

Mineral Additive Based Mortar for the Enhancement of Water Repellent Properties

Zunaithur Rahman. D., Jeyamugesh. S., Ilakkiya. N. and Vijayaraghavan. J.

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Abstract

Vegetable oils from sunflower, peanuts and rapeseeds were tested as water repellents for mortars. Dosages were 0, 0.5, 1.0 and 1.5 % oil by cement weight. The oils were dispersed in the mixing water with the aid of Polyvinyl acetate. Compressive strength of 1:3 mortars with 0.50 w/c at 3 and 28 days were measured and significant strength decrease was only noticed at 28 days. Final Results show that, these represented oils were added to achieve minimum increase in compressive strength with maximum reduction in water absorption, bulk density, volume of voids due to addition sunflower oil, peanut oil and rapeseed oil with various proportions.

Keywords: Vegetable oils, water repellents, Polyvinyl acetate, Compressive strength, water absorption, bulk density, volume of voids.

Introduction

In a modern concept of using more and more organic admixtures for mortar and concrete are mostly incorporated with mineral oil derivatives. Further improvements of future generation will expect natural replacements which can promote sustainable development. Water vapour is transported out by adding water repellent to concrete. It is approved that ingress of aggressive action carried by liquid water will be decreased (repellent effect) and that the interior of concrete or mortar will vapour out gradually thus requiring comparatively lesser water to proceed thereby less prone to degrading reactions [1,3,5].

High workability, adequate strength, abrasion resistance, low permeability and superior chemical resistance is possible and yielded by using oil which function as air

entraining admixtures. These properties can be useful for the surfaces which are subjected to mild abrasion and aggressive chemical action [3,8].

Concrete curing till the invention of modern curing chemicals were introduced in the 1970's and there is evident usage of natural, plant based curing compounds have been used successfully in the past. Linseed oil had been widely used in concrete curing operations [2]. Vegetable and animal fat had been used as damp proofing agents in the form of paste or emulsion under the aid of organic carrier as finely divided silica [3,4,6].

Corn, mustard oil and 0.8% of linseed oil had been added for gradually reducing the water absorption and some of the hydration retardation problems and possible improper dispersion of the oil. It may overcome in the dispersing of oil in the mixing water to blending to its present study [3]. The objectives of the investigation are to test and clarify if different vegetable oils can function effectively as water repellents by the action of bio admixtures.

A. Methodology Adopted

- Finding the properties of materials.
- Calculate mix design and mix proportions of materials to be used.
- Determine compressive strength, water absorption, bulk density and volume of voids of the various mortar mixes.
- Compare the obtained results with reference cement mortar.

Materials

A. Cement

OPC 43 grade was carried out for these tests and its required properties. Specific gravity - 3.15, Initial & Final setting time is 85 & 225 mins.

B. Fine Aggregate

The Natural river sand was used as fine aggregate, not exceed 4.75mm gauge, free from all impurities. Specific gravity - 2.6

C. Water

The drinking water should be used for mortar preparation. Water cement ratio - 0.5.

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D. Vegetable oil

Sun flower oil, Peanut oil, Rapeseed oil had been used for carrying out these tests.

E. Lime stone filler

It is a binding material to control the hydration process. 20% of lime stone filler added to the cement weight.

F. Polyvinyl acetate

It is a chemical added with the water and oil mixer to provide good contact and perfect bond between oil and water. 0.3% of polyvinyl acetate added to the cement weight.



Fig 1. a) Sun flower seed, b) Peanut seed, c) Rape seed, d) Polyvinyl acetate

Specimen Details

A. Mix Proportions

Standard mortar is composed of OPC cement, sand, water whereas design mortar consists of OPC cement, sand, water, 20% of lime stone filler, 0.3% of polyvinyl acetate, 0 to 1.5% vegetable oil like sun flower, peanut and rapeseed oil. Mix proportion is 1:3:0.5.

B. Description of Specimen

There are two specimens were used for this testing purpose mainly cube of size 70.6x70.6x70.6 mm used for compressive strength test, whereas cylinder of dia 100 mm and height 20 mm used for water absorption test, density test and volume of voids test.

Results And Discussion

A. Compressive Strength test

This test was carried out to determine the compressive strength of various mortars after 3 and 28 days curing.

TABLE I. AVERAGE COMPRESSIVE STRENGTH (N/mm²)

Oil type	Dose (%)	Average Compressive Strength (N/mm ²)	
		3 Days	28 Days
None	0	5.50	12.47
Sun Flower	0.5	5.13	11.88
	1.0	5.30	11.66
	1.5	4.90	10.70
Peanut	0.5	5.33	11.93
	1.0	5.30	10.60
	1.5	5.25	10.68
Rapeseed	0.5	5.33	11.97
	1.0	5.37	11.66
	1.5	4.75	10.93

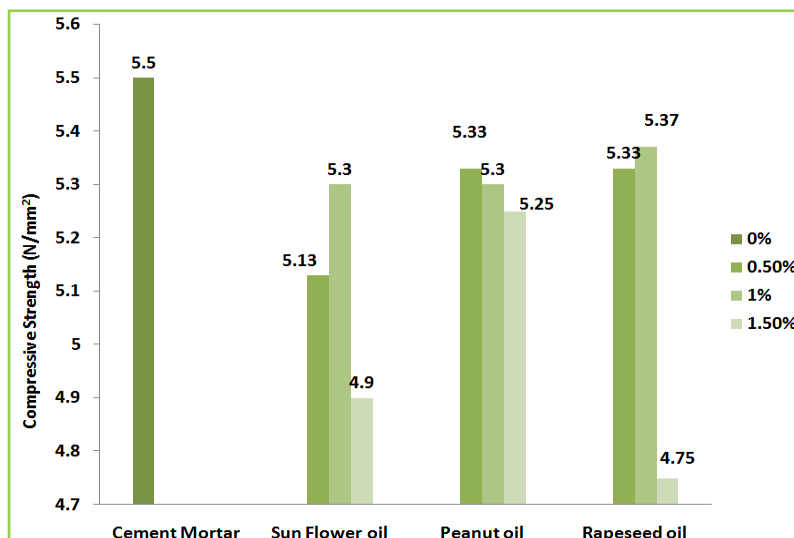


Fig 2. Average Compressive Strength after 3 days

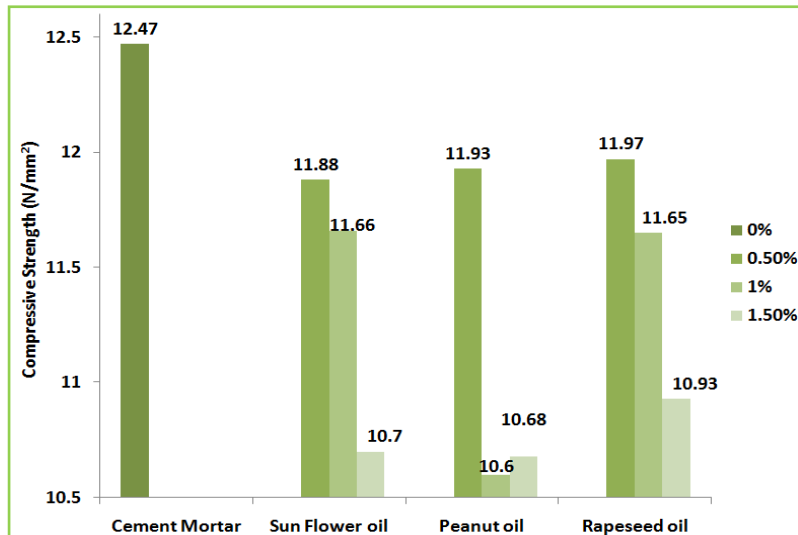


Fig 3. Average Compressive Strength after 28 days

B. Water absorption test

This test was carried out after 48 hours immersion in water at a temperature of $27 \pm 2^{\circ}$ C and boiling at a temperature of 100° C for 24 hours to determine water absorption or permeability of mortar with different proportion of vegetable oil after 28 days curing.

TABLE II. WATER ABSORPTION (%)

Oil type	Dose (%)	After immersion (%)	After boiling (%)
None	0	7.84	9.07
Sun Flower	0.5	6.13	7.14
	1.0	4.87	5.90
	1.5	4.33	5.36
Peanut	0.5	5.31	6.36
	1.0	3.90	4.68
	1.5	3.06	3.55
Rapeseed	0.5	4.57	5.73
	1.0	3.66	4.37
	1.5	3.03	3.75

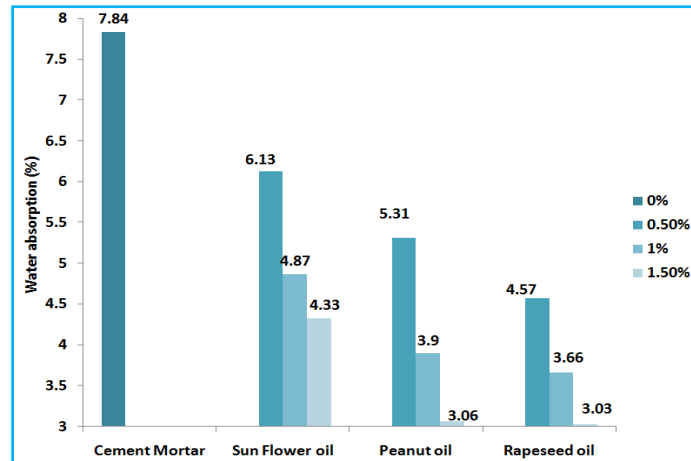


Fig 4. Water Absorption after immersion (%)

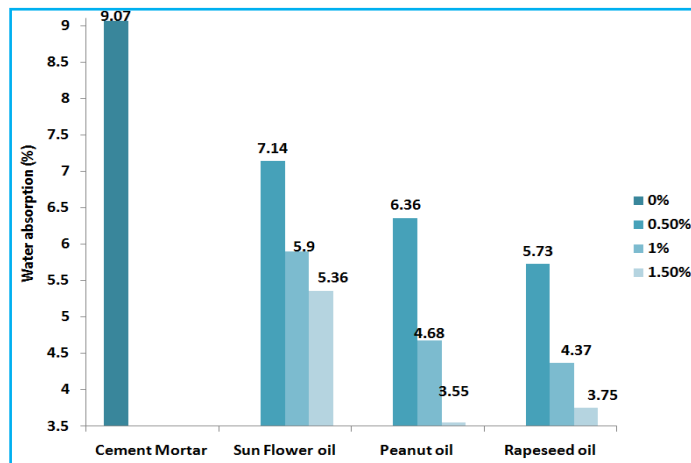


Fig 5. Water Absorption after boiling (%)

C. Bulk Density test

Bulk density was determined from the ratio between the weight of the dry sample and its volume after 28 days curing.

TABLE III. BULK DENSITY (g/cm³)

Oil type	Dose (%)	Bulk density (g/cm ³)
None	0	1.26
Sun Flower	0.5	1.52
	1.0	1.27
	1.5	1.29
Peanut	0.5	1.27
	1.0	1.29
	1.5	1.31
Rapeseed	0.5	1.33
	1.0	1.33
	1.5	1.35

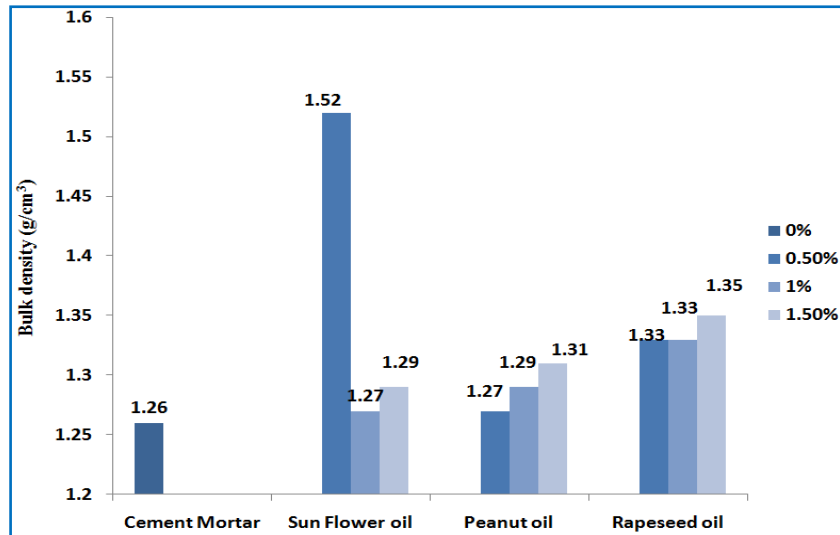


Fig 6. Bulk Density (g/cm³)

D. Volume of voids test

Volume of voids was calculated from mass of dry sample, bulk density and specific gravity of mortar after 28 days curing.

TABLE IV. VOLUME OF VOIDS (%)

Oil type	Dose (%)	Volume of voids (%)
None	0	8.57
Sun Flower	0.5	8.2
	1.0	6.91
	1.5	6.37
	0.5	7.39
Peanut	1.0	5.62
	1.5	4.35
	0.5	7.01
	1.0	6.26
Rapeseed	1.5	5.73

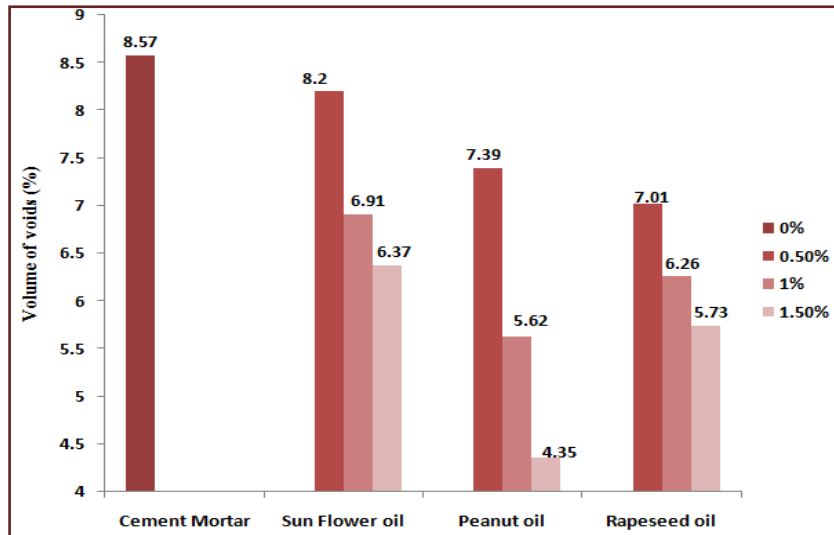


Fig 7. Volume of Voids (%)

Conclusion

A. Compressive strength test

- After 3 days of curing, addition of 1% of rapeseed oil gives good strength when compared to other oils. But it could not satisfy the strength of reference cement mortar.
- After 28 days of curing, addition of 0.5% of rapeseed oil gives good strength when compared to other oils. But it could not satisfy the strength of reference cement mortar.

B. Water absorption test

- After immersion and boiling process in water absorption test, addition of 1.5% of peanut and rapeseed oil gives lower water absorption and it nearly achieves 60% reduction in water absorption compared to reference cement mortar.

C. Bulk density test

- Addition of 0.5% of sunflower oil only increase 15% of weight when compared to reference cement mortar and addition of other oils like peanut and rapeseed oils attains its own weight.

D. Volume of voids test

- Addition of 1.5% of peanut oil attains 50% reductions of voids when compared to reference cement mortar.

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