IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684,p-ISSN: 2320-334X,
PP 14-20
www.iosrjournals.org

Studies on properties of concrete with various Waterproofing compounds

Annu Baby[1], Jeena Mathew[2]
[1](M Tech Student, Civil Engineering, SNGCE Kadayiruppu, India)
[2](Asst. Professor Civil Engineering, SNGCE Kadayiruppu, India)

Abstract: *Concrete is a versatile construction material, used in wide variety of situations. So it is very important to consider its durability as it has indirect effect on economy, serviceability and maintenance. In case of hydraulic and water retaining structures, concrete is directly exposed to water or humid environment. Hence, permeability of concrete becomes major concern for the durability of such structures. Water proofing compounds can be used to improve the pore structure of concrete and hence to reduce the water permeability of concrete. Nowadays, a number of waterproofing products are available in market which works on reduction of permeability of concrete. Few of them are required to be added while mixing the concrete ingredients and few others are applied on the concrete surface. The main aim of this project is to study the effect of different waterproofing compounds on durability and mechanical properties of concrete. Also to evaluate the use of Natural Rubber latex as an efficient water proofing compound.*

Keywords - *Compressive strength, Durability, Manufactured Waterproofing compounds, Natural Polymer*

I. Introduction

In present study manufactured and natural waterproofing compounds were used. The main objective of this project was to study the effect of manufactured and natural waterproofing compounds in concrete. There are two ways for water to penetrate through the concrete. When concrete is under hydrostatic pressure on one surface, water passes through the channels formed by the interconnecting cracks and voids to the other surface. The other way for the passage of moisture through the concrete from the wet side to the dry side is by capillary action. Water proofing admixtures can be use to improve the pore structure of concrete and hence to reduce the water permeability of concrete. An integral waterproofing admixture is a combination of admixtures that have the ability of producing concrete with reduced permeability.

II. Scope Of The Study

In case of hydraulic and water retaining structures, concrete is directly exposed to water or humid environment. More severe damage in concrete changes the capillary pore structure (crack widths) and increases permeability parameters. Water proofing admixtures are used to reduce the water permeability of plain concrete. In present experimental work, various water proofing chemicals are to be used in concrete to evaluate its performance and effect on properties of concrete. The water proofing admixtures was added during mixing of concrete ingredients.

III. Experimental Investigation

A. Material properties

i) Cement: Ordinary Portland cement of grade 53 was used. Laboratory test were conducted to determine the properties of cement. The cement satisfies the requirements as per IS: 12269-1970.

ii) Fine aggregate: Locally available river sand passing through 4.75 mm is sieve was used for the experiments. Laboratory tests were conducted to determine different physical properties as per IS 383 (part III)-1970. Sieve analysis was done to determine the grain size distribution of river sand. Specific gravity of fine aggregate is 2.7 and grading zone is zone II.

iii) Coarse aggregate: For proper gradation, combination of 12.5 mm and 20 mm aggregates are used. Laboratory tests were conducted to determine the different physical properties as per IS 383 (part III)-1970.specific gravity of coarse aggregate is 2.8.

iv) Mixing water: Clean drinking water available was used for casting as well as curing of the test specimens.

v) Super plasticizer: The super plasticizer used was masterglenium B233. Marsh cone test is conducted to study the rheological properties of cement and mortar. From marsh cone test 0.5% is obtained as percentage of super plasticizer.

Table 1: Properties of super plasticizer

Supply form	Liquid
Color	Brown
pH	≥6
Chloride ion content	<0.2%

vi) Lignosulphonates polymer based waterproofing compound (compound 1): It reduces the water demand for required workability and minimizes segregation and bleeding.

Table 2: Properties of compound 1

Appearance	Liquid
Color	Red
Ph value	8.8
Setting time(minutes)	30-600 min
Chloride content	Nil
Water solubility	Soluble
Boiling point	100°c
Composition	Plasticizers
	Dye
	Water

vii) Acrylic copolymer based waterproofing compound (compound 2) : Acrylic copolymer based manufactured waterproofing compound is specially formulated integral liquid waterproofing compound composed of surface active plasticizing agents, polymers & additives.

Table 3: Properties of compound 2

Appearance	Free flowing liquid
Color	Wine red
Non volatile content @ 25°c	1.05-1.07
Ph value	9-13
Setting time(minutes)	30-600 min
Chloride content	Max 2 %
Water solubility	Soluble
Boiling point	100°c
Composition	Fatty acid soap
	Soluble silicate
	Emulsifier

viii) Natural polymer based waterproofing compound (compound3): Polymers have good binding properties and good adhesion with aggregates. They have long-chain structure, which helps in developing long-range network structure of bonding.

Table 4: Properties of compound 3

Sl.No	Property	Rubber latex
1	Colour	White
2	Total solid content(% by weight)	61.5 max
3	Dry rubber content(% by weight)	60 min
4	Non rubber solid content	1.50 max
5	KOH number	0.55 max
6	Ammonia content , NH3%	0.70 max
8	Ph	10.4 min
9	Coagulum content , % by mass	0.01 max
10	Copper content as PPM	5
11	Iron content as PPM	8
12	Particle size of rubber latex	0.2µm
13	Specific gravity of rubber latex	0.94

B. Mix proportion
The final proportion was 1:1.1:2.6 (cement: fine aggregate: coarse aggregate) with w/c of 0.379.

IV. Properties Of Concrete

A. Fresh properties of concrete
i). Workability of concrete
Slump test was done to measure the workability of concrete. Based on IS: 1199 – 1959.

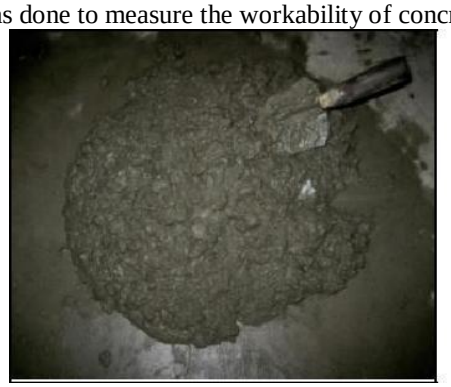
Fig 1: Prepared concrete mix


Fig 2: Slump check of concrete

B. Mechanical properties of hardened concrete
i). Compressive strength of hardened concrete
The compressive strength test was carried out on cubical specimen of size 150mm in a compression testing machine of capacity 2000kN, as per IS 516:1959 specification.

C. Durability properties of hardened concrete
i) Weight loss of concrete due to acid environment
To check the loss of weight due to acid environment 150 mm concrete cube specimens were tested based on modified ASTM C 267-01 test method


Fig 3: Specimen Before acid attack


Fig 4: Specimen After acid attack

ii) Strength loss of concrete due to acid environment
To check the loss of strength of concrete with different waterproofing materials against sulphuric acid, 150 mm concrete cube specimens were tested based on modified ASTM C 267-01 test method

Fig 5: Compression test of concrete before acid attack Fig 6: Compression test of concrete after acid attack

iii)Water absorption of concrete

Water absorption test were conducted for concrete with and without waterproofing compounds. Water absorption test of concrete is based on ASTM C 140.

iv)Porosity of concrete

28 days cured, 150 mm concrete cube specimens were used for conducting porosity test. Based on ASTM C-1754.

Fig 7: water curing **Fig 8:** Oven drying

v) Permeability of concrete

Based on IS: 3085-1965 permeability test were conducted for concrete with and without waterproofing compounds. 100 mm concrete cube specimens were used for conducting permeability test.

Fig 9: Permeability apparatus

vi)Sorptivity of concrete

Sorptivity is the transport of liquids in porous solids due to surface tension acting in capillaries. It is measured as the rate of uptake of water. Test was conducted based on ASTM C1585-04.100x50mm discs were used.

Fig 10:100x50mm test sample

Fig 11: Sorptivity test

V. Results And Discussion

A. Optimum percentage of natural polymer

Determined the 7 & 28 days compressive strength of concrete with 0 to 1.25% of natural polymer(by weight of cement).Optimum percentage of natural polymer is obtained as 1%.

B. Workability of concrete

As compared with normal concrete, concrete with 0.25% compound 1, 0.4% compound 2 and 1% natural polymer showed higher slump values. Concrete with 0.25% compound 1 showed 20% increase in slump and concrete with 0.40% compound 2 showed 13.33% increase in slump and concrete with 1% natural polymer showed 6.67% increase in slump value.

Fig 12: Slump value of different mixes

C. Compressive strength of hardened concrete

As compared with normal concrete, concrete with 0.25% waterproofing compound 1 showed 12 %, concrete with 0.4% compound 2 showed 9% and concrete with 1% natural polymer showed 11.2% increase in 7 days compressive strength. Concrete with 0.25% waterproofing compound1 showed 7.25%, concrete with 0.4% compound 2 showed 4.19% and concrete with 1% natural polymer showed 4.6% increase in 28 days compressive strength of concrete

Fig 13: Compressive strength test result of various concrete mixes

D. Weight loss due to acid attack

As compared with normal concrete, concrete with 0.25% compound 1 showed 64.52%, concrete with 0.4% compound 2 showed 60.16%, and concrete with 1% natural polymer showed 56.22% decrease in percentage weight loss due to acid attack.

Fig 14: Weight loss of concrete with various mixes

E. Strength loss due to acid attack

As compared with normal concrete, concrete with 0.25% compound 1 showed 58.07%, concrete with 0.4% compound 2 showed 53.85%, and concrete with 1%natural polymer showed 43.98% decrease in percentage strength loss due to acid attack

Fig 15: Strength loss of concrete with various mixes

F) Water absorption of concrete

As compared with normal concrete, concrete with 0.25% waterproofing compound 1 showed 77.6%, concrete with 0.4% waterproofing compound 2 showed 64.8%, and concrete with natural polymer showed 49% decrease in water absorption.

Fig 16: Water absorption of concrete with various mixes

G) Porosity of concrete

As compared with normal concrete, concrete with 0.25% waterproofing compound 1 showed 70.75 %, concrete with 0.4% waterproofing compound 2 showed 65%, and concrete with natural polymer showed 50% decrease in porosity.

Fig 17: Porosity of concrete with various mixes

H) Permeability of concrete

As compared with normal concrete, concrete with 0.25% waterproofing compound 1 showed 69.56 %, concrete with 0.4% waterproofing compound 2 showed 64.8%, and concrete with 1% natural polymer showed 52.08% decrease in permeability.

Fig 18: Coefficient of permeability of various concrete mixes

I) Sorptivity of concrete

As compared with normal concrete, concrete with 0.25% waterproofing compound 1 showed 68.46 %, concrete with 0.4% waterproofing compound 2 showed 52.3%, and concrete with 1% natural polymer showed 42.3% decrease in sorptivity.

Fig 19: Sorptivity of various concrete mixes

VI. Conclusions

The optimum percentage of Natural polymer is obtained as 1%.As compared with normal concrete, concrete with 0.25% compound 1, 0.4% compound 2 and 1% natural polymer showed higher slump & compressive strength. Waterproofing compounds improves the pores structure of concrete and made the concrete denser than the normal concrete and showed better result than normal concrete. As Compared with normal concrete, concrete with 0.25% compound 1, concrete with 0.4% compound 2, and concrete with 1% natural polymer showed decrease in water absorption, porosity, permeability, sorptivity and strength and weight loss due to acid environment. Results of Natural polymer based waterproofing concrete are comparable with manufactured polymer based waterproofing concrete. Natural polymer can be used as a waterproofing compound in concrete because they are economical compared to manufactured waterproofing compound, easily available, not harmful to health.

References

[1]. Anil kumar, Raghavendra and Sudha kumar (2014), ―Durability characteristics of high performance concrete with ground granulated blast furnace slag‖,*International journal of enhanced research in science technology & Engineering,*Vol 4,Issue 11
[2]. Dr.K.Srinivasu, M.L.N.Krishna Sai, Venkata Sairam Kumar.N (2014), ―A Review on Use of Metakaolin in Cement Mortar and Concrete‖, *International Journal of Innovative Research in Science*,Vol 3,Issue 7.
[3]. Nimitha, Vijayaraghavan and Dr. Wayal (2013) ―Effect of manufactured sand on durability properties of concrete‖, *American journal of engineering research*, Vol 2,Issue 12.
[4]. Sudarsana Rao, Munirathnam, Ghorpade and Sashidha (2013) ―Influence of natural rubber latex on permeability of fibre reinforced high-performance concrete‖, *International journal of enhanced research in science technology & Engineering,* vol 2, Issue 7.
[5]. Mohammad Reza and Seyed Mousavi (2013) ―Effects of Nano-Silica on permeability of concrete and steel bars reinforcement corrosion‖, *Australian journal of basic and applied sciences*, pp 464-467.
[6]. M. S. Shobha,Dr. C. Shashidhar,Dr. H. Sudarsana Rao (2013),―Strength Studies of Natural Rubber Latex Modified High Performance Concrete‖,*International Journal of Engineering Research & Technology,*Vol 2, Issue 5.

[7]. Prajapati and Arora (2011), ―A study on oxygen permeability of concrete containing different water proofing admixtures and cementations materials‖,*International journal of advanced engineering research and studies*, Vol. 1
[8]. Kartini, Mahmud and Hamidah (2010), ―Absorption and permeability performance of rice husk ash blended grade 30 concrete‖, *Journal of engineering science and technology*, Vol. 5.
[9]. Faiz abdullah and Mirza (2009), ―Effect of sand replacement and silica fume addition on chloride ion permeability of lightweight concrete‖, *Journals of king Abdul-Aziz university*,Vol. 20 , pp: 61-73.
[10]. Ha-won song (2009), ―Estimation of the permeability of silica fume cement concrete‖, *The Arabian journal for science and engineering*, Vol. 35.
[11]. Mohammad Ismail, Bala Muhammad and Nur Aiza Mohamad(2009), ―Durability performance of natural rubber latex modified concrete‖, *Malaysian Journal of Civil Engineering*,Vol 2,Issue2.
[12]. Zhang shu Qiang,Chen Hong fang, Zhong Hua, Leung Fuk Ming and Nick Peng (2008) ―Use of concrete admixtures to produce waterproof concrete‖, *Asia results 33rd conference on our world in concrete & structures*: 25– 27 August 2008,
[13]. Gyanen.Takhelmayum, Ravi Prasad, Savitha A.L (2008), ―Experimental Study on the Properties of cement concrete using Rice Husk Ash‖, *International Journal of Engineering Science and Innovative Technology*,Vol3,Issue 6.
[14]. IS 456:2000-Indian standard plain and reinforced concrete - Code of practice IS1199:1959- Methods of sampling and analysis of concrete
[15]. IS 1199:1959- Methods of sampling and analysis of concrete
[16]. IS 516:1959- Methods of tests for strength of concrete
[17]. IS: 3085-1965 -Method of test for permeability of cement mortar and concrete ASTM C 267-01 -Standard test methods for chemical resistance of mortars, grouts, and monolithic surfacing and polymer concretes
[18]. ASTM C 267-01 -Standard test methods for chemical resistance of mortars, grouts, and monolithic surfacing and polymer concretes
[19]. ASTM C 140–Standard test methods for sampling and testing concrete masonry units and related units
[20]. ASTM C1585-04-Standard test method for measurement of weight of absorption of water by hydraulic cement concrete.
[21]. ASTM C 1754-Standard test method for density and void content of hardened pervious concrete.