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Waterproofing of Structures using Additive-Bituminous Solution

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Abstract: ***Waterproofing is basically a process of designing a structure in order to prevent water and moisture from penetrating into a structure in order to make it watertight. Since the discovery of cement during 19 century , concrete was supposed to be a impermeable for a long time but afterwards it discovered that concrete was not impermeable and due to this reason, water is absorbed in concrete structure through exposed to hydrostatic pressure or capillary rise through permeability and leads to performance degradation of life of structure .***

In this research work i have used few waste material like plastic, lignin , crumb rubber powder processed and few additives like bioethanol , phenol formaldehyde as a replacement of pure bitumen content up to 25 % .
The objective of this research work is to investigate the feasibility waterproofing property of conventional and additive modified bitumen as a waterproofing membrane and asphalt substitute or performance modifier. The physical properties of the virgin asphalt and the additive-asphalt blends were determined using laboratory performance tests according to IS codes 1201-1978 to 1220-1978 ,IS 13826:1993 , IS 3384:1986 And IS 73:1993 specifications.
Keywords: Waterproofing Bitumen, Plastic, Crumb Rubber, Lignin

I. INTRODUCTION

Waterproofing action is done in order to achieve water tightness of a concrete structure , stopping the penetration of water through hair line cracks or voids or joints .waterproofing finds application in Capillary rise through foundation, external wall, common walls, exterior wall-floor joints, columns, Chejja. waterproofing membranes improves the durability and deterioration of structural element .it becomes more effective when the ground water level is enough close to the foundation of the building or structure. Bituminous waterproofing membrane should serve and need few requirements like :

A. Suitable for installation ,homogeneous and ease to application
B. Thermally stable
C. Adhesion at joins ,overlaps and concrete structure
D. Resist to puncture from loose particles
E. Safe to handle at work and health safety
F. Capable of bridging cracks upto 1.5 or 2 mm
G. Resistance to moisture transmission from traffic induced pressure
H. Resistive to chemical weathering .

II. MATERIALS

The following sections include the description of the lignin, crumb rubber ,plastic and bitumen used in this study

A. Lignin

Lignin is a class of complex organic polymers that form important structural materials in the support tissues of vascular plants and some algae.
Lignin's are particularly important in the formation of cell walls, especially in wood and bark, because they lend rigidity and do not rot easily. It is by product of 2nd generation processing of bioethanol. lignin can work as emulsifier ,dispersant or also as a binder . Density of lignin is around 1500-1920 kg/m3 .

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B. Bitumen

Bitumen materials have been consistently used in road construction. In this study 80 – 100 grade bitumen was used same bitumen was used for all the mixes so the type and grade of binder would be constant. Asphalt also known as bitumen is a sticky, black, and highly viscous liquid or semi-solid form of petroleum. It may be found in natural deposits or may be a refined product, and is classed as a pitch .It has specific gravity of around 1.03

Fig 1. Bitumen Sample

C. Crumb Rubber

Crumb rubber is a material produced by shredding and commutating used tires. Crumb rubber is a material produced by shredding and commutating used tires. There is no doubt that the increasing piles of tires create environmental concerns. Crumb Rubber Modified Bitumen (CRMB) is hydrocarbon binder obtained through physical and chemical interaction of crumb rubber (produced by recycling of used tyre) with bitumen and some specific additive There is no doubt that the increasing piles of tires
Crumb Rubber Modified Bitumen (CRMB) is hydrocarbon binder obtained through physical and chemical interaction of crumb rubber (produced by recycling of used tyres) with bitumen and some specific additives.

D. Bioethanol Is A Processed From Bio-Binder From Vegetable Oil

Phenyl formaldehyde behave like a filler playing a role of rheology improve and tougher to neat bitumen physical hardening due to free volume shrinkage also occurs .

III. METHODOLOGY AND TEST RESULTS FOR MATERIALS

In this project I have replaced pure bitumen by a content of plastic ,crumb processed rubber , lignin , additives by a percentage of 10%,8%,6%,1% (sample 1) & 6%,7%,8%,1% (sample 2) & 1%,4%,4%,1%(sample 3) respectively and is analyzed for a series of test like ductility ,softening point ,penetration ,flash and fire point and water absorption test .
On the basis of IS codes 1201-1978 to 1220-1978 test were performed on the sample and is checked for water absorption . The percentage of absorption of water as capillary rise and under hydrostatic pressure is calculated and noted down .

Table 1. Proportion of various constituents

TEST	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4
BITUMEN	100 %	90 %	78%	75%
CRUMB RUBBER	00 %	04%	07%	08%
PLASTIC	00%	01%	06%	10%
LIGNIN	00%	04%	08%	06%
ADDETIVES	00%	01%	01%	01%

Standard tests were conducted to determine their physical properties as summarized in table their result and conclusion as follows:

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Table 2. Sample Of Bitumen is taken and is analyzed

TEST	RESULTS
PENETRATION TEST	59
DUCTILITY TEST	67 cm
SOFTENING POINT	42 ^{o}C
FIRE TEST	320 ^{o}C

IV. WATER ABSORPTION TEST

Three sample of each combination mortar cube (cement sand) 1:4of standard size (7.06 cm side cube) in three exposed conditions were analyzed . First condition is that the cube is open to atmosphere, second condition is sample is wrapped with bitumen solution and is kept under water And the third condition is that the sample is kept in water of pressure head of few cm. Samples were kept a wrapped layer of modified bitumen of thickness around 0.98 to 1.26 mm.

The mortar cubes were Owen dried so as to be free from any water content in their pores . After kept for 24 hours in different exposure conditions , initial weight and weight after 24 hours of exposure is noted and is represented below in table .

Fig 2. Sample kept in various exposure condition

Table 4. Observation table for various dampness conditions

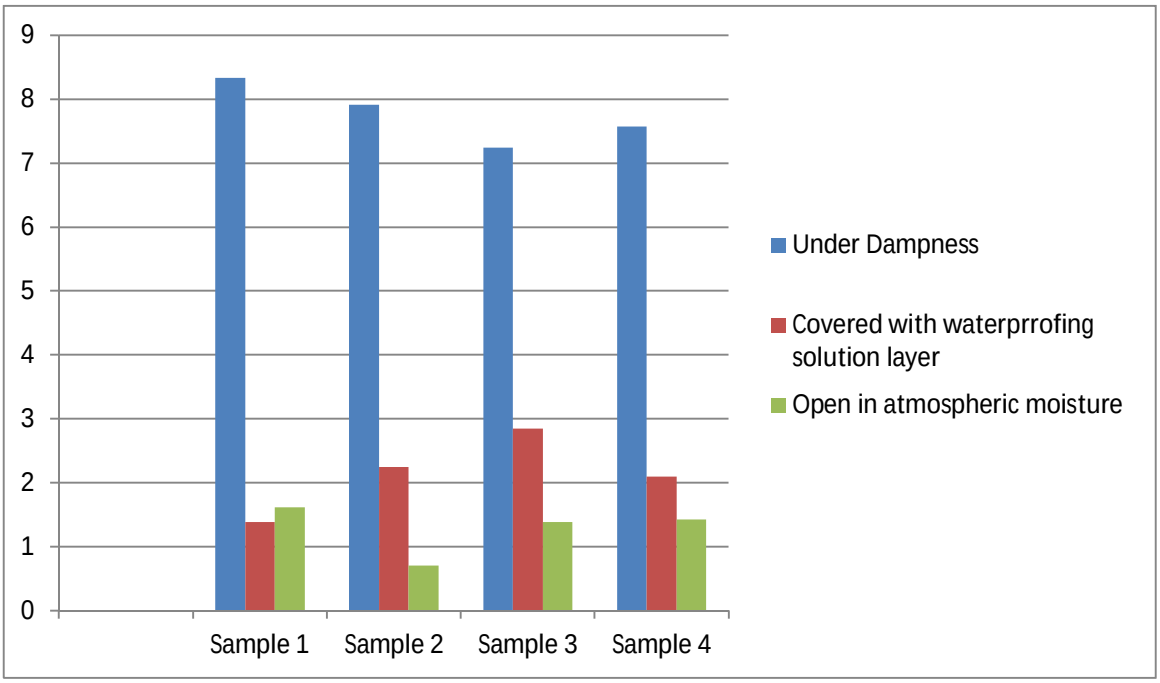
Sr.No	Exposure Conditions	Under dampness	Covered with bitumen / modified bitumen solution	Open in atmospheric moisture
		% mass change after 24 hrs. of exposed condition	% mass change after 24 hrs. of exposed condition	% mass change after 24 hrs. of exposed condition
1	Sample 1	+8.33	+1.388	+1.621
2	Sample 2	+7.91	+2.23	+0.704
3	Sample 3	+7.24	+2.85	+1.388
4	Sample 4	+7.57	+2.097	+1.428

V. CONCLUSION

By studying the test results of laboratory tests on plain bitumen and crumb rubber/lignin/plastic and additive modified bitumen it is concluded that the penetration values and softening points and fire point of plain bitumen can be improved significantly by modifying it where as ductility of the plain bitumen is more than the modified bitumen

After careful evaluation of the properties and taking various tests as per standards the result is noted that water penetration ability is optimized using replacement of 22% of replacement of pure bitumen . The sample with the combination of 78 % bitumen , 6% plastic , 8 % lignin ,7 % crumb rubber and 1 % additives gives the maximum resistance to water to seep into the voids of structures . 22% addition of replace has best suitability for blending it with bitumen. This will help to dispose the waste tire rubber in a proper way and solve the problem of environmental concerns up to a certain extent

Graph 1 : Percentage change in weight after absorption when exposed to different exposure condition



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VII. FUTURE SCOPE

In current research investigation at selected percentage of constituents with bitumen is analyzed for water absorption test . in future other test like viscosity , specific gravity , test for bitumen felts can be analyzed and checked for water proofing ability . pressure head test and seepage or permeability test may also can be applied **.**

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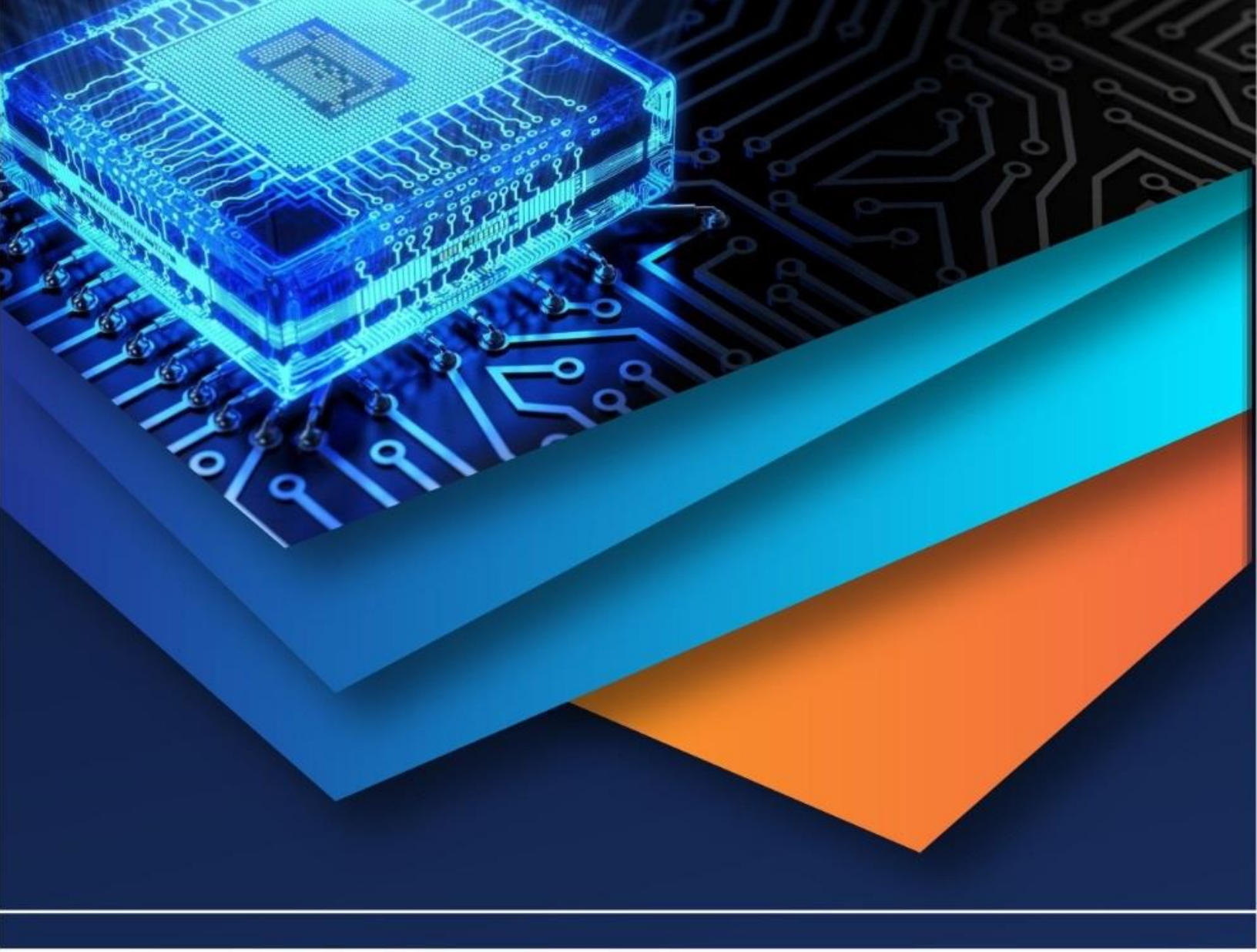

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