transportation (SDT) started using RCA in the layers of structural of Portland cement concrete (P.C.C.) pavement in the United States the late 1970s. RCA Aggregates is rarely used in the United States as a structural and component of PCC pavement. The impetus for its continuous use is the same now as it was then: a lack of landfill areas and a low availability of quality natural aggregates. However, as The American pavement engineers and many researchers are continuing to place a greater emphasis on sustainability, the renewable roadways, the conventional uses for Recycle Concrete Aggregates in American roadways should become reconsider along with new priorities. After that early 1990s, the same states that had been using recycled concrete as a coarse aggregate in rigid pavements began finding uses for it. Currently in the United States, RCA is implemented into a base layer or its fines are used to stabilize subbase or frost protection layer.

Mohammad Saeed Pourtahmasb and Mohamed RehanKarim (2014)

According to Mohammad Saeed Pourtahmasb and Mohamed RehanKarim the RCA is considered one of the very large waste problems of the world which is produce by demolishing concretes structures s as a building, bridges and dams. This paper presents the experimental research on feasibility of reusing RCA in stone mastic asphalt (SMA) mixtures as a partial replacement of course. The main engineering properties of the Stone Majestic Asphalt mixture containing RCA has been evaluated for different percentages of binder on Marshall mix design method. The main outcomes were analyzed using two-factor analysis of variance (ANOVA).

The Test result several performance of SMA mixture is affected by RCA due to higher porosity and absorption of RCA in comparison with virgin granite aggregate.

Farzaneh Tahmoorian, Bijan Samali (2018)

Farzaneh Tahmoorian, Bijan Samali (2018) investigated the viability of application of waste material while constructing pavement. The usage of recycled construction aggregate in asphalt mixtures resulted environmental benefits as well as it is economical for the user. This paper comprises of lab investigation for the measurements like particle size, flakiness index, weak particles, compressive strength, water absorption and wet/dry strength. This can be a good substitute for the natural aggregate as the natural aggregate becoming exhausted day by day. This is a really good solution for natural aggregate scarcity as well as reduction of waste on site. In this research work researchers utilized RCA as coarse aggregate and results of tests shows that RCA meets the provisions of aggregate in asphalt mixture. Along with above test the researchers also evaluated the chemical and physical properties of RCA. The conclusion includes that RCA is having lower value of flaky but in the other hand it has higher water absorption properties

V. CONCLUSI ON

The use of recycled concrete aggregate in asphalt mixes is a sustainable construction practice. However, the addition of RCA has an adverse effect on some of the properties and the performance of the asphalt mixes. In this study, the use of RCA increased the asphalt content required to attain the same properties. The higher the natural aggregate ratio, the higher the demand for asphalt content is the test results show that the RCA is highly absorptive and that as the percentage of RCA in the mix increases, the optimum asphalt content increases. This increase becomes significant for replacement percentages exceeding 20%. Mixes containing RCA show lower water sensitivity (stripping resistance) than RCA-free mixes. However, replacements up to 40% do not violate the 60% TSR limit. Although this limit is acceptable, the volumetric properties were violated at the 40% RCA replacement value. Therefore, replacements more than 40% should not be used in hot mix asphalt. Considering the performance behavior and the need for higher asphalt content, the use of RCA in hot asphalt mixes is not recommended beyond a replacement ratio exceeding 40%. Considering the environmental benefits of the use of RCA, the authors suggest using RCA replacement ratio up to 40%. The use of such ratio will also be acceptable for bitumen grade VG30. Regarding ITS, mixes containing bitumen VG30 showed better performance and can allow higher percentages than the suggested 40% replacement ratios. Although the increase of RCA percentage decreased the resilient modulus of the asphalt mixes, it increased their skid resistance. Regarding higher than the 40%-replacement ratios, the use of RCA may be used in lower specification limit roads such as medium low traffic roads.

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