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Research Article

Suitability Analysis of Readymade Bituminous Pothole Patching Mix in Nepal

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Abstract

The objective of the study is the analysis of the suitability of Readymade Bituminous Pothole Patching Mix for pothole repair in the case of Road Division Bharatpur, Nepal. It is performed since 2019 in the national highways lies in Chitwan district and Dhading district of Nepal which is under supervision of Road Division Bharatpur, Nepal. The lab tests of aggregate have been performed in the lab of Road division Bharatpur and the test of bitumen were done in the supplier's laboratory only. The aggregates being used for the production of Readymade bituminous pothole patching mix is satisfying the requirements of IRC: 2014, the rate of Readymade bituminous mix is more economical than the Hot mix method and Cold mix method. A scheduled questionnaire survey has been conducted with engineers and supervisor of the road division Bharatpur. From the questionnaire it was concluded that Low Energy Use for Production and Placement, Paving Operation Benefit, Obtain Desired Density, Low Air Void Contents, Minimize Fume and Odor, Stiffness and Rutting Resistant and Less Fatigue and Thermal Cracking are the main factors obtained from RDB Engineers, supervisors and length workers. This Readymade pothole patching mix can be stockpiled and remains workable for at least 6 months and can be used even in rainy season.

Keywords: bitumen, aggregate, hot mix method, cold mix method, road division bharatpur, stiffness, fatigue

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Introduction

Development of a nation relies upon the availability of different areas with sufficient road network (Mishra and Magar, 2017). Development of potholes on road surface is exceptionally regular wonders during and after monsoon. Hypothetically Potholes ought to be filled utilizing Hot Mix created in Hot Mix Plants (HMA). HMA method is the pothole patching method in which 180 degrees of heat is used to mix the materials of asphalt and after mixing, the asphalt mix is transported to site which is filled in the potholes which were cut before in rectangular

shape and after that the filled potholes compacted with roller. HMA plants are closed down during monsoons and the hot bituminous blend isn't accessible front filling of potholes (Mali & Patil, 2018; Mishra & Jha, 2019).

This readymade pothole patching mix also known as warm mixed asphalt doesn't need any planning of the pothole, for example, figuring out and applying tack coat; the mix is just removed from the 50-kg bag, leveled with a rake, hit with a hand rammer by ordinary worker (no roller), some light sand or grass/leaves is sprinkled on surface to picking out by vehicle tires, and opened to traffic immediately (Kandhal, 2008, 2018). It is under application in Nepal; however, the context of Nepal is not same as of India in terms of different factors which might affects it. So, the research is worth of doing to develop scientific way of its use in Nepal through first of its study.

Warm Mix Asphalt (WMA) is a recent trend created in Europe and after effective execution in Europe USA additionally accepted the warm mix technology in each of the 50 states. Presently in India Central Road Research Institute – Delhi and some of the other organization working on this trend. To reduce the emission of various hazardous gas fumes, consumption of fuel, compaction & placing Temperature and haul distance industries have Warm Mix Asphalt instead of hot mix asphalt (Gandu et al 2019; Croteau & Tessier, 2008; Kakar eat al, 2017).

Readymade Bituminous Pothole Patching Mix Using Cut-Back Bitumen

Although the Indian Road Congress has provided a specification for readymade bituminous pothole repair mix, it is relatively new in Nepal. IRC produced "Specifications for Readymade Bituminous Pothole Patching Mix Using Cut-Back Bitumen" with the assistance of the H-6 committee. The Indian government debated on the draft, noting the Rajasthan PWD's and Jaipur Development Authority's good experience with the patching mix manufactured to specifications for fixing potholes (Indian Road Congress, 2014; Indian Standard, 1999; Indian Standard Part III 2002).

Materials

- Cutback-Bitumen
- Anti-Stripping Agent
- Coarse Aggregate
- Fine Aggregate

Mixtures' Composition

The total aggregate grade should fall within the limitations as described when evaluated in accordance with 18:2386 Part 1 (wet sieving technique). An aggregate with water absorption of 1.0 or below should be utilized wherever possible. As described the quantity of residual bitumen binder in the mix (total cutback bitumen minus diluents like kerosene). If the premade patching mix fails to satisfy the grading (particularly the 0.075 mm sieve) and the minimal residual bitumen content, it will be rejected. Before the Engineer accepts the generated mix, it must be evaluated by an independent certified testing facility (Indian Road Congress, 2014).

According to IRC, gradation of Stockpile Patching Mix is described as, the sieve size 9.5 mm should pass 100 %, sieve size 4.75 mm should pass 40 to 100 %, sieve size 2.36 mm should pass 10 to 40%, sieve size 1.18 mm should pass 0 to 10% and finally sieve size 0.075 mm should pass 0 to 2%.

Minimum residual bitumen content by weight of mix is as described below. For aggregate water absorption less than 1% the minimum residual bitumen content should be 4.5%, for aggregate water absorption from 1.1 to 1.5% the minimum

residual bitumen content should be 5% and for aggregate water absorption from 1.6 to 2% the minimum residual bitumen content should be 5.5% (Indian Road Congress, 2014).

The amount of residual bitumen in MC-800 must be determined by contacting the supplier. For example, if the MC-800 comprises 80% bitumen and 20% kerosene, and the mix contains 6.0 percent MC-800 by weight, the residual bitumen concentration in the mix will be 4.8 percent (Indian Road Congress, 2014).

Preparation and Storage of Mixture

Preferably, the prepared patching mix will be manufactured in a batch type hot mix facility. If a portable or permanent asphalt drum plant is utilized, drying/heating aggregates with a burner flame and mixing with MC-800 must never be done at the same time because MC-800 containing volatile kerosene would catch fire and constitute a safety concern. When MC-800 is introduced for mixing, the Contractor and Engineer must verify that there is no open flame within or outside the drum. The mix should be able to be stored, handled, laid, and completed without the bitumen being stripped from the aggregate (Indian Road Congress, 2014).The ready-to-use patching mix may be used in damp potholes and must withstand rain and freezing conditions. As a result, before combining MC-800 bitumen with dry aggregate, an appropriate anti-stripping agent MUST be applied (Kandhal, 2018). For the first 48 hours, the combined material should not be stacked higher than1.5 m to assist prevent stripping and minimize heat accumulation in a stockpile (which might cause the entire stockpile to fire owing to the chimney effect). The stockpile can then be made conical in shape and elevated in height. On chilling, the premade cold mix should be packed and sealed in plastic lined, strong 50 kilogram bags, unless otherwise indicated. Before mixing, make sure the mineral aggregate is clean and dry on the surface (Indian Road Congress, 2014).

The temperature of aggregate and bituminous material should comply some temperature ranges that is for bituminous material MC-800 the aggregate temperature should be ranges from 25 to 65 °C and bitumen temperature should be ranges from 75 to 95°C (Indian Road Congress, 2014).

Because the aggregate temperature range is narrow and the maximum aggregate temperature is limited to 65°C, drying the aggregate within this temperature range may be impossible. As a result, the aggregate may be dried at high temperatures and then cooled before adding the bituminous binder. Pre-drying the aggregate at high temperatures will also assist to reduce the fines (material that passes through a 0.075 mm screen) that will end up in the bag house. Fines would be fewer than 2% in the final mix, as required by the rigorous gradation standards. High aggregate temperatures while mixing with cutback bitumen will not only produce excessive kerosene loss from the cutback, but will also put the plant pug mill in danger. The pug mil must be properly and adequately vented. Because MC-800 cutback includes flammable kerosene, there must never be an open flame in the proximity of it (Kandhal, 2018). It is not safe to keep the loose mix or sealed bags in a closed building/ warehouse since the mix includes flammable kerosene. Store in a well-ventilated warehouse or beneath an open shed. In the area of the stored mix, no open flame or smoking is permitted (Indian Road Congress, 2014).

Preparation of Potholes, Placing and Compacting of Readymade Pothole Patching

A hard wire brush should be used to clean the pothole, and a soft brush should be used to remove any loose debris, including dust. It is

not necessary for a pothole to be dry. Excess water, on the other hand, must be scooped away from the pothole. The mixture is designed to fill potholes up to 75 mm (3 inches) in depth. Patching mix should be poured and compacted in 75 mm thick layers for deeper potholes. If the pothole is deep and extends to the WMM or granular foundation, an appropriate tack coat or prime coat should be applied as soon as possible before applying the patching mix. With a hand rammer/small compactor, compress the patch's outer edge or perimeter first, then work inwards. Continue to moisten the hand rammer with water or lay empty plastic lined bags on the loose mix to prevent the hand rammer from picking up the loose mix at first. Place the repairing mix and compress it in 75 mm thick layers for deep potholes. The compacted area should be slightly raised above the current road surface after compaction to allow for future traffic compaction. It is preferable to use a tiny roller rather than a hand rammer when there are several closely spaced areas. If a roller is used, the mix should be put and distributed slightly above the surface, so that the compacted surface is flush with the adjacent surface after rolling. Before allowing traffic onto the compacted patch, a sufficient amount of clean sand must be sprayed over the patch to avoid traffic pick-up (Indian Road Congress, 2014).

Quality Control and Acceptance of Mixture

Tests for Quality Confirmation

- Water Resistance Test
- Workability Test
- Wet Coating Test
- Static Immersion Test

Research objectives

The general Objective of the research is to analyze the suitability along with the factors affecting acceptance of Readymade Bituminous Pothole Patching Mix for Pothole Repair in national highways under Road Division Bharatpur based on IRC quality conformance.

Methodology

The study area covers four different highways under Road Division Bharatpur.

Sampling techniques and Sample Size

Formula used for calculating the sample size: To decide test size we had utilized Slovens formula

The sample size will be controlled by the equation:

$$n = \frac{N}{(1+Ne^2)} \textit{ (Sloven's Formula).}$$

Where,

n = Number of tests,

N = Total population and

e = Error resistance (level)=0.05,

Confidence interval at 95% =1.96.

$$n = \frac{32}{(1+32\times0.05^2)} = 29.62 = 30$$

Data Collection

Both primary and secondary data were collected.

Experiment/Lab work

Following experiment/ lab work had been performed for the study based on IRC, as primary data.

- Grain size analysis
- Flakiness Index
- Determination of Elongation Index
- Determination of Los Angeles Abrasion Value
- Aggregate Impact Value (Dry/Wet)
- Aggregate Impact Value (Wet)
- Water Absorption Test
- Water resistance Test

- Workability Test
- Observation Method

Each project site was accessed and observed to collect the different data necessary for the pothole patching method followed at site. This method was adopted to provide consistency over time in data collection. The observation method covers the objective of "To assess the suitability of Readymade Bituminous Pothole Patching Mix for Pothole Repair in national highways under Road Division Bharatpur."From observation method the situation of the road site before and after using the Readymade Bituminous Pothole Patching Mix was observed (Indian Road Congress, 2014).

Questionnaire Survey

The questions were developed and provided to the involved personnel to answer. Structured questionnaire were prepared and the collected answers were recorded for analysis. Questionnaire was designed for the Engineers, Supervisors, Length workers and road users as well. Questionnaire survey fulfilled the objective of "To identify the factors affecting working conditions for assuring acceptance of Readymade Bituminous Pothole Patching Mixfor Pothole Repair in national highways under Road Division Bharatpur"

- Interview
- Scheduled Questionnaire Survey

Secondary Data Collection

The secondary data needed for the study obtained from various sources.

- Document, Site Progress Report, Inspection Report
- Data from relevant governmental and non-governmental bodies.
- Standards and Specifications of DOR
- Indian Road Congress, 2014
- Literature Review: Published Articles, Journals, Research Papers were reviewed and findings were validated with the help of standards, recent research, lab work, key informant interview and observation.

Data Analysis

Data obtained through primary and secondary sources had been managed and analyzed using excels application and mathematical formula. The data obtained through interviews and surveys was processed in excel sheet. Respondent had been analyzed and interpreted in percentage, and presented using simple descriptive statistics, tables, bar charts and pie chart.

- Experimental analysis and presentation of experimental data based on standards.
- Rate Analysis of Hot mix, Cold mix and Readymade Bituminous Pothole Patching Mix
- Ranking of factors in each category based on the Relative Importance Index (RII) (Likert, 1932; Mishra et al., 2020).

Lab tests mentioned in IRC Grain size analysis, Flakiness & Elongation Index (combined), Los Angeles Abrasion and Aggregate Impact Value test was conducted. Based on the respondent feedback collected through key informant Interview, the occurrence of potholes on particular site had been identified. The cost analysis of premix made by hot mix plant, cold mix plant and cost analysis of Readymade Bituminous Pothole Patching Mix (Readymade Premix) had been done.

Respondents were identified the factors affecting working conditions for assuring acceptance of Readymade Bituminous Pothole Patching Mix with their working experience.

There were comprises of 4 factors that affects the working condition of Readymade Bituminous Pothole Patching Mix, they were Performance factor, economic factor, workers risk factor and environment factor Likert Scale is also used in the questionnaire where respondents specify their level of agreement or disagreement on a symmetric agree-disagree scale for a series of statements.

The Relative Importance Index (RII) was determined in the following way:

$$RII=\frac{1n_1+2n_2+3n_3+4n_4+5n_5}{A(n_1+n_2+n_3+n_4+n_5)} \quad \text{... (i)}$$

Where,

n_1 = number of respondents who answered strongly disagree, insignificantly, not probable.

n_2 = number of respondents who answered disagree, minor, somewhat improbable.

n_3 = number of respondents who answered undecided, moderate, neutral.

n_4 = number of respondents who answered agree, major, somewhat probable and

n_5 = number of respondents who answered strongly agree, severe, very probable.

Results and Discussion

Suitability of Readymade Bituminous Pothole Patching Mix

Suitability of Readymade Bituminous Pothole Patching Mix was analyzed in national highways under Road division Bharatpur. East West (Mahendra) Highway, Prithvi highway, Bharatpur bypass and Aaptari Devghat Road and Narayangardh muglin road had been assessed based on IRC requirements in Nepalese context.

Assessment of coarse aggregate

Grain Size Analysis

As per IRC maximum size of grain should be 2 % (% passing from 0.075 micron) as requirement. From standard analysis it can be seen that 0.70% size of grain passes from 0.075 micron sieve. Similarly five nos. of test had been conducted in the laboratory and the result obtained was 0.70%, 0.60%, 0.77%, 0.65% and 0.76 %.The mean value of the in average percentage passing from the sieve size 0.075 micron is 0.696%So the sample was suitable for using in Readymade Bituminous Pothole Patching Mix based on IRC quality conformation (Mishra et. al, 2020)

Flakiness and Elongation Test

As per IRC maximum combined value of Flakiness and elongation should be 35 % as requirement. From standard analysis, it had shown that 32.74% value of FI. Similarly five nos. of test had been conducted in the laboratory and the result obtained was 32.74%,32.96%,31.90%,32.54% and 32.79%In average combined value of Flakiness and elongation is 32.586%. So the sample was suitable for using in Readymade Bituminous Pothole Patching Mix

Los Angeles Abrasion value Test

As per IRC maximum Value of Los Angeles Abrasion should be 40 % as requirement. From analysis it had shown that 31.68% value of LAA. Similarly five nos. of test had been conducted in the laboratory and the result obtained was 32.68%, 32.04%, 31.50%, 31.90% and 32.20%. Here average value of LAA is 31.864%. So the sample was suitable for using in Readymade Bituminous Pothole Patching Mix based on IRC.

As per IRC max. Value of AIV should be 30 % as requirement. From standard analysis it had shown that 26.38% value of AIV. Similarly five nos. of test had been conducted in the laboratory and the result obtained was 26.38%, 26.94%, 26.50%, 26.66% and 26.91%.Here the average aggregate impact value is 26.678%.So

the sample was suitable for using in Readymade Bituminous Pothole Patching Mix based on IRC.

Water Absorption Test

As per IRC max. Value of Water Absorption should be 2 % as requirement. From standard, analysis it had shown that 1.45%, 1.49% and 1.43% value of Water Absorption. Here the average Water Absorption value is 1.46%.So the sample was suitable for using in Readymade Bituminous Pothole Patching Mix based on IRC.

Standard analysis shows that 1.45%, 1.49% and 1.43% value of Water Absorption was obtained. Here the average Water Absorption value is 1.46%. As per IRC, 2014, Max. Value of Water Absorption should be 2 % as requirement. So the sample was suitable for using in Readymade Bituminous Pothole Patching Mix based on IRC, 2014.

Assessment of Bitumen

Cutback Bitumen MC 800 was used for the Readymade Bituminous pothole Patching Mix. RD Bharatpur had been ordered the Cutback Bitumen MC 800According to composition of IRC, 2014, Inorder to pass the required three test named Wet Coating Test, Static Immersion Test and Water Resistance Test for this type of bitumen. The test has been conducted through the chemist of the supplier company.

Quality Control and Acceptance of Mixture

Water Resistance Test: Fifty grams of patching mix, newly made or from the stockpile or a sealed container bag, heated for 1 hour at 120°C in a laboratory oven, then cooled to 95°C in a laboratory oven air, then placed in a 600 ml glass beaker with 400 ml hot water and swirled with a whisk. For 3 minutes, a glass rod rotated at 1 revolution per second. The water was decanted then the mixture was spread out on absorbent paper then the coating was seen. The test was repeated for 3 times. The result was obtained as bituminous coating covered more than 90% of the aggregate in each test visually in average.

Workability Test. In a freezer, approximately 2.5 kg of the patching mix to -7°Cwas cooled. After cooling, the mixture easily broke apart using a spatula with a blade length of around 200 mm as a result. The test was repeated 3 times and the result obtained was the mix could not broke easily apart.

For the minimum temperature of Dhading and Chitwan district I have collected the minimum temperature of last 5 years. According to data provided by the Department of Hydrology and Meteorology, the lowest temperature recorded in Dhading during the last five years was 2°C, while the lowest temperature recorded in Chitwan district was 4°C. Since the minimum temperature of both districts is not in negative measurement the mix could be workable for the Dhading and Chitwan district. In the field observation it was found that the mix was easily workable at 4°C in year 2020 but for workability in different temperature stages further detail research is required.

Wet Coating Test. The result of this test was sourced from RDB Chitwan and the result was found that by visual inspection after test about 99% of coating was retained.

Static Immersion Test. The result of this test was sourced from RDB Chitwan and the result was found that by visual inspection after test about 97% of coating was retained.

Patch Survival rating Table. The details of Patch survival rating table is presented in standard analysis.

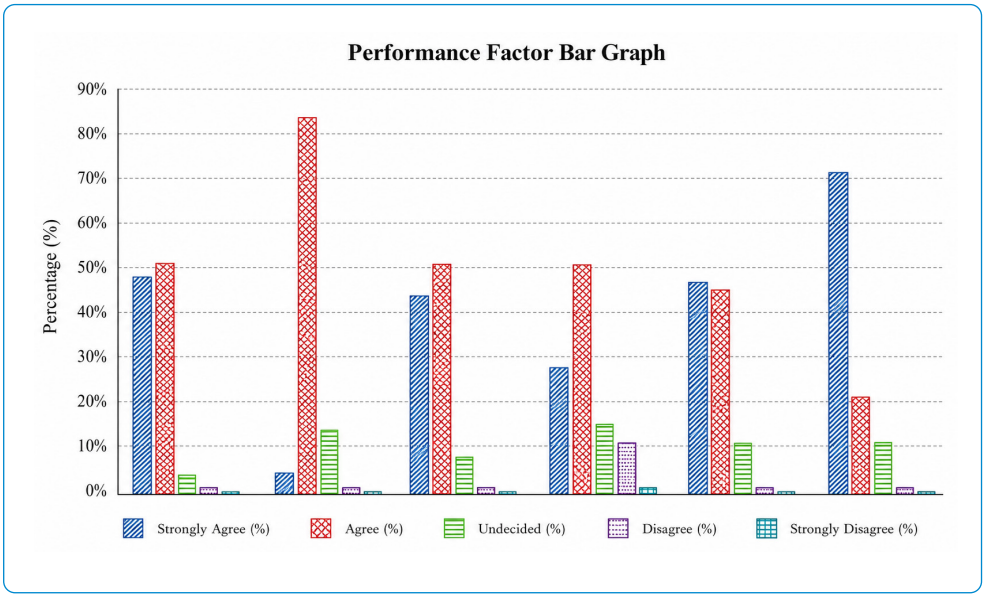
For Bharatpur Bypass and Aaptari Devghat Road, Chitwan

Factor Affecting Acceptance of Readymade Bituminous Pothole Patching Mix

Factors affecting acceptance of Readymade Bituminous Pothole Patching Mix were identified. Questionnaires were set up to identify different four factors i.e. Performance factor, economic factor, workers risk factor and environment factor. Accordingly, twenty one factors were identified from literature review. The third objective of study identified the factor affecting acceptance of Readymade Bituminous Pothole Patching Mix from 30 set of questionnaire had been recognized and assembled into four significant groups for roads where Readymade Bituminous Pothole Patching Mix was used. These factors were positioned in each group dependent on Relative Importance Index (RII). The details of ranking is presented in standard analysis.

Figure 1

Performance Factor Affecting Acceptance of Readymade Bituminous Pothole Patching Mix



Performance Factor Affecting Acceptance of Readymade Bituminous Pothole Patching mix

Sets of questionnaire were conducted to get the information about the performance of readymade bituminous pothole patching mix with engineers, supervisors and length worker of RDB. As shown in (Figure 1) it was found that 47% were strongly agree, 50% were agree and 3% undecided. Similarly for the factor "less fatigue and thermal cracking", it was found that 3% were strongly agree, 83% were agree and 13% were undecided. Again for the factor "deformation resistant", it was found that 43% were strongly agree, 50% were agree, 13% were undecided and 10% were disagree. Similarly for the factor "low air void contents", it was found that 27% were strongly agree, 50% were agree, 13% were undecided and 10% were disagree. Again during the questionnaire it was found that 47% were strongly agree, 43% were agree, 13% were undecided and 10% disagree for obtaining desired density. And finally for the factor" longer haulage distance tolerant", 70% were strongly agree, 20% were agree, 10% were undecided.

Economic Factor Affecting Acceptance of Readymade Bituminous Pothole Patching Mix

Simiarly, it was found that 70% were strongly agree, 27% were agree and 3% undecided in Minimize Pavement Life Cycle Cost factor. Similarly for the factor "Minimum Wear and Tear of Plant", it was found that 17% were strongly agree, 50% were agree, 27% were undecided and 7% were disagree. Again for the factor "Less Use of Energy", it was found that 13% were strongly agree, 77% were agree, 3% were undecided and 7% were disagree. Similarly for the factor "Less Waste of Material", it was found that 47% were strongly agree and 53% were agree. And finally for the factor "Less Maintenance Repetition cost", 48% were strongly agree, 36% were agree, 12% were undecided and 4% were disagree.

Workers Risk Factor Affecting Acceptance of Readymade Bituminous Pothole Patching Mix

In the same way, it was found that 33% were strongly agree, 57% were agree and 10% undecided in Reduce Exposure to the High Heat factor. Similarly for the factor "Minimize Fume And Odour", it was found that 37% were strongly agree, 57% were agree, 3% were undecided and 3% were disagree. Again for the factor "Reduction of Inhalation of CO2 and Dermal Exposure To Bitumen" it was found that 30% were strongly agree, 57% were agree and 13% were undecided. And finally for the factor "Paving Operation Benefit", 43% were strongly agree, 50% were agree and 7% were undecided.

Environment Factor aAffecting Acceptance of Readymade Bituminous Pothole Patching Mix

From the continuity of the research it was it was found that 47% were strongly agree, 50% were agree and 3% undecided in Low Energy Use for Production and Placement factor. Similarly for the factor "Reduce CO2 Emission From Fuel and Asphalt Used Production", it was found that 20% were strongly agree, 57% were agree, 3% were undecided and 20% were disagree. Again for the factor "Less Harmful for the Society Near Production Plan", it was found that 27% were strongly agree, 53% were agree, 3% were undecided and 17% were disagree. Similarly for the factor "Natural Resources Lasts Long", it was found that 27% were strongly agree, 53% were agree and 20% were undecided. Again during the questionnaire it was found that 23% were strongly agree, 67% were agree and 10% were undecided for Low Degradation of Environment. And finally for the factor "Reduce Greenhouse Effecting Gases", 23% were strongly agree, 23% were agree, 37% were undecided and 17% were disagree.

Assessment of suitability of Readymade Bituminous Pothole Patching Mix

The experiments and lab tests were performed under the supervision of lab technician of RDB and were performed according to Manual of standard test, 2016 and IRC 2014. Five sets of tests were performed for each mentioned tests i.e. Grain size analysis, Los Angeles Abrasion (LAA) Test, Flakiness Index and Elongation of Aggregate, Aggregate Impact Value Test and Three for Water Absorption Test. The average values of five sets and three sets of experiment were taken for the assurance of the obtained value. Similarly the test for quality conformation of the Readymade Bituminous Pothole Patching Mix was done by performing the test named Water Resistance Test, Workability Test, Wet Coating Test and Static Immersion Test in IRC, 2014.

Factors Affecting Acceptance of Readymade Bituminous Pothole Patching Mix

Factors that affect the acceptance of Readymade Bituminous Pothole Patching Mix

were taken from literature review referenced of European Asphalt Pavement Association (2009), Anderson and May (2008), D' Angelo et.al, (2008) and more (Europen Asphalt Pavement Association, 2009; Croteau Tessier, 2008; D'Angelo et al., 2008; Day et al., 2019; Gudimettla et al., 2004; Hongve, 2006). Those were performance factor, economic factor, workers risk factor and environment factor. To support those factors sub factors were referenced and those were, Performance factor: Stiffness and rutting resistant, less fatigue and thermal cracking, low air void contents, Obtain desired density and Longer haulage distance tolerant. Next factor is Economic factor: Minimize pavement life cycle cost, Minimum wear and tear of plant, Less use of energy, Less waste of material and less maintenance repetition cost. Other factor is workers risk factor: reduce exposure to the high heat, Minimize Fume and Odor, Reduction of Inhalation of CO2 and Dermal Exposure To Bitumen and Paving Operation Benefit. Now last factor is Environment factor: Low Energy Use for Production and Placement, Reduce CO2 Emission From Fuel and Asphalt Used Production, Less Harmful for The Society Near Production Plant, Natural Resources Lasts Long, Low Degradation of Environment Due to Less Waste of Material and Reduce Greenhouse Effecting Gases.

By the analysis of the factors using RII method, the primary factors of performance factor is Longer Haulage Distance Tolerant, Stiffness and Rutting Resistant, Obtain Desire Density, Deformation Resistant, Low Air Void Contents and Less Fatigue and Thermal Cracking simultaneously. Similarly primary factors for economic factor is Minimize Pavement Life Cycle Cost, Less Maintenance Repetition cost, Less Waste of Material, Less Use of Energy and Minimum Wear and Tear of Plant simultaneously. Again primary factors of workers risk factor is Paving Operation Benefit, Minimize Fume and Odour, Reduce Exposure to The High Heat and Reduction of Inhalation of CO2 and Dermal Exposure to Bitumen. Similarly primary factor of environment factor is Low Energy Use for Production and Placement, Low Degradation of Environment Due to Less Waste of Material, Natural Resources Lasts Long, Less Harmful for The Society Near Production Plant, Reduce CO2 Emission From Fuel and Asphalt Used Production and Reduce Greenhouse Effecting Gases.

Conclusion

From the experiment held on the lab it is concluded that the Readymade Bituminous Pothole Patching Mix is suitable for the highways under Road Division Bharatpur on the basis of requirement of IRC 2014. But it was found that the mix was not suitable in the cold places. It could be due to improper bitumen type, low bitumen content, excessive fines or improper gradation. Even one-half percent lower bitumen content can make the patching mix unworkable. The mixing composition given in IS:217 Specification for Cutback Bitumen mentioned in IRC, 2014 was done so that to pass the Wet Coating Test, Static Immersion Test and Water Resistance Test, it was observed good results.

From categorization of twenty factors into main four groups it was concluded that Minimize Pavement Life Cycle Cost, Less Maintenance Repetition Cost, Less Waste of Material, Low Energy Use for Production and Placement Paving Operation Benefit are the main factors obtained from RDB Engineers, supervisors and length workers by questionnaire survey.

Recommendation

- Readymade Bituminous Pothole Patching Mix (Readymade Premix) is suitable for the roads or highways under the supervision of RDB on the basis of lab test and different

observations but the mix was not workable at -7°C. So it is recommended to further research for cold places according to different factors that affects the workability of the mix.

- Many benefits was found by the questionnaire survey and key informant interview i.e. Minimize Pavement Life Cycle Cost, Less Maintenance Repetition Cost, Less Waste of Material, Low Energy Use for Production and Placement Paving Operation Benefit etc.

So it is recommended that the use of Readymade Bituminous Pothole Patching Mix for pothole patching is more beneficial for all season and it is suitable for the roads and highways under the supervision of RDB.

References

Anderson, R. M., & May, R. (2008). *Engineering properties, emissions, and field performances of warm mix asphalt technologies* (*Interim Report NCHRP 9-47*). Asphalt Institute.

Croteau, J. M., & Tessier, B. (2008). *Warm mix asphalt paving technologies*: *A road builder's perspective*. Colas Canada.

D'Angelo, J., Harm, E., Bartoszek, J., Baumgardner, G., Corrigan, M., Cowsert, J., Harman, T., Jamshidi, M., Jones, W., Newcomb, D., Prowell, B., Sines, R., & Yeaton, B. (2008). *Warm-mix asphalt: European practice* (FHWA-PL-08-007). Federal Highway Administration.

Day, D., Lancaster, I. M., & McKay, D. (2019). Emulsion cold mix asphalt in the UK: A decade of site and laboratory experience. *Journal of Traffic and Transportation Engineering* (*English Edition*), *6*(4), 359–365. https://doi.org/10.1016/j.jtte.2019.05.002

European Asphalt Pavement Association. (2009). *The use of warm mixed asphalt*.

Federal Highway Administration. (1999). *Materials and procedures for repair of potholes in asphalt-surfaced pavements*. U.S. Department of Transportation, Strategic Highway Research Program, National Research Council.

Gandu, S., Kumar, R., & Vasudeva, R. (2019). *A review on warm mix asphalt*. ResearchGate.

Gudimettla, J. M., Cooley, L. A., Jr., & Brown, E. R. (2004). Workability of hot-mix asphalt. Transportation Research Record: *Journal of the Transportation Research Board*, *1891*, 229–237.

Hongve, J. (2006). *Bituminous surfacing options for low volume roads constructed by labour based methods*.

Indian Roads Congress. (2008). *Specifications for mix seal surfacing* (*MSS*) *and close graded premix surfacing* (*CGPS*). Indian Roads Congress.

Indian Road Congress (2014). *Specifications for readymade bituminous pothole patching mix using cut-back bitumen*.

Indian Standard. (2002). *Methods of test for aggregate for concrete—Part I*: *Particle size and shape* (*IS 2386-1*). Bureau of Indian Standards.

Kakar, M. R., Hamzah, M. O., & Valentin, J. (2017). Analyzing the stripping potential of warm mix asphalt using imaging technique. *IOP Conference Series*: *Materials Science and Engineering*, *236*, 012013. https://doi.org/10.1088/1757-899X/236/1/012013

Kandhal, P. S. (2008). A simple defective method of repairing potholes in India. *Journal of the Indian Roads Congress*, *69*(3),1–32.

Kandhal, P. S. (2018). *A simple guide for producing and placing readymade, cold, pothole patching mix in accordance with Indian Roads Congress Specification IRC:116-2014*. Auburn University.

Likert, R. (1932). *A technique for the measurement of attitudes*. Archives of Psychology, 140, 1–55.

Mali, S. N., & Patil, D. S. (2018). Mix design of HMA and CMA for pothole repairs. *JournalNX*: *A Multidisciplinary Peer Reviewed Journal*, 44–47.

Mishra, A. K., Gupta, D., & Aithal, P. S. (2020). Factors identification and conformance of quality of cement and coarse aggregate used at Gautam Buddha Airport upgrading component, Nepal. *International Journal of Management, Technology, and Social Sciences* (*IJMTS*), *5*(2), 187-200. http://dx.doi.org/10.2139/ssrn.3724452

Mishra, A. K., & Jha, A. (2019). Quality assessment of Sarbottam cement of Nepal. *International Journal of Operations Management and Services*, *9*(1), 1–22.

Mishra, A. K., & Magar, B. R. (2017). Implementability of municipal transport master plan of Bandipur Inner ring road, Tanahu. Nepal. *International Journal of Scientific & Technology Research*, *6*(8), 306–313.

Mishra, A. K., Sah, R. C., & Aithal, P. S. (2020). Operational assessment of public transport: A case of Kathmandu, Nepal. *International Journal of Case Studies in Business, IT, and Education*, *4*(2), 132–152. https://doi.org/10.5281/zenodo.4033197

Nepal Department of Roads. (2016). *Manual of standard tests*.

Nepal Department of Roads. (2016). *Standard specifications for road and bridge works.*