

Laboratory Evaluation and Field Observation of Potholes Patch Repair Mix Prepared With Natural Aggregate with Cationic Type Medium Setting Emulsion

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Abstract— Improvement of potholes on streets and roads of India after the onset of storms is a typical marvel. Frequently, potholes are repaired with outdated methods, for example, putting soil or exposed aggregate in the pothole in light of the fact that no hot mix asphalt is accessible amid storms and winter season. In today's situation street condition are seeing to be better because of joining of interchange strategies, procedures, innovations. An economical, nonexclusive, readymade stockpile cold patching mix has been proposed, which is produced in a batch type cold mix plant utilizing local aggregate. This nonspecific mix can be put without setting up the pothole, for example, drying, squaring the edges, cleaning, and tack coating. To the motoring public, potholes are one of the most visible and annoying forms of pavement distress. Most pothole repairs made during the winter months are short-lived. Potholes that must be filled repeatedly are expensive to repair. Recent field trials of this mix in Surat City have been profoundly fruitful.

Key words: Patch Repair Mix, Potholes Repair, Cold Patch

I. INTRODUCTION

Patching potholes in asphalt pavements is an important maintenance operation for highway agencies because this activity is expensive and time-consuming. Poor sub grade drainage and filtering leaching rainy seasons can break interlocking in the middle of bitumen and aggregate and it eventually leads to cracks and potholes. Absence of appropriate curing prompts serious harm to recently laid pavement. A smooth surface with good skid resistance, free of alligator cracks, pumping, pushing, wheel rutting, ravelling, frost heaving, and pot holing, is desirable for safe travel by the people. But a number of factors can make a road unsuitable for further use Likewise, India confronts temperature changes (5°C-50°C) consistently, which results in harm to streets, and rainy season also plays a huge role in this during June to August. Every one of these variables thusly prompts perilous trip, improper monitoring of transportation, wear and tear of vehicles, expanded fuel utilization and carbon emission and increasing accident prone area. Since this imperfection in streets can't be disregarded due to the damage they cause furthermore, we cannot construct the road again and again, there comes the part of patch-repair works. Different makers have advanced numerous restrictive pothole-fixing items. These mixes are typically appropriately customized with one stone sort under entirely controlled conditions and supplied in drums or packs. The expense of such materials is high, which makes their utilization restrictive from the monetary point of view. Along these lines, there is a need to determine a nonspecific patching mix, which can be delivered.

There are so many products are commercially available for the repair of potholes as:

- 1) Hincol Road Bond (India)
- 2) Degafill Pothole Repair
- 3) Dr. Fixit Pothole Repair (India)
- 4) RonaRoad Green Patch Pothole Repair (U.K.)
- 5) Ultracrete Instant Road Repair (Brazil)
- 6) Kandhal Patch Mix Repair (India)
- 7) Sealcoats Patch Mixes (India)
- 8) Green patch pothole repair
- 9) Pothole solution

II. OBJECTIVE

The overall objective is to identify failure mechanisms and review current mix designs for materials developed, their performance evaluation, and field application procedures to establish design needs and criteria.

To achieve this following objectives are planned:

- 1) To test the physical properties of the natural aggregate and emulsions for assessing their suitability for pothole and patch repair works. Marshall mix design is carried out.
- 2) Other test needs to be conducted like indirect tensile strength (ITS), Retain Marshall, Wet indirect tensile strength, for Medium setting emulsion with natural aggregate.
- 3) To evaluate the field performance of patch mixtures medium setting emulsion mix with natural aggregate, also to evaluate their cost benefit analysis.

III. SCOPE

Developed all-weather cold paving material is a kind of high-tech road patching material, mixed and prepared by using high-performance cold paving additive, Cationic type emulsion Medium setting and aggregate according to certain processing technology, with an appearance of black grain-like solid, slight petroleum smell, insoluble in water, insensitive to motive impact and static electricity, and with stable properties.

IV. ADVANTAGES OF COLD MIXES

- 1) Environmentally and energy efficient technology for repair
- 2) Uniform quality of mix with high stability
- 3) Resistance for deformation, bleeding and cracking
- 4) Resistance to stripping by water
- 5) Resistance to pushing after placement
- 6) Instant setting and fast development of strength
- 7) Preparation of surface for repairs in minimal
- 8) Repairs in possible in all adverse climate including wet condition
- 9) No wastage of materials and minimum manpower needed

V. TEST AND EVALUATION METHODS FOR USE IN LABORATORY AND IN SITU

The tests and evaluation methods used to select pothole repair materials and techniques. From these results, it was found that pothole repair materials and techniques need to be assessed by a certification procedure prior to use because the size of works makes compliance checking impractical.

VI. LABORATORY TESTS ON AGGREGATES

Aggregates were sieved as per the requirement of Impact, Stripping, Soundness, Water absorption test procedures. These test were performed as per procedures described in relevant IS codes. The tests performed are as follows;

- Impact Value Test and Wet Impact Value Test, IS:2386 (Part 4)-1963
- Water absorption and Specific Gravity Test, IS: 2386 (Part 3)-1963
- Soundness Test, IS: 2386 (Part 5)-1963
- Stripping Value Test, IS:6241-1974

Sr. No	Name of experiment	Experiment value	Limits as per morth 2013
1	Impact value test	22.2%	24% max
2	Wet Impact value test	24.25% (Difference Dry-Wet=2.05%)	Difference b/w dry and wet impact should not >10%
3	Water Absorption	1.65% (10mm)	2% max
4	Specific Gravity	2.33	2-3
5	Soundness in Sodium Sulphate	3.85% (4.75mm-10mm)	12% max

Table 1: Experimental value of natural aggregate

VII. RESULTS OF TESTS ON EMULSION

S R N O.	NAME OF THE TEST	EXPERIMENT VALUE	REQUIREMENT PER IS:8887-2004
1	Residue on 600micron IS sieve(% mass)	0.032	0.05(maximum)
2	Viscosity by saybolt furol viscometer, seconds, at 25°C	59	30-150
3	Coagulation of emulsion at low temperature	NIL	NIL
4	Particle charge	POSITIVE	POSITIVE
5	Miscibility with water (coagulation)	NO COAGULATION	NO COAGULATION
6	Test on Residue; A) residue by evaporation,% B)penetration,25°C/100g/5sec	65.5 74.2 89	65 (minimum) 60-150

	C) ductility, 27°C/cm		50 (minimum)
7	Solubility in trichloroethylene	99.1	98

Table 2: Test result of Medium setting emulsion

VIII. PROCEDURE FOR DESIGNING MARSHALL MOLDS

For designing Marshal Mix samples, we require mold assembly, compaction pedestal, breaking head and sample extractor. Firstly, we need to select a specific aggregate grading, which is given in the following table.

SIEVE SIZE, mm	PERCENTAGE PASSING
9.5	100
4.75	40-100
2.36	10-40
1.18	0-10
0.075	0-02

Table 3: Aggregate grading

IX. DESIGN OF PATCH-REPAIR MIX

Optimization of the mix design of materials takes place not only in terms of volumetric and compaction characteristics, but also requires the consideration of engineering properties of the mix, durability and long term performance. At the same instance, economic point of view also remains high lightened in the selection of mix designs.

In the view of mix design it is always a difficult task to address its performance. It is because of a number of diversities including:

- Problems in finding the mode of failure of material and mechanism for it.
- The different types of mix properties and material properties that can affect performance e.g. binder content, material solidity, gradation of aggregate etc.
- External factors as climate, traffic frequencies, loading intensity etc.

X. MARSHALL MIX DESIGN

The first purpose of Marshall Samples is the determination of optimum bitumen content for any mix. Here, we designed marshal molds with medium setting emulsion so, their optimum bitumen contents are described in the text below.

A. Medium Setting Emulsion with Natural Aggregate

MS emulsion Percentage (%)	Density	Stability	Flow
8	1.87	2.75	1.10
9	1.90	3.84	1.79
10	2.02	5.76	2.04
11	1.98	4.16	3.71

Table 4: Medium setting emulsion with natural aggregate density, stability and flow

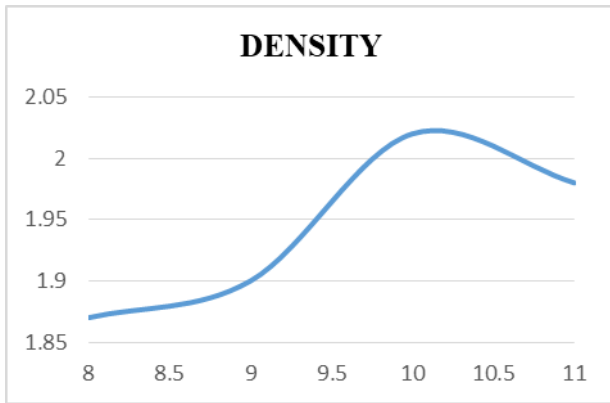


Fig. 1: Relationship between binder content and density

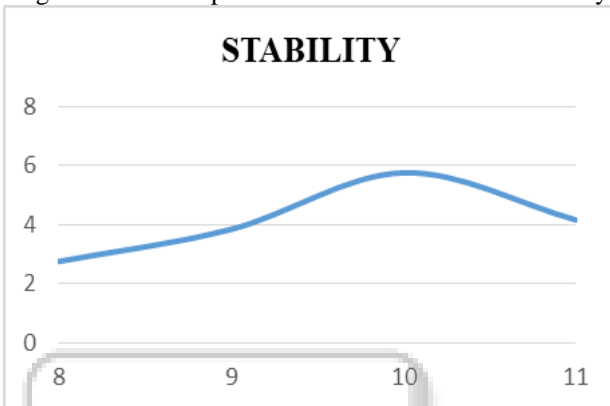


Fig. 2: Relationship between binder content and stability

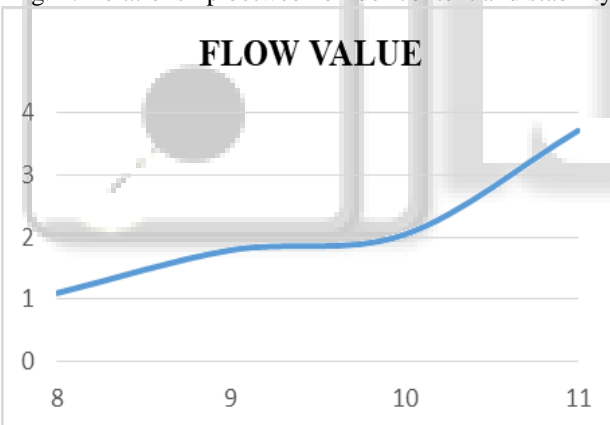


Fig. 3: Relationship between binder content and flow value

XI. RETAIN MARSHALL STABILITY

MS emulsion with natural aggregate	Stability	Flow
10%	1.94	3.68

Table 5: Retain Marshall Stability

XII. INDIRECT TENSILE STRINGTH

This test method determines the tensile strength of compacted bituminous mixtures. The tensile properties of bituminous mixtures are of interest to pavement engineers because of the problems associated with cracking. The tensile characteristics of bituminous mixtures are evaluated by loading the Marshall specimen along a diametric plane with a compressive load at a constant rate acting parallel to and along the vertical diametrical plane of the specimen through two opposite loading strips. The values of indirect tensile strength may be

used to evaluate the relative quality of bituminous mixtures in conjunction with laboratory mix design, testing and for estimating the resistance to cracking. The results can also be used to determine the resistance to field pavement moisture when results are obtained on both water conditioned and unconditioned specimens.

XIII. MEDIUM SETTING EMULSION WITH NATURAL AGGREGATE

Medium setting emulsion Percentage (%)	Loading (KGF)	Dia. Of mould (cm)	Height of mould (cm)	ITS value kg/cm ²
8	119	10.0	7.4	1.02
9	127	10.0	7.3	1.10
10	169	10.0	7.2	1.49
11	110	10.0	7.7	0.90

Table 6: Medium setting emulsion with natural aggregate ITS value

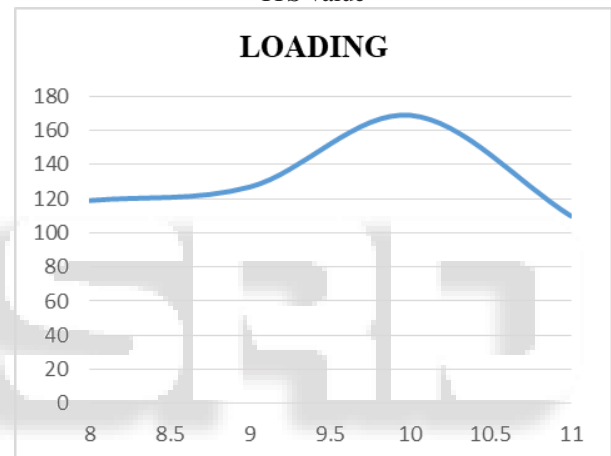


Fig. 4: Relationship between binder content and loading

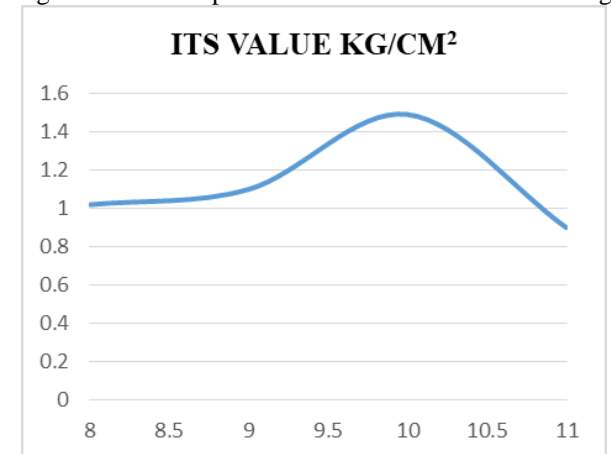


Fig. 5: Relationship between binder content and ITS value

XIV. WET INDIRECT TENSILE STRINGTH

MS with Natural aggregate	Loading	Dia of mould (cm)	Height of mould (cm)	Its value kg/cm ²
10%	127	10.0	7.2	1.12

Table 7: Wet IT'S of MS emulsion with Natural and Coal mix waste aggregate

XV. EXPERIENCE FOR TRIAL SECTION

The issued was later supplemented with a secondary one which focused on experience gained by dedicated trial sections for the durability of various pothole repair materials. There is need to implement a simple and effective method of repairing potholes not only during the monsoon but also throughout the year. This can be achieved by using the latest cold mix asphalt technology for producing and stockpiling readymade bituminous potholes patching mix. The generic cold patching mix meeting the specimen was produced on limited scale in Surat City during 2017 in winter. Potholes on Vesu Char Rasta, Surat and some main streets of Surat were patched with this mix.



Fig. 6: potholes fill with natural aggregate and medium setting emulsion

A. The Result from the Evaluation Is As Follow

- 1) The same conditions (traffic and climate) and evaluation methods are not used for the different trial sites and,

therefore, it is difficult to determine the actual durability of the repair materials. It is, therefore, important to develop a common evaluation system that uniquely determines when damage is being assessed to have a negative effect on the functional properties of the repair.

- 2) It appears that some of the generic types of repair materials have limitations on their application, such as size of the pothole and the temperature during application.

XVI. CONCLUSION

- 1) Physical properties of the coal mixed waste aggregates were found at par with natural aggregates. This indicated their suitability for road construction and maintenance of bituminous road works.
- 2) Mechanical properties such as Marshall's stability, indirect tensile strength, Retain Marshall stability, Wet indirect tensile strength with Medium setting Emulsion based with coal mixed waste aggregates and natural aggregate has to be satisfied according to MoRth 5th revision 2013.

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