International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

To Study Experimental Analysis of Replacement of Aggregate with Recycled Concrete Aggregate in Bituminous Concrete - A Review

Abhishek Meshram[1], Dr. Alok Goyal[2]

[1]P. G. Scholar, Department of Civil Engineering, Sardar Patel University, Balaghat, Madhya Pradesh, India

[2]Associate Professor, Department of Civil Engineering, Sardar Patel University, Balaghat, Madhya Pradesh, India

Abstract: ***The propose of this research work is to use recycled concrete aggregate (RCA) in replacement of fresh aggregate in bituminous concrete to provide good strength, made economic roads & environment friendly. In bituminous concrete aggregate is replaced by RCA with 0%, 5%, 10%, 15%, 20% to observe behaviour of bituminous concrete. We made 3 sample of each percent and take average of values. The experimental results shows that when we replace the fresh aggregate with recycled concrete aggregate in 0%, 5%, 10%, 15%, 20% then its behavior about Marshall stability, Marshall flow, Air void, Percent volume of bitumen (Vb), Void in mineral aggregate (VMA), Void filled by bitumen (VFB).***

Keywords: Recycled concrete aggregate (RCA), Hot mix asphalt (HMA), Marshall stability, Air void

1. Introduction

- The extensive use of natural aggregates in road construction and the simultaneous increase in solid waste generation have prompted researchers in the pavement industry to explore the feasibility of utilizing certain waste materials in pavement construction.
- Construction and demolition wastes, including Recycled Construction Aggregate (RCA), make up a significant portion of municipal solid waste. The incorporation of RCA in asphalt mixtures generally offers notable economic and environmental benefits.
- Despite its promising potential, the limited availability of sufficient and conclusive data on the engineering properties of RCA has hindered the establishment of reliable design specifications. Addressing this knowledge gap, the purpose of this paper is to investigate the viability of using RCA in asphalt mixtures.
- These investigations have highlighted the heterogeneity of RCA and its influence on various properties, such as wear resistance, water absorption, fragmentation resistance, and mechanical performance.
- The use of RCA has shown promise in reducing environmental impacts, promoting sustainability, and addressing resource depletion concerns.
- Research is necessary to establish consistent behavior patterns and optimize the performance of RCA in different pavement applications.
- Now a day every one want recycling of old and form new. So we are using recycled concrete aggregate in bituminous concrete of pavement of road in some quantity as percent of fresh concrete.
- It will used 0%, 5%, 10%, 15% and 20% in bituminous concrete. The recycled concrete aggregate properties can be tested and compared with fresh aggregates. It must be good quality as possible and it should be provide good and enough strength to the bituminous concrete pavement used road.
- It will use in pavement in place of the fresh aggregate so that it can provide enough stability and economic purpose.

2. Literature Review

Fabiana Da ConceiãoLeite , Rosângela Dos Santos Motta, Kamilla L. Vasconcelos, LiediBernucci, [1] In order to assess the suitability of recycled concrete aggregates (RCA) for use in asphalt mixtures, an experimental program was conducted to evaluate their physical and mechanical properties. This laboratory investigation involved measuring various parameters, including RCA compressive strength, particle shape, water absorption, flakiness index, crushing value, weak particles, wet/dry strength variation, and particle density. The research findings revealed that RCA exhibits a lower proportion of flaky and misshapen particles compared to basalt. This suggests that asphalt mixtures incorporating a certain amount of RCA can have improved workability, deformation resistance, and compaction properties. However, the test results also indicated higher water absorption and wet/dry strength variation for RCA compared to natural materials. These findings highlight the importance of an appropriate mix design to account for the unique characteristics of RCA and ensure optimal performance. Overall, the experimental program demonstrated that RCA can be a viable alternative to natural aggregates in asphalt mixtures, but careful consideration and adjustment of the mix design are necessary to address the higher water absorption and wet/dry strength variation associated with RCA.

Y. Huang, R. N. Bird, and O. Heidrich [2] The construction and maintenance of roads in the UK heavily rely on quarried aggregates, leading to a significant demand for primary (virgin) materials. To address concerns related to landfill pressures and the depletion of natural resources, there has been a growing interest in using secondary (recycled) materials as substitutes for primary aggregates. However, widespread adoption of secondary aggregates in road

applications, particularly in surface layers of asphalt pavements, has been hindered due to concerns over potential inferior road performance and additional costs. This study focuses on evaluating the use of recycled solid waste materials (SWM) such as waste glass, steel slag, tyres, and plastics as alternative materials in asphalt pavements. The review encompasses an assessment of relevant standards, technical requirements, and existing literature on the performance of asphalt pavements constructed using these recycled materials. Waste management data indicates that there is significant potential for the supply of secondary materials for road construction. However, various factors have effectively limited recycling activities. These barriers, which may also apply to the secondary use of other SWM, are discussed in detail. After identifying and quantifying these barriers, potential strategies for their removal are briefly discussed. The aim of this study is to address the concerns and barriers associated with the use of secondary aggregates in asphalt pavements. By evaluating technical requirements, standards, and performance data, this research seeks to provide insights into the feasibility of utilizing recycled solid waste materials in surface layers of road pavements. Ultimately, the goal is to promote sustainable practices by reducing the reliance on primary materials and finding viable alternatives through the effective management and utilization of secondary aggregates.

HüseyinAkbulut, CahitGürer [3], The production of asphalt pavement materials heavily relies on aggregates, which typically constitute over 95% of the material's weight. The highway and construction industries consume a substantial amount of aggregates, resulting in significant energy consumption and environmental impact. Traditionally, aggregates are sourced from nearby quarries, leading to the depletion of natural aggregate sources and the deterioration of the earth's surface, causing environmental concerns. To address these challenges, the utilization of marble wastes from marble quarries as aggregates has been explored. This approach aims to meet the increasing demands for aggregates while mitigating the detrimental effects on the environment. In this study, recycled aggregates obtained from marble quarries in the Afyonkarahisar-Iscehisar region were compared to conventional aggregate specimens commonly used in asphalt pavements in the Alyordarahisar city. Various tests, including the Los Angeles abrasion test, aggregate impact value test, freezing and thawing test, flakiness index test, and Marshall stability flow test, were conducted on the aggregate specimens. The results indicate that the physical properties of the recycled aggregates meet the specified requirements. Therefore, these waste materials have the potential to be used as aggregates in light to moderately trafficked asphalt pavements. By utilizing marble wastes as aggregates, this study suggests a more sustainable approach to meet the growing demand for asphalt pavement materials. By reducing the reliance on natural aggregate sources and utilizing recycled materials, the environmental impact associated with quarrying can be minimized. Mohammad SaeedPourtahmasb, Mohamed RehanKarim[4] Recycled concrete aggregate (RCA) is a significant waste material produced through the demolition of concrete structures such as buildings, bridges, and dams. Scientists, researchers, and authorities are actively exploring the recycling of waste materials for both environmental and economic benefits. In this study, we present experimental research focusing on the feasibility of utilizing RCA as a partial replacement for coarse and fine aggregates in stone mastic asphalt (SMA) mixtures. The engineering properties of SMA mixtures containing various percentages of RCA were evaluated using the Marshall mix design method. The obtained results were subjected to statistical analysis using two-factor analysis of variance (ANOVA). The test outcomes revealed that the performance of SMA mixtures is influenced by the presence of RCA, primarily due to its higher porosity and absorption compared to virgin granite aggregates. However, SMA mixtures containing a specific amount of RCA exhibited acceptable trends and were able to meet the standard requirements. It is important to note that achieving desirable performance characteristics requires careful consideration of the properties of SMA mixtures containing RCA. Despite the higher porosity and absorption of RCA, suitable adjustments and precautions can be taken to ensure satisfactory performance. This research highlights the potential for incorporating RCA into SMA mixtures, offering a sustainable approach to utilize waste materials in asphalt production.

Jayakody, Shiran, ChamindaGallage, Arun Kumar [5] The increase in population and economic development often leads to the construction and demolition of various infrastructures, resulting in the generation of used concrete as a primary waste product. Recycling this waste concrete to produce recycled concrete aggregates (RCA) for base and sub-base materials in road construction offers significant economic and sustainability benefits. However, the presence of mortar, bricks, glass, and reclaimed asphalt pavement (RAP) in RCA can result in inconsistent properties and performance. This study focused on evaluating six different types of RCA samples through classification tests, including particle size distribution, plasticity, compaction, unconfined compressive strength (UCS), and California bearing ratio (CBR) tests. The obtained results were compared with the standard road materials used in Queensland, Australia. The findings of the study indicated that the 'RM1-100/RM3-0' and 'RM1-80/RM3-20' material types of RCA samples met the minimum required specifications for base materials used in high volume unbound granular roads. However, the other types of RCA samples did not meet the minimum requirements. These results highlight the importance of careful selection and characterization of RCA for specific road construction applications. While some RCA samples met the required specifications, others fell short. This indicates the need for further refinement and optimization of recycling processes to ensure consistent and reliable performance of RCA in road construction projects. By identifying the specific types of RCA that meet the required specifications, this study contributes to promoting the use of recycled materials in road construction, leading to both economic and sustainability benefits. However, further research and development are necessary to improve the overall performance and consistency of RCA in order to fully maximize its potential as a valuable resource in road construction projects.

E. Vazquez, M. Barra, D. Aponte, C. Jim ´ enez, and S. Valls[6] Recycled aggregates concrete (RAC) is gaining importance as a sustainable alternative in construction, but

certain properties, such as chloride penetration and diffusion, have raised concerns. To investigate the impact of recycled concrete aggregates (RCA) on concrete properties, an extensive experimental campaign was conducted. The study examined the influence of composition and mix design on concretes with varying water-to-cement (w/c) ratios ranging from 0.45 to 0.60, and replacement levels of coarse aggregates at 0%, 20%, 50%, and 100% with RCA. The concretes were subjected to saline attack, and the total chloride contents and chloride penetration profiles were determined. X-ray diffraction (XRD) and scanning electron microscopy (SEM) analyses were performed on both new cement paste and RCA from different concrete mixes to assess chloride binding. The results revealed a chloride binding phenomenon in RAC, which could potentially compensate for the higher permeability associated with RCA. The analysis of chloride diffusion showed that high RCA content, combined with a sufficiently low w/c ratio, improved the durability of RAC in terms of the presence of chlorides. These findings suggest that RAC can exhibit enhanced resistance to chloride penetration and diffusion, contributing to improved durability. The chloride binding observed in RAC indicates a potential mechanism that counteracts the increased permeability associated with RCA. Therefore, by carefully controlling the mix design and ensuring an appropriate w/c ratio, incorporating a higher proportion of RCA in concrete can lead to improved durability in terms of chlorides. This research emphasizes the potential of RAC as a sustainable construction material and highlights the importance of optimizing mix designs to achieve desired durability properties. Further investigation and analysis are necessary to deepen our understanding of the chloride binding phenomenon in RAC and its long-term performance under various environmental conditions.

A. R. Pasand´ın and I. Perez[7] The utilization of recycled concrete aggregates (RCA) in hot-mix asphalt (HMA) can contribute to sustainable construction practices. Previous investigations have examined the use of RCA in HMA, and some researchers have noted concerns regarding its durability due to the effects of water. In this study, laboratory characterization of HMA containing RCA from construction and demolition waste (CDW) was conducted for base layers in road pavements. Various percentages of RCA, including 5%, 10%, 20%, and 30%, were analyzed as substitutes for natural aggregates. To enhance the water resistance of the HMA mixes, the RCA were coated with a 5% bitumen emulsion prior to the mixing process. The results demonstrated that the mixes met the water resistance specifications required for base layers in accordance with Spanish standards. Additionally, the stiffness, permanent deformation, and fatigue properties of the mixtures were investigated. The findings indicated that HMA incorporating RCA coated with bitumen emulsion exhibited mechanical properties similar to those obtained with conventional mixtures. This suggests that the addition of RCA, when properly treated with bitumen emulsion, can yield HMA with comparable performance to traditional mixtures. These results highlight the potential of using RCA in HMA for base layers, promoting sustainable construction practices. Further research and evaluation are necessary to assess the long-term performance and durability of HMA incorporating RCA. Nonetheless, this investigation provides valuable insights into the use of coated RCA in HMA and supports the notion that sustainable construction can be achieved by incorporating recycled materials in infrastructure projects

J. Mills-Beale and Z. You[8] The asphalt transportation industry is increasingly prioritizing sustainable design and construction practices for highways. This shift is driven by several factors, including the depletion of construction materials, limited landfill capacity, escalating dumping fees, and the need to reduce environmental emissions. To address these challenges, this research project focuses on investigating the use of Recycled Concrete Aggregates (RCA) as sustainable alternatives in Hot Mix Asphalt (HMA) for low volume roads. The objective of this study is to characterize the mechanical properties of asphalt mixtures incorporating recycled concrete aggregates. In a light traffic volume HMA (control mix), the RCA replaces Michigan traprock virgin aggregates (VA) at various substitution rates of 25%, 35%, 50%, and 75%. The performance of the hybrid VA-RCA HMA is evaluated using SuperpaveTM mix specifications. Several parameters are considered to assess the field performance suitability of the hybrid mixes. The rutting potential is evaluated using the Asphalt Pavement Analyzer (APA), while the Dynamic Modulus (E*), Tensile Strength Ratio (TSR) for moisture susceptibility, Indirect Tensile Test (IDT) resilient modulus, and Construction Energy Index (CEI) are determined. The results indicate that all four hybrid VA-RCA HMA mixes meet the minimum rutting specification of 8 mm. The master curves demonstrate that the dynamic stiffness of the hybrid mixes is lower compared to the control 4E1 mix, with a further decrease observed as the RCA content increases. Moisture susceptibility, evaluated through the tensile strength ratio, indicates that decreasing RCA content leads to increased tensile strength ratio, with only the mix containing 75% RCA failing to meet the specification criterion. The compaction energy index analysis reveals that the use of RCA can result in energy savings during compaction. Based on the findings, it is recommended that incorporating a certain amount of RCA in HMA is acceptable for low volume roads. The study highlights the potential of using recycled concrete aggregates to achieve sustainable asphalt mixtures while meeting performance requirements. However, further research and field evaluations are necessary to validate the long-term performance and durability of the hybrid VA-RCA HMA mixes.

F. S. Kharuddin, W. N.A. Wan Azahar, P. J. Ramadhansyah, M. R. Hainin, Z. F. Mohamed Jaafar[9] The pavement industry heavily relies on conventional materials for road construction, but the scarcity of mined resources necessitates the exploration of local alternatives to partially replace asphalt components. The traditional pavement industry also contributes to thermal and greenhouse emissions through mining activities. Furthermore, the generation of construction and demolition (C&D) waste in Malaysia is increasing at an alarming rate. Recycling C&D waste, particularly in the form of crushed bricks (RCB), is seen as a viable option to modify asphalt pavement production, promoting greener and more sustainable practices. In this study, RCB is introduced as a partial replacement for coarse aggregates in the bituminous wearing course. The coarse aggregates are substituted with RCB at proportions of 0%, 10%, 20%, 30%, and 40% by

weight. Laboratory evaluations of the Los Angeles Abrasion Value, Aggregate Crushing Value, and Marshall Test were conducted to assess the performance of the modified asphalt concrete. The results indicate that asphaltic concrete modified with 10% RCB exhibits the lowest abrasion and crushing values, measuring 20.2% and 30% respectively. Moreover, this mix demonstrates the highest Marshall Stability and the lowest flow, with values of 15.61 kN and 3.37 mm respectively. Therefore, the partial replacement of coarse aggregates with 10% RCB in the bituminous mix proves suitable for use in the wearing course. It serves as an alternative material to reduce dependence on natural aggregates and efficiently utilize C&D waste. The findings of this study highlight the potential of incorporating RCB in bituminous mixtures for sustainable pavement construction. By utilizing recycled materials and reducing reliance on natural aggregates, this approach promotes greener practices in the asphalt industry. However, further research and field evaluations are necessary to assess the long-term performance, durability, and environmental benefits of using RCB in pavement construction.

Juan Gabriel Bastidas-Martínez, , Fredy Alberto Reyes-Lizcano, Hugo Alexander Rondón-Quintana[10] The production of asphalt mixtures for pavements requires significant quantities of natural aggregates (NA), leading to high environmental impacts and concerns about environmental preservation. To address these issues, researchers have explored various alternative materials obtained from construction and demolition processes in civil construction as potential replacements for NA. This study provides a comprehensive review of the existing knowledge regarding the use of recycled concrete aggregates (RCA) in the manufacturing of asphalt mixtures, focusing mainly on hot-mix asphalt (HMA) type. The review examines environmental aspects associated with the use of RCA and discusses the potential benefits and limitations of using RCA as a substitute for NA in asphalt mixtures. However, due to the heterogeneity of RCA characteristics, it is challenging to establish a consistent behavior pattern. The properties of RCA can vary significantly depending on the source of the original concrete. The literature suggests that RCA has considerable potential for application in the production of asphalt mixtures. Many studies have demonstrated that mixtures incorporating RCA meet the quality requirements specified in construction specifications, particularly for low-volume roads. This indicates that RCA can be successfully used as a replacement for NA in asphalt mixtures, providing a sustainable alternative. Based on the review, the study also presents recommendations and suggestions for future research in this area. These suggestions aim to further enhance our understanding of the behavior of RCA in asphalt mixtures and explore its potential applications in different pavement scenarios. In summary, this study highlights the potential of using RCA as a substitute for NA in the manufacturing of asphalt mixtures. By utilizing recycled concrete aggregates, the environmental impacts associated with NA extraction can be reduced. The findings of this review contribute to the existing knowledge on the subject and provide valuable insights for future research endeavors in this field.

Waqar Ahmed Gul, Murat Guler[11], Natural aggregate plays a crucial role in asphalt concrete and Portland cement concrete mixtures. However, the disposal of demolition wastes presents challenges, and using recycled concrete aggregate (RCA) in asphalt mixtures offers a solution to these issues while conserving natural aggregate resources. This study focuses on incorporating RCA in asphalt mixtures through repeated creep tests. The standard Marshall mixture design method is adapted to meet the requirements for specimen size and aspect ratio in uniaxial testing. By utilizing this modified method, specimens are prepared to assess the impact of RCA on mixture performance. The study demonstrates that the addition of RCA can enhance the resistance of asphalt mixtures to permanent deformation, specifically rutting. The extent of improvement depends on the gradation of the mixture. The findings indicate that incorporating RCA into asphalt mixtures can be an effective strategy to mitigate permanent deformation issues and improve the overall performance of the pavement. By utilizing recycled materials like RCA, the study promotes sustainability and conservation of natural aggregate resources.

S. Serranti, R. Palmieri,G. Bonifazi[12], This research introduces a novel approach utilizing HyperSpectral Imaging (HSI) to develop an efficient, fast, cost-effective, and on-line method for detecting and characterizing various materials in a Demolition Waste (DW) flow stream. The aim is to enhance the recycling process by identifying and characterizing recycled aggregates for quality control purposes. The implemented HSI-based approach demonstrates the capability to recognize and characterize recycled aggregates, which are essential for ensuring quality control. It can effectively identify contaminants present in the DW flow stream, including plastic, brick, gypsum, wood, and foam. The approach not only detects these contaminants but also measures their morphological and morphometrical parameters. The presence of contaminants can have a detrimental impact on the quality of recycled aggregates. Therefore, it is crucial to identify and quantify these materials accurately. Recycled aggregates should possess specific physical and mechanical characteristics in line with market requirements to ensure their successful reuse in the production of high-value "green concrete." By employing HSI technology, this research offers a promising solution to improve the recycling process of DW and enhance the quality control of recycled aggregates. The ability to detect and characterize different materials within the flow stream enables more effective sorting and selection of high-quality recycled aggregates, contributing to the production of sustainable and environmentally friendly concrete.

MdShajib, MdUllahAftaburRahman [13] Concrete is a widely utilized construction material due to its durability, fire resistance, satisfactory compressive strength, availability, and cost-effectiveness. However, the depletion of natural resources and the environmental concerns associated with the disposal of construction and demolition (C&D) waste pose significant challenges. To address these issues, recycled aggregate (RA) sourced from C&D waste can be a promising alternative to replace natural aggregate in concrete production. This research paper focuses on identifying important features and properties of recycled

aggregate (RA) and recycled aggregate concrete (RAC) from an engineering perspective. It highlights the need to establish limiting values for the characterization of recycled aggregate and addresses unresolved issues such as stress-strain relations and the lack of development of code provisions for RAC. Furthermore, the paper briefly discusses a numerical study conducted on RAC to explore its characteristics. Additionally, the economic aspects of RAC, including both positive and negative aspects, are emphasized. In summary, this research paper underscores the significant advantages of utilizing RAC in concrete engineering. It emphasizes the importance of sustainable practices by utilizing recycled materials and addresses key considerations related to the properties, performance, and economics of RAC. By promoting the use of RAC, the construction industry can contribute to environmental sustainability and resource conservation. A. R.Pasandín, I. Pérez[14] , In this study, the effect of ageing time on the primary properties of hot-mix asphalt (HMA) containing recycled concrete aggregates (RCA) sourced from construction and demolition waste (CDW) was evaluated in a laboratory setting. The HMA mixtures were subjected to different ageing times by placing them in an oven for 0 hours, 2 hours, and 4 hours at the mixing temperature prior to compaction. The study focused on assessing the volumetric properties, stiffness, and resistance to permanent deformation of the HMA mixtures. The percentage of RCA used in place of natural aggregate varied at 0%, 5%, 10%, 20%, and 30% in the mixtures. The results indicated that as the ageing time of HMA containing RCA increased, several changes in the properties of the mixtures were observed. Firstly, the number of air voids in the mixtures increased with longer ageing times. Additionally, the stiffness of the mixtures at ambient temperature also increased as the ageing time increased. Lastly, the initial permanent deformation of the mixtures was influenced by the ageing time, showing an increase with longer ageing times. These findings suggest that the ageing time of HMA containing RCA has a notable impact on its primary properties. The increased number of air voids, stiffness, and initial permanent deformation observed with longer ageing times indicate changes in the performance characteristics of the mixtures. This information can be valuable for optimizing the design and performance of HMA containing RCA, contributing to more sustainable and durable asphalt pavements .

César Medina, Wenzhong Zhu, TorstenHowind, María Isabel Sánchez De Rojas, MoisésFrías[15] This article presents the findings of a feasibility study conducted to assess the viability of using a low-quality recycled aggregate, derived from construction and demolition waste, as a partial replacement for natural coarse aggregate in the production of concrete with a strength grade of 30 MPa. The recycled aggregate used in the study contained a significant amount of asphalt and floating materials. The study investigated various properties of the concrete, including workability, density, compressive strength, tensile strength, water absorption, and sorptivity. Different concrete mixes were prepared, incorporating 25% or 50% of the recycled aggregate, with and without the presence of floating materials. The results demonstrated that the inclusion of up to 50% of the recycled aggregate did not have any detrimental effects on the workability of fresh concrete. However, as the replacement ratio of recycled aggregate and the content of floating particles increased, several physical and mechanical properties of hardened concrete were observed to decline. These properties included strength, density, sorptivity, and water absorption. Despite the decrease in these properties, the concretes containing the mixed recycled aggregates were found to be suitable for housing construction, considering the achieved strength and other relevant properties. The study highlighted the potential of replacing natural coarse aggregate with recycled construction and demolition waste as a means of improving the technical, economic, and environmental aspects of the construction industry, thus contributing to its overall sustainability.

AyadA.Mohammed,AbdelmajeedAltlomate,MohammedA.Al-Zarroug, MuftahK.Hussain, SafaaS.Al-Ramash[16] This research focuses on evaluating the performance of hot asphalt mixtures containing recycled concrete aggregate (RCA). The study aims to assess the suitability of using RCA as a replacement for natural aggregate in asphalt mixtures. Various tests were conducted on the aggregates, including sieve analysis, specific gravity, absorption, and abrasion, to ensure the quality of the recycled concrete aggregate. Similar tests were also carried out on natural aggregate for comparison purposes. Additionally, several bitumen tests were performed, such as penetration test, softening point, flash and fire point, and specific gravity, to determine the applicability of the bitumen as a binder material in the asphalt mixture. Marshal samples were prepared using both natural aggregate and recycled coarse concrete aggregate to evaluate the mechanical properties of the asphalt mix. The results were compared with specifications to assess the performance of the recycled aggregate. The findings indicated that it is feasible to use recycled aggregate in hot mix asphalt, with the caveat of increasing the bitumen content by approximately 0.6% compared to the asphalt mix containing natural aggregate. The optimum bitumen content for mixes with recycled coarse aggregate was found to be 5.8%, while for natural aggregate, it was 5.2%. Overall, the research suggests that incorporating recycled concrete aggregate into hot mix asphalt is possible, but it requires adjusting the bitumen content to achieve the desired performance characteristics.

HenokAddissie, AlemayehuGebissa, MarkosTsegaye[17] This research focuses on evaluating the performance of plastic modified bitumen for sub-tropical areas of Ethiopia. The objective is to address the issues related to the sensitivity of bitumen to temperature, loading time, and climate in asphalt mixtures. In Ethiopia, asphalt binders have traditionally been selected based on penetration grade at 25°C for road construction. However, the increasing traffic, the need for better performance of dense graded asphalt (DGA), and the desire for cost-effective and long-lasting pavement solutions necessitate the exploration of alternative asphalt mastics and mixtures. The study investigates the effect of temperature on the strain (deformation) of two commonly used bitumens in Ethiopia, namely 40/50 and 85/100. Additionally, the rheological properties of these bitumens, as well as their modified versions with polyvinyl chloride (PVC) and low-density polyethylene (LDPE) polymers, are examined using penetration grade and

SuperPave grading systems. Different percentages of PVC (0-7%) and LDPE (0-9%, only odd numbers) are mixed with the bitumens, and a series of consistency, rotational viscometer, and performance grading tests are conducted at various temperatures. The results indicate that the 3% PVC modified binder and 5% LDPE modified binder exhibit better penetration, softening point, ductility, viscosity, and performance grade compared to other percentages of the modifiers for both the 40/50 and 85/100 bitumen grades. These promising modified binders, along with the neat 40/50 and 85/100 bitumens, undergo additional SuperPave rheology tests such as rolling thin film oven, amplitude sweep, multiple stress creep recovery, and Fourier transform infra-red tests. The SuperPave test results demonstrate that the PVC and LDPE modified binders have lower percentage of heat loss, higher linear viscoelastic region (LVER), lower unrecoverable creep compliance, and higher percentage recovery compared to the unmodified bitumens for both the 40/50 and 85/100 grades. In conclusion, the selected modifiers improve the 40/50 and 85/100 bitumens to the equivalent of 30/40 and 60/70 penetration grades, respectively. Furthermore, the SuperPave grading shows an improvement from PG64-Z (40/50) to PG82-Z and from PG52-Z (85/100) to PG76-Z (with 3% PVC) and PG82-Z (with 5% LDPE). Overall, the study demonstrates the potential of plastic modified bitumen to enhance the performance characteristics of asphalt binders in sub-tropical areas. The improved bitumens exhibit favorable properties in terms of penetration grade, SuperPave grading, and rheological performance, indicating their suitability for use in asphalt mixtures in Ethiopia. SushantaBhusal, Haifang Wen[18] This study investigated the effects of recycled concrete aggregate (RCA) on the performance of hot mix asphalt (HMA). The objective was to determine whether the addition of RCA adversely affects the behavior of the asphalt mix and whether it is a suitable practice for sustainable construction. The study involved producing asphalt mixes by blending RCA with virgin aggregate at various percentages: 0%, 20%, 40%, 60%, 80%, and 100%. Mix design results revealed that RCA has a high absorption capacity, and as the percentage of RCA in the mix increased, the optimum asphalt content also increased significantly. In terms of performance behavior, the incorporation of RCA into the HMA mix led to a reduction in modulus, resistance to rutting, fatigue resistance, thermal cracking resistance, and resistance to moisture damage. These findings suggest that the addition of RCA negatively impacts the overall performance of the asphalt mix. Although all the mixes containing RCA met the volumetric requirements, the study concludes that using RCA as an aggregate in HMA is not recommended due to the observed reductions in performance behavior and the need for higher asphalt content. Additionally, it is noted that the absorbed asphalt in RCA may play a significant role at high temperatures, potentially causing asphalt expansion. Based on these findings, alternative strategies should be considered for incorporating RCA into asphalt mixes without compromising the performance of the pavement. Further research and development efforts are needed to address the challenges associated with the use of RCA and to optimize its utilization in HMA for sustainable construction practices.

3. Conclusion

The researchers have endeavored to discover the variety in stability which happens because of different ration of RCA following are the results of writing survey:

- Having good marshal stability.
- Having low marshall flow.
- Having a good life of bituminous concrete used for projects.

References

[1] Fabiana Da ConceiãoLeite , Rosângela Dos Santos Motta, Kamilla L. Vasconcelos, LiediBernucci, **"**Laboratory evaluation of recycled construction and demolition waste for pavements" Construction and Building Materials, vol 25, no.6, 2011.

[2] Y. Huang, R. N. Bird, and O. Heidrich, "A review of the use of recycled solid waste materials in asphalt pavements," Resources, Conservation and Recycling, vol. 52, no. 1, pp. 58–73, 2007.

[3] HüseyinAkbulut, CahitGürer, "Use of aggregates produced from marble quarry waste in asphalt pavements" Building and Environment, vol 42,no. 5,2007.

[4] Mohammad Saeed Pourtahmasb, Mohamed Rehan Karim, "Utilization of Recycled Concrete Aggregates in Stone Mastic Asphalt Mixtures" Advances in Materials Science and Engineering, 2014.

[5] Jayakody, Shiran, ChamindaGallage, Arun Kumar, "Assessment of recycled concrete aggregates as a pavement material" Geomechanics and Engineering, vol 6,no. 3, 2014.

[6] E. Vazquez, M. Barra, D. Aponte, C. Jim ´ enez, and S. Valls, "Improvement of the durability of concrete with recycled aggregates in chloride exposed environment, " Construction and Building Materials, vol. 67, pp. 61–67, 2014.

[7] A. R. Pasand´ın and I. Perez, "Mechanical properties of hot mix asphalt made with recycled concrete aggregates coated with bitumen emulsion, " Construction and Building Materials, vol. 55, no. 31, pp. 350–358, 2014.

[8] J. Mills-Beale and Z. You, "The mechanical properties of asphalt mixtures with recycled concrete aggregates, " Construction and Building Materials, vol. 24, no. 3, pp. 230–235, 2010.

[9] F. S. Kharuddin, W. N.A. Wan Azahar, P. J. Ramadhansyah, M. R. Hainin, Z. F. Mohamed Jaafar, "Performance of asphaltic concrete modified with recycled crushed bricks," IOP Conference Series: Earth and Environmental Science, 2021.

[10] Juan Gabriel Bastidas-Martínez, , Fredy Alberto Reyes-Lizcano, Hugo Alexander Rondón-Quintana, "Use of recycled concrete aggregates in asphalt mixtures for pavements: A review", Journal of Traffic and Transportation Engineering (English Edition), vol. 9, no. 5, pp. 725–741, 2010.

[11] Waqar Ahmed Gul, Murat Guler, "Rutting susceptibility of asphalt concrete with recycled concrete aggregate using revised Marshall procedure",

Construction and Building Materials, vol. 55, pp. 341–749, 2014.
[12] S. Serranti, R. Palmieri,G. Bonifazi, "QUALITY CONTROL OF RECYCLED AGGREGATES FROM DEMOLITION WASTE BY ADVANCED SENSING", 2015.
[13] MdShajib, MdUllahAftaburRahman, "Evaluation of different aspects of recycled aggregate and recycled aggregate concrete", 2016.
[14] A. R.Pasandín, I. Pérez, "Effect of ageing time on properties of hot-mix asphalt containing recycled concrete aggregates", Journal of Construction and Building Materials, vol. 52, pp. 284–293, 2014.
[15] César Medina, Wenzhong Zhu, TorstenHowind, María Isabel Sánchez De Rojas, MoisésFrías, "Influence of mixed recycled aggregate on the physical-mechanical properties of recycled concrete", Journal of Cleaner Production, vol. 68, pp. 216–225, 2014.
[16] AyadA.Mohammed,AbdelmajeedAltlomate,MohammedA.Al-Zarroug, MuftahK.Hussain, SafaaS.Al-Ramash5, "Performance Evaluation of Hot Mix Asphalt Containing Recycled Concrete Aggregate",
[17] HenokAddissie, AlemayehuGebissa, MarkosTsegaye, "Rheological Properties of Plastic Modified Bitumen for Sub-Tropical Areas of Ethiopia", American Journal of Civil Engineering and Architecture, vol. 6, no. 6, pp. 223–235, 2018.
[18] SushantaBhusal, Haifang Wen, "Evaluating Recycled Concrete Aggregate as Hot Mix Asphalt Aggregate", Advances in Civil Engineering Materials, vol. 2, no. 1, pp. 252–265, 2013.