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Characterization of Classified Indian Reclaimed Asphalt Pavement (RAP): Aggregate Impact Value and Aggregate Abrasion Value of Rap Aggregates

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Abstract: ***Reuse of existing deteriorated bituminous pavement material in construction and maintenance of flexible pavement is called recycling of bituminous pavement. Removed and reprocessed deteriorated pavement material which is recycled is termed as Reclaimed asphalt pavement (RAP). In India during construction of flexible pavement different types of bituminous layers are in practice depending upon CBR of sub-grade and traffic count i.e. CVPD of the road stretch. Depending upon types of bituminous layer i.e. PC Seal Coat, Bituminous Macadam(BM), Dense grade bituminous Macadam (DBM), Semi Dense Bituminous Concrete (SDBC) or Bituminous Concrete(BC) Reclaimed Asphalt Pavement can classified in different groups These classified RAP groups materials will have different characteristics i.e. Rap aggregates and Recovered bitumen of different group of RAP will have different characteristics. In this study characterization of RAP limited to Aggregate Impact Value (AIV) and Aggregate Abrasion Value (AAV)of RAP aggregates of RAP classified in different groups. Results of this study will be compared to standard value of AIV and AAV required for bituminous construction to predict that RAP aggregates are suitable or not for use in bituminous mixes.***

Keywords: ***Rap, Reclaimed, Recycling, Aggregates, Bitumen, Bituminous mix, Asphalt, Characterization, Performance, Aggregate Impact Value, Aggregate Abrasion Value, AIV, AAV.***

I. NTRODUCTION

Mobility of people and goods has been a primitive and everlasting need through the centuries. Mankind has been compelled to move from one place to another in a continuous and persistent struggle to survive. Either for hunting and exploring new land or for chasing enemies and shifting shelter, mankind has been driven to draw and construct safe and secure trackways, developing gradually, through the years, to stone roads and later on, to modern highways. Looking back to the history of roads, it is clear and discernible that technological development, but also every extension of the pre-existing network, took place under stable social conditions, especially during flourishing states: Persian reign, Roman Empire, Byzantine Empire [1]. Indus – Valley Civilization (2600 – 2800 B.C.) flourished with well planned towns having an elaborate street and drainage system. The Roman Civilization (8th Century B.C.) was well known for good road system it built. About 1,00,000 km. road network served military and administrative purposes of the Roman Empire extended over vast regions. During Egyptian Civilization (3000 B.C.), the construction of Pyramids was facilitated because of a good road for transporting huge stone blocks. The Mauryan Emperors (321 to 185 B.C.) built very good roads. Kautilya, the great administrator of that time and the author of Arthasastra, laid down the standard widths of various classes of roads. Initiatives taken by Ashoka in history of road building is appreciable. History of roads in India would be incomplete if the great deed of Sher Shah Suri, the Pashtun monarch, who in a short tenure during 16th century, built Grant Trunk Road. The period covering decline of the Mughals and the beginning of the British rule was a period of neglect of road system in India. Only William Bentinck and Lord Dalhousie took some steps to improve the roads [2]. Post independence development of Indian road network accelerated by Nagpur Plan (1943-1961), Bombay Plan (1961-1981), Lucknow Plan (1981-2001) and finally in running Road Development Plan Vision (2001-2021) [3]. Present Indian road network have total road length 58,97,671 km which incorporated 1,32,500 km National Highways/ Expressway, 1,56,694 km State Highways and 56,08,477 km Other Roads [4]. Thus India has a big road network, hence required financial attention to manage and maintain this network. The Ministry of Road Transport and Highways saw an increase of 10% in its budgetary allocation, but a large chunk of it is through monetization of national highways by the NHAI. The total budget allocation has gone up from ₹83,015 crore last fiscal to ₹91,823.2 crore for financial year 2020-2021. Of this hike of ₹8,808 crore, as much as ₹5,809 crore is through investment in NHAI met from monetization of national highways. The balance allocation is for road works [5]. It is clear that Indian road network required much more manpower, funds and natural resources. Most of the road length is flexible pavement hence need aggregate and binder resources primarily. Since natural resources of aggregates and bitumen binders are limited hence these required to preserve. Another problem of periodic resurfacing or renewal maintenance raised the road elevation which causes vertical clearance, drainage and plinth level related alerts.

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To overcome all these difficulties recycling of bituminous pavement introduced. Recycling asphalt pavement creates a cycle of reusing materials that optimizes the use of natural resources. Reclaimed asphalt pavement (RAP) is a useful alternative to virgin materials because it reduces the need to use virgin aggregate, which is a scarce commodity [6]. Recycling and reusing RAP allows the structural capacity of pavements, their resistance and geometric homogenization to be increased with a minimum use of new materials and removal to landfill deposits [7]. The technology of recycling has become extremely important particularly in urban areas where the levels of roads are raising year after year due to frequent maintenance activities creating drainage problems and making the roads impassable on many occasions. In addition, recycling techniques also helps in conservation of natural occurring materials thus helping minimization of environmental degradation [8]. Production of asphalt can incorporate reclaimed materials from the deconstruction of road surfaces. This aids in reducing production costs and saves natural resources, bitumen and aggregates. However, recycling can only be justified if the performance and longevity of the produced pavement is equal or better than that of traditional mixtures [9]. Bituminous pavement recycling technology is not yet a popular in India and other developing countries because there are no sufficient guidelines and standards available; hence they have to learn and apply. Advantages of use of RAP necessitate adoption of pavement recycling techniques in near future. Hence it is a major scope of Characterization and Performance Evaluation of Reclaimed Asphalt Pavements (RAP) [10]. So it becomes first priority to develop guidelines and standards pertaining use of recycled or reclaimed asphalt pavement (RAP). In this way first step will be characterization of classified reclaimed asphalt pavement (RAP) by investigating characteristics or properties of RAP aggregates and recovered bitumen. This study deals with finding out two basic characteristics or properties of RAP aggregates i.e. Aggregate Impact Value (AIV) and Aggregate abrasion Value (AAV) by conducting laboratory experiments on aggregates obtained from different categories of reclaimed asphalt pavements (RAP) classified on the basis of origin and sources of RAP. On the basis of origin and sources RAP are classified in four categories i.e. PS, BS, DS & DB Groups [11, 12] as given in Table No. 1

Table No.01: Categorization of RAP in Different Groups [11, 12]

Sl. No.	Recycled Layers	Group of Sample	Description
1	PC+SEAL	PS	Initially Open Graded Premix Carpet (OGPC) and Seal Coat exist at the road from where sample is collected.
2	BM+SDBC	BS	Initially Semi Dense Bituminous Concrete Over layer of Bituminous Macadam exist at the road from where sample is collected.
3	DBM+SDBC	DS	Initially Semi Dense Bituminous Concrete Over layer of Dense Bituminous Macadam exist at the road from where sample is collected.
4	DBM+BC	DB	Initially Bituminous Concrete Over layer of Dense Bituminous Macadam exist at the road from where sample is collected.

II. MATERIAL

The RAP is a deteriorated bituminous mix that contains aged bitumen and aggregates. Hence, its performance is poorer when compared to the fresh mix. The purpose of the bituminous recycling is to regain the properties of the RAP; such that is tends to perform as good as fresh mix. Thus, the process of bituminous recycling involves mixing of the RAP after Crushing, Screening and Stock Pilling. Use of RAP materials in road constructions will require characterized RAP, bitumen rejuvenators and virgin aggregates etc. Generally reclaimed asphalt pavement (RAP) is available as mixture of material used in binder/bituminous base course and wearing/surface course. Hence they cannot separate from removed bituminous material. Thus sampling of RAP is done for further study is given in table no 2. Minimum four road sites are selected for sampling of each group of reclaimed asphalt pavement. At least four chainages identified on each road and minimum four samples collected at each chainage. This indicates that total number of samples in each RAP group will be 64. As per existing guidelines and standards flexible pavements includes different bituminous layers which recycled depending upon traffic count as CVPD of a particular road. If CVPD is up to 2.0 msa OGPC (open graded premix carpet) with seal coat used; 2.0- 5.0 msa SDBC over BM or DBM used; If CVPD if more than 5.0 msa BC over DBM layer used. Different groups of RAP samples are collected from different roads of Lucknow and Barabanki district of Uttar Pradesh in India. All the samples are collected 15-30 year period of flexible pavement [12] .Complete details of collected samples are given in Table No. 2 [11,12]

III. METHODOLOGY

Experimental work done with different set of RAP samples and results can be used to characterize the RAP materials. First of all RAP collected from different areas and different roads for this study. Samples were oven dried and crushed so that lumps were break to a level so that each and every bitumen coated coarse aggregates separated to each other. Bitumen from RAP sample washed out by using trichloroethylene or benzene solution and extracting with bitumen extractor. These samples were oven dried again and tested for AIV and AAV and results were summaries for further study of performance of reclaimed asphalt pavement (RAP) aggregates in different layers of pavements. Methodology developed for characterization of Indian reclaimed asphalt pavement will include steps listed below [11,12]:-

- Identification of roads for collection of reclaimed asphalt pavement (RAP).
- Drying samples in oven for 24 hours at 100^0 C.
- Crushing of oven dried collected samples.
- Washing of crushed samples with trichloroethylene or benzene solution.
- Another part of sample put in ignition furnace.
- Two part of washed or ignited and oven dried sample separate out.
- One sample is tested for Aggregate Impact Value (AIV).
- Other sample is tested for Aggregate Abrasion value (AAV).

➢ Tabulation of result of Aggregate Impact Value (AIV) and Aggregate Abrasion Value (AAV).
➢ Averaging the result for predicting AIV and AAV.
➢ Presenting All results of AIV and AAV for each group separately.
➢ Summarizing findings and compare with standards.

Table No.2: Sampling of RAP of Different Groups [11, 12]

Sl. No.	Group of Sample	Coding of different Samples	Chainage	Name of Roads	Location	Category of Roads
1.	PS	PS1 PS1' PS1'' PS1'''	0.400 Km 1.500 Km 2.600 Km 3.700 Km	Para Link Road	Lucknow, Uttar Pradesh, India	Village Roads (VR)
		PS2 PS2' PS2'' PS'''	0.800 Km 1.600 Km 2.500 Km 3.800 Km	Amity college to Khargapur Link Road	Lucknow, Uttar Pradesh, India	Village Roads (VR)
		PS3 PS3' PS3'' PS3'''	3.200 Km 4.500 Km 5.400 Km 6.200 Km	Lalpur Link Road	Lucknow, Uttar Pradesh, India	Village Roads (VR)
		PS4 PS4' PS4'' PS4'''	2.300 Km 3.500 Km 4.600 Km 5.800 Km	Nigoha Bazar to Meerak Nagar Link Road	Lucknow, Uttar Pradesh, India	Village Roads (VR)
2.	BS	BS1 BS1' BS1'' BS1'''	36.400 Km 37.500 Km 38.600 Km 39.700 Km	Haidergargh-Subeha-Shukul Bazar Road (ODR)	Barabanki, Uttar Pradesh, India	Other District Road (ODR)
		BS2 BS2' BS2'' BS2'''	10.100 Km 11.500 Km 12.300 Km 13.600 Km	Bhanmau-Zaidpur-Safdarganj-Badosarai Road (ODR)	Barabanki, Uttar Pradesh, India	Other District Road (ODR)
		BS3 BS3' BS3'' BS3'''	23.400 Km 24.600 Km 25.600 Km 26.800 Km	Barabanki-Deviganj-Subeha Road (ODR)	Barabanki, Uttar Pradesh, India	Other District Road (ODR)
		BS4 BS4' BS4'' BS4'''	09.400 Km 10.200 Km 11.600 Km 12.400 Km	Mohammadpur-Siddhaur-Kaiserganj Road (ODR)	Barabanki, Uttar Pradesh, India	Other District Road (ODR)
3.	DS	DS1 DS1' DS1'' DS1'''	130.200Km 131.400Km 132.600Km 133.800Km	Barabanki-Haidergargh-Bachhrawan Road (SH-13)	Barabanki, Uttar Pradesh, India	State Highway (SH)
		DS2 DS2' DS2'' DS2'''	10.400 Km 11.200 Km 12.400 Km 13.200 Km	Haidergargh-Ramsnehighat Road (MDR-3)	Barabanki, Uttar Pradesh, India	Major District Road (MDR)
		DS3 DS3' DS3'' DS3'''	16.400 Km 17.500 Km 18.600 Km 19.700 Km	Intauja-Mahona-Kumhrawan-Kursi-Deva-Chinhat Road (MDR-88)	Barabanki, Uttar Pradesh, India	Major District Road (MDR)
		DS4 DS4' DS4'' DS4'''	1.400 Km 2.500 Km 3.600 Km 4.700 Km	Haidergargh-Maharajganj Road (SH-13A)	Barabanki, Uttar Pradesh, India	State Highway (SH)
4.	DB	DB1 DB1' DB1'' DB1'''	260.400 Km 261.500 Km 262.600 Km 263.700 Km	Palia-Shahjanpur-Hardoi Road (SH-25)	Lucknow, Uttar Pradesh, India	State Highway (SH)

		DB2 DB2' DB2'' DB2'''	59.400 Km 60.400 Km 61.600 Km 62.300 Km	Lucknow-Sultnpur Road (NH-56)	Barabanki, Uttar Pradesh, India	National Highway (NH)
		DB3 DB3' DB3'' DB3'''	22.400 Km 23.500 Km 24.600 Km 25.700 Km	Lucknow-Faizabad-Gorakhpur-Mokama Road (NH28)	Barabanki, Uttar Pradesh, India	National Highway (NH) City Portion.
		DB4 DB4' DB4'' DB4'''	2.400 Km 3.500 Km 4.600 Km 5.700 Km	Barabanki-Bahraich-Nanpara-Rupaidiha road (NH-28 C)	Barabanki, Uttar Pradesh, India	National Highway (NH)

IV. EXPERIMENTAL PROGRAM

Different tests on cores of RAP and crushed and oven dried RAP aggregate samples were done in four lots for each group of RAP. Each lot has at least sixteen samples of RAP collected at Identified road sites. Laboratory test are done on original RAP samples and RAP aggregates and findings are given in tables. Graphical and pictorial presentation along with statistical analysis of data executed. Three laboratory tests are conducted on Original RAP samples to study about properties of RAP i.e. Binder/Bitumen Content, Density of Cores and Moisture Content. Further Characterization of RAP aggregates can be done by conducting seven laboratory tests on RAP aggregates i.e. Gradation, Shape Tests, Aggregate Impact Value (AIV), Aggregate Abrasion Value (AAV), Crushing, Polished Stone Value and Soundness. Apart from these further characterization of Reclaimed Asphalt Pavement (RAP) will require characterization of recovered bitumen. Characterization of recovered bitumen can be done by conducting nine laboratory tests on recovered bitumen of RAP of different class i.e. Penetration Test, Ductility Test, Softening Point Test, Specific Gravity Test, Viscosity Test, Flash and Fire Point Test, Float Test, Determination of Water Content, Determination of loss on heating [12]. In this study experiments related to Aggregate Impact Value (AIV) and Los Angeles Abrasion Value (LAAV) conducted.

V. SCOPE OF STUDY

Characterization of reclaimed asphalt pavement (RAP) is itself a broad area, but this paper is limited to study of two basic and important properties or characteristics RAP Aggregates i.e.

1. Aggregate Impact Value (AIV)
2. Aggregate Abrasion Value (AAV)

Aggregate Impact Value (IS 2386 – Part 4) : Determination of aggregate impact value of coarse aggregate can be done as setup and procedure given in IS 2386-Part 4. Impact testing machine shown in Figure. 1 .Aggregate impact value gives a relative measure of the resistance of an aggregate to sudden shock or impact, which in some aggregates differs from its resistance to a slow compressive load. Aggregate impact value shall be less than 45% for aggregate used in concrete for concrete other than wearing surface and 30% for concrete used in wearing surface [13].

Aggregate Abrasion Test (Los Angeles Machine) (IS 2386 – Part 4): Determination of aggregate abrasion value of coarse aggregate by the Los Angeles Machine can be done as setup and procedure given in IS 2386- Part 4.

Testing of aggregate against wear is an important test for aggregate to be used for road constructions, ware house floors and pavement construction.

content and gradation pattern is shown in Figure 04.

VI. FINDINGS

Aggregate Impact Value (AIV) and Aggregate Abrasion Value (AAV) tests performed on Sample of RAP Aggregates obtained from different sources of RAP from different sites of deteriorated pavement. After extraction or ignition aggregate samples are tested to find out Aggregate Impact Value (AIV) and Aggregate Abrasion Value (AAV) characteristics and results are compared with standard AIV and AAV requirement of aggregatse for BC and DBM as per Indian Standards. Group wise results were summarized as below:-

A."Group PS" RAP: These are RAP Samples collected from the deteriorated pavement sites where initially bituminous layer is OGPC and Seal Coat over a granular layer. In practice these types of RAP samples are available at Village Roads (VR) where initial CVPD after construction is up to 2.0 msa [12]. Aggregate Impact Value (AIV) and Aggregate Abrasion Value (AAV) Characteristics of this group are presented by table no.03& 04 respectively.

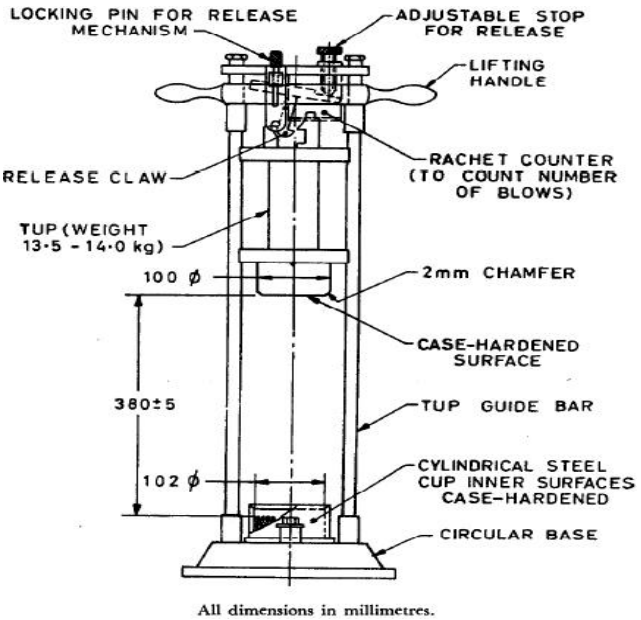

Fig. 1: Aggregate Impact Testing Machine[13]

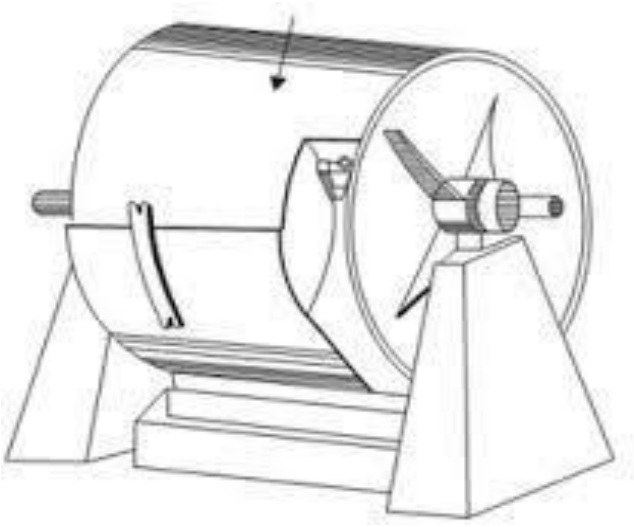

Fig. 2: Los Angeles Abrasion test [13].

Table No. 03: Aggregate Impact Value (AIV) characteristics of "Group PS" RAP Aggregates

Sl. No.	Group of Sample	Coding of different Samples	Aggregate Impact Value	
			AIV (%)	Average (%)
1	PS	PS1 PS1' PS1'' PS1'''	26 25 26 26	26
		PS2 PS2' PS2'' PS2'''	26 25 26 26	26
		PS3 PS3' PS3'' PS3'''	27 28 29 27	28
		PS4 PS4' PS4'' PS4'''	28 25 26 28	27
Average of PS group				**27%**

Fig. 3: Laboratory setup and Equipments for AIV and LAAV tests (IS: 2386-Part 4)

Table No.04: Aggregate Abrasion Value (AAV) characteristics of "Group PS" RAP Aggregates

Sl. No.	Group of Sample	Coding of different Samples	Aggregate Abrasion Value	
			Los Angeles Abrasion Value (%)	Average
1	PS	PS1 PS1' PS1'' PS1'''	29 28 29 29	29
		PS2 PS2' PS2'' PS2'''	28 27 28 28	28
		PS3 PS3' PS3'' PS3'''	28 28 29 29	29
		PS4 PS4' PS4'' PS4'''	29 28 28 29	29
Average of PS group				**29%**

Table No. 05: Aggregate Impact Value (AIV) characteristics of "Group BS" RAP Aggregates

Sl. No.	Group of Sample	Coding of different Samples	Aggregate Impact Value	
			AIV (%)	Average (%)
1	BS	BS1 BS1' BS1'' BS1'''	24 24 25 23	24
		BS2 BS2' BS2'' BS2'''	22 23 24 22	23
		BS3 BS3' BS3'' BS3'''	24 25 23 24	24
		BS4 BS4' BS4'' BS4'''	25 25 25 25	25
Average of BS group				**24%**

B. "Group BS" RAP: These are RAP samples collected from the deteriorated pavement sites where initially bituminous layer is Semi Dense Bituminous Concrete (SDBC) over layer of Bituminous Macadam supported by a granular base. In Practice these type of RAP samples are available at Other District Roads (ODR) and Major District Roads (MDR) where initial CVPD after construction is up to 2.0 to 5.0 msa.[12].Aggregate Impact Value (AIV) and Aggregate Abrasion Value (AAV) Characteristics of this group are presented by table no.05& 06 respectively. construction is up to 2.0 to 5.0 msa. Characteristics of this group are presented by table no.05& 06.

C. "Group DS" RAP: These are RAP samples collected from the deteriorated pavement sites where initially bituminous layer is Semi Dense Bituminous Concrete (SDBC) over layer of Dense Bituminous Macadam (DBM) supported by a granular base. In Practice these types of RAP samples are available at Other District Roads (ODR), Major District Roads (MDR) and State Highway (SH) where initial CVPD after construction is up to 2.0 to 5.0 msa.[12]. Aggregate Impact Value (AIV) and Aggregate Abrasion Value (AAV) Characteristics of this group are presented by table no.07& 08 respectively.

Table No.06: Aggregate Abrasion Value (AAV) characteristics of "Group BS" RAP Aggregates

Sl. No.	Group of Sample	Coding of different Samples	Aggregate Abrasion Value	
			Los Angeles Abrasion Value (%)	Average (%)
1	BS	BS1 BS1' BS1'' BS1'''	26 27 27 27	27
		BS2 BS2' BS2'' BS2'''	25 26 26 24	26
		BS3 BS3' BS3'' BS3'''	26 28 28 27	27
		BS4 BS4' BS4'' BS4'''	29 28 28 28	28
Average of BS group				**27%**

Table No. 07: Aggregate Impact Value (AIV) characteristics of "Group DS" RAP Aggregates

Sl. No.	Group of Sample	Coding of different Samples	Aggregate Impact Value	
			AIV (%)	Average (%)
1	DS	DS1 DS1' DS1'' DS1'''	21 22 22 23	22
		DS2 DS2' DS2'' DS2'''	21 21 21 21	21
		DS3 DS3' DS3'' DS3'''	22 21 20 21	21
		DS4 DS4' DS4'' DS4'''	21 20 21 22	21
Average of DS group				**21%**

D. "Group DB" RAP: These are RAP samples collected from the deteriorated pavement sites where initially bituminous layer is Bituminous Concrete (BC) over layer of Dense Bituminous Macadam (DBM) supported by a granular base. In Practice these types of RAP samples are available at State Highway (SH) and National Highway (NH) where initial CVPD after construction is more than 5.0 msa.[12]. Aggregate Impact Value (AIV) and Aggregate Abrasion Value (AAV) Characteristics of this group are presented by table no.09& 10 respectively.

Indian Standards of Aggregate Impact Value (AIV) and Aggregate Abrasion Value (AAV) as per MORTH specification [14] is summaries in table no 11. Results obtained in this study will compare to these standard value to predict the suitability of different groups of RAP aggregate in different layers of flexible pavements. Test Method used are as described in IS: 2386 (Part 4) or IS: 5640.

Table No.08: Aggregate Abrasion Value (AAV) Characteristics of "Group DS" RAP Aggregates

Sl. No.	Group of Sample	Coding of different Samples	Aggregate Abrasion Value	
			Los Angeles Abrasion Value (%)	Average (%)
1	DS	DS1 DS1' DS1'' DS1'''	21 22 22 23	24
		DS2 DS2' DS2'' DS2'''	21 21 21 21	22
		DS3 DS3' DS3'' DS3'''	22 21 20 21	22

		DS4 DS4' DS4'' DS4'''	23 23 23 24	23
Average of DS group				**23%**

Table No. 09: Aggregate Impact Value (AIV) Characteristics of "Group DB" RAP Aggregates

Sl. No.	Group of Sample	Coding of different Samples	Aggregate Impact Value	
			AIV (%)	Average (%)
1	DB	DB1 DB1' DB1'' DB1'''	16 17 17 18	17
		DB2 DB2' DB2'' DB2'''	21 20 20 20	20
		DB3 DB3' DB3'' DB3'''	19 19 20 20	19
		DB4 DB4' DB4'' DB4'''	19 19 19 18	19
Average of DB group				**19%**

Table No.10: Aggregate Abrasion Value (AAV) Characteristics of "Group DB" RAP Aggregates

Sl. No.	Group of Sample	Coding of different Samples	Aggregate Abrasion Value	
			Los Angeles Abrasion Value (%)	Average (%)
1	DB	DB1 DB1' DB1'' PS1'''	22 20 20 22	21
		DB2 DB2' DB2'' DB2'''	22 22 21 21	21
		DB3 DB3' DB3'' DB3'''	20 21 21 21	21
		DB4 DB4' DB4'' DB4'''	23 23 24 22	23
Average of DB group				**21%**

Table No.11: Indian Standards of Aggregate Impact Value (AIV) and Los Angeles Aggregate Abrasion Value (LAAV), MORTH Specification [14]

Sl.	Layer or Component of Flexible Pavement	Requirement of Aggregate used	
		Maximum Aggregate Impact Value (%) (AIV)	Maximum Los Angeles Aggregate Abrasion Value (%) (AAV)
1	GSB	40	-
2	WMM	30	40
3	WBM	30	40
4	OGPC	30	40
5	BM	30	40
6	DBM	27	35
7	SDBC	27	35
8	BC	24	30

VII. RESULTS

Total 64 numbers samples of RAP aggregates of different group of classified Indian RAP were tested to find out Aggregate Impact Value (AIV) and Aggregate Abrasion Value (AAV) and average of the results reported; on the basis of this experimental study and standard specification given (in table no. 11) results and descriptions are summarized in table no. 12.

Table No.12: Result Summary and Descriptions

Sl.	RAP Group	Characteristics of RAP Aggregates		Remarks / Descriptions
		Aggregate Impact Value (AIV) %	Los Angeles Aggregate Abrasion Value (AAV) %	

1	Group PS	27	29	1.As AIV of Group PS RAP Aggregate is 27%, it reflects that as AIV is concerned Group PS RAP Aggregates are Marginally suitable for DBM but unsuitable for BC. 2. As Los Angeles Abrasion Value of Group PS RAP Aggregates is 29%, it reflects that as LAAV is concerned Group PS RAP Aggregates are suitable for DBM but marginally suitable for BC.
2	Group BS	24	27	1.As AIV of Group BS RAP Aggregates is 24%, it reflects that as AIV is concerned Group BS RAP Aggregates are suitable for DBM but marginally suitable for BC. 2. As Los Angeles Abrasion Value of Group BS RAP Aggregates is 27%, it reflects that as LAAV is concerned Group BS RAP Aggregates are suitable for DBM and BC both.
3	Group DS	21	23	1.As AIV of Group DS RAP Aggregates is 21%, it reflects that as AIV is concerned Group DS RAP Aggregates are suitable for DBM and BC both. 2. As Los Angeles Abrasion Value of Group DS RAP Aggregates is 23%, it reflects that as LAAV is concerned Group DS RAP Aggregates are suitable for DBM and BC both.
4	Group DB	19	21	1.As AIV of Group DB RAP Aggregates is 19%, it reflects that as AIV is concerned Group DB RAP Aggregates are suitable for DBM and BC both. 2. As Los Angeles Abrasion Value of Group DS RAP Aggregates is 25%, it reflects that as LAAV is concerned Group DS RAP Aggregates are suitable for DBM and BC both.

VIII. CONCLUSION

(1) This experimental study indicates that RAP aggregates obtained from different groups of Reclaimed Asphalt Pavement (RAP) have significant Aggregate Impact Value (AIV) and Aggregate Abrasion Value (AAV). It is clear that Reclaimed Asphalt Pavement (RAP) Aggregates can be used as a substitute of virgin or fresh aggregates in different proportions which will be helpful to preserve the natural aggregate resources and to contribute in sustainable development.

(2) As Aggregate Impact Value (AIV) is concerned Group PS RAP aggregate are marginally suitable for DBM but unsuitable for use in BC; while Group BS RAP Aggregate are suitable for DBM but marginally suitable for BC. Two other Groups of RAP Aggregates i.e. DS and DB Group are suitable for both DBM and BC as AIV is concerned.

(3) As Los Angeles Aggregate Abrasion Value (LAAV) is concerned Group PS RAP Aggregate are suitable for DBM but marginally suitable for BC. Three other Groups of RAP Aggregates i.e. BS,DS and DB are suitable for both DBM and BC as LAAV is concerned.

(4) It is found that Aggregate Impact Value (AIV) and Aggregate Abrasion Value (AAV) will improved with increase in superiority of RAP group i.e. PS, BS, DS and DB are in sequence of increasing superiority and improving sequence of AIV and AAV both, it seems this result pattern is due to closest grading and less weathering effects in superior layers of Flexible Pavements.

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