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The use of Geo-Synthetic Material in Canal Lining

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Abstract:
Water is most important in agricultures area.so it is necessary to develop irrigation system to Avoid wastage ofwater due to percolation through ground. In this study, polypropylene geosynthetic material was used for cube casting in 0.15%,0.20%The cubes was casted for compressive strength and beams was casted for flexural strength purpose. Different tests was conducted on the specimens like compressive strength, flexural strength, permeability tests. Also study carried out on strength behaviour for different percentage of geosyntheticFibre material and comparisons was to be done between standard concrete and with using Fibre in concrete. The Various Result Can be given from different tests so the for using the 0.15% of fibre in concrete is better result .also different study of material can be study in this paper.

Keywords: Polypropylene Fibre,canals, lining material ,compressive strength, flexural strength,pearmiability.

A) Introduction

a) General

Canal lining is the process of reducing seepage loss of irrigation water by adding an impermeable layer to the edges of the ditches. Seepage can result in losses of 30 to 50 percent of irrigation water from canals, so adding Geosynthetic lining can make irrigation systems more effective. Canal linings are also used to prevent weeds growth, which can spread all over an irrigation system and reduce water flow. Lining a canal can also prevent waterlogging around low-lying areas of the canal.

The irrigation has been practiced from the time immemorial and so it has been building of irrigation canals, but is not only since last century that canals were designed on more or less scientifically. The transportation and distribution of water are an integral part of any irrigational system. Irrigation system should be built in such a way that they will operate effectively. Many surface irrigation projects in many countries are performed at levels much below their potential in terms of crop productivity, water table condition, equity and efficiency. Water is a very valuable natural resource. When this valuable resource runs through the canals some part of the water is lost by seepage and evaporation etc. This loss is known as transportation loss. The transportation loss was calculated experimentally by different inventors on different canals around the world. In this project we have tried to review some of the research work and suggest an average water loss from the canal irrespective of the soil and other environmental condition. There are many more materials which have been used in canal lining to reduce this water loss. No such material can be said to be the best material for reducing water loss because its suitability depends on the site and its environmental condition. Concrete used in lining is durable but it will be costly whereas, use of geo-synthetic material is easy to apply and less costly but some protection required to resist weathering action and other physical and environmental impacts.

Use of continuous reinforcement in concrete (reinforced concrete) increases strength and durability, but requires careful placement and skilled workmanship. Alternatively, introduction of fibres in discrete form in plain or reinforced concrete may provide a better solution. The advanced development of fiber reinforced concrete (FRC) started in the early sixties (1J. Addition of fibres to concrete makes it a homogeneous and isotropic material. When concrete cracks, the randomly oriented fibres start functioning, attracts crack formation and propagation, and thus improve strength and durability. The failure modes of FRC are either bond failure between fibre and matrix or material failure in this paper, the state-of-the-art of fibre reinforced concrete is discussed and results of intensive tests made by the author on the properties of fibre reinforced concrete using local materials are involved.

b) Suitability of the material lining:

(i) Economy
(ii) Structural stability
(iii) Durability
(iv) Resistant erosion
(v) I permeability
(vi) Hydraulic Efficiency

c) The principles types of canal lining :

1. Concrete lining
2. Shotcrete lining
3. Precast concrete lining
4. Geosynthetic fibre concrete lining
5. Brick lining
6. Asphaltic lining
7. Earth lining

d) Canal lining Advantages:

1. Reduction in seepage losses
2. Low maintenance
3. Minimizes the possibility of lowland Damages
4. Prevents growth of weeds & plants.
5. Improved hydraulic efficiency of canals
6. Reduces cross sectional dimensions of canals.

e) Disadvantages of canal lining:

1. Higher initial investment.
2. Repair is costly.
3. Longer construction period.

B. OBJECTIVE OF PROPOSED WORK

1. To increase the tensile strength, compressive strength by using Geosythetic material with concrete in canal lining.
2. To reduced damage to lowlands from seepage of canal water.
3. To decrease the permeability and then improve the hydraulic efficiency of canal lining.
4. To increase the durability and life of lining.
5. To decrease in cost of maintenance and overall Canal lining cost.
6. To reduce time required for placing of lining.

C. METHODOLOGY

1. Preparation of Beam size 100 X 100 X 500 by using with different % Of geosynthetic material & without adding fibre.
2. Selection of material used for canal lining and their collection.
3. To determine workability of fresh Concrete test by using Slump Cone Test.
4. Compressive test on different available material on compression testing machine & universal testing machine (UTM).
5. To determine Compaction Factor for Workability of fresh Concrete test .
6. Cost analysis between different materials used for canal lining.

Comparison between the result and selection of economical and strong material for canal lining

D) Selection of Type of Lining:

1. **Functional Success:** The canals are lined to prevent seepage loss. Obviously the type which gives maximum required water-tightness to the canal section should be chosen.
2. **Economic Consideration:** It is very essential to make sure that the type selected is such that the benefits derived from it are sufficient to balance the annual cost of the lining with safe margin.
3. **Structural Stability:** The type of lining selected should be sufficiently strong to resist the damaging forces. Lining should be sufficiently flexible to allow moderate settlement of sub grade without cracking.
4. **Hydraulic Efficiency:** The lining selected should give smooth finish to the surface. If the surface is rough the coefficient of rigidity will be high. It reduces the velocity of flow and consequently discharge capacity of the canal is reduced.
5. **Durability:** The type of lining selected should have sufficient working or useful life. The lining should be resistant to wearing, weathering and chemical attack.

E.PROCEDURE:-

Step.1. Target Mean Strength:-

For the degree of quality control specified namely "Good", the value of standard deviation,

σ = 4.9N/mm2 (IS 456:2000).

Hence, the target means strength for the desired comp. strength,

= [20 +1.65x4.9)]

= 28.085N/mm^2

Step.2. Selection of water cement ratio:-

From Table 5 of IS456:2000,

Maximum water cement ratio =0.55(Mild exposure)

Based on experience adopt water cement ratio as 0.36

0.36<0.55, Hence…. OK

Step.3. Selection of water and sand content:-

Maximum water content for 20mm aggregate = 186 litre

Estimated water content for 100mm slump ==197 litre

As polypropylene fibre is used, the water content can be reduced up to 20% and above. Based on trials with polypropylene fibre, the water content reduction of 30% has been achieved. Hence, the arrived water content

= (197 0.70)

= 138 litre

Step.4. Determination of cement content:-

Water cement ratio = 0.36

Water = 138 litre.

Cement =0.29

Step.5. Proportion of volume of coarse aggregate and fine aggregate content:-

Volume of 20mm size coarse aggregate and Zone-I fine aggregate and water-cement ratio of 0.50 is 0.60.

In the present case water-cement ratio is 0.36% Therefore, volume of coarse aggregate is required

to be increased to decrease the fine aggregate content. As the water-cement ratio is lower by 0.21, the proportion of volume of coarse aggregate is increased by 0.042. (At the rate of -/+ 0.01

for every 0.05 change in water-cement ratio.)Therefore, corrected proportion of volume of Coarse aggregate for the water-cement ratio of 0.36 is 0.642.

Step.6. Mix calculations:-

The mix calculations per unit volume of concrete shall be as follows:

1. **Calculation for volume of cube**

   Volume of one cube= (0.15x0.15x0.15) m^3

   = 0.003375 m3

   Weight of one cube = 0.003375x2362 = 7.972 kg

2. **Calculation of volume of concrete for M20 grade**

   Volume of cement for one meter cube = 1/ (1+4) = 0.2 m3

   Weight of cement per meter cube= 0.2 x 1200 = 240 kg

Volume of aggregate for one meter cube = 0.2 x 4 =0.8
Weight of aggregate per meter cube = 0.8 x 1450 = 1160 kg
Water cement ratio =0.36
Weight of water = 258.16 x (1/0.36) = 717.111 kg
Density of concrete = (weight of (cement +sand +aggregate +water)) per meter cube
= (240+1160+717.11) = 2117.1 kg/m3
Weight of concrete for one cube = 2117.11 x 0.003375 = 7.14501 kg.

Weight of Polypropylene fibre

- **a.** 0.1% of Polypropylene fibre = 7.145 × 0.1 = 71.451gm
- **b.** 0.15% of Polypropylene fibre = 7.145 × 0.15 = 107.11 gm.
- **c.** 0.20% of Polypropylene fibre = 7.145 × 0.2 = 143.11 gm

F. Testing procedures

a) Slump Cone test

Indian standard is adopted for workability determination of both fresh PC and FRCs.. The procedure for measuring the workability of FRCs is same as that of PC, due to non-availability

b) Compressive strength test

Hydraulic testing machine is used as per Indian standard (UTM) for compressive strength, compressive behaviour, compressive pre-crack/post-crack energies, and compressive toughness index.

c) Flexural strength test

Following the Indian standard UTM testing machine is used for flexural strength test of all beam-lets. The flexure strength tests are performed to study the modulus of rupture (MOR), flexural behaviour, flexural pre-crack/post-crack energies, and flexural toughness index.

d) Permeability test

Permeability test is performed as per Indian standard, to determine the permeability. The size of the specimens used for permeability test is 150 mm x 150 mm x 150mm because the selected tested beam-lets in flexural strength tests are utilized for determining the permeability. Only that halves of the tested beam-lets are selected which have no apparent crack in that portion.

e) Summary

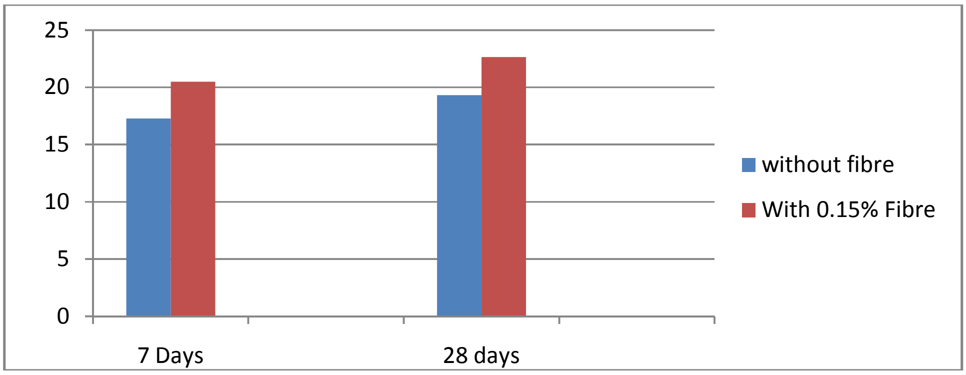
The proportion of concrete, sand, aggregates for PC and FRCs is 1, 3, and 1.5 with a w/c proportion of 0.7. In addition to that, 0.15% and 0.20% fibre content, by mass of cement, and fibre length of 50 mm are utilized in the case of FRCs. A total of 32 specimens i.e. 16 cube and 16 beam-lets are produced. Indian standards are followed for the execution of slump, compressive strength and flexural strength and permeability tests. The properties of FRCs are also determined by using the same standards of Indian.

G) TEST RESULTS AND ANALYSIS

1. Compressive strength

A) With Adding 0.15% of fibre& without adding Fibre

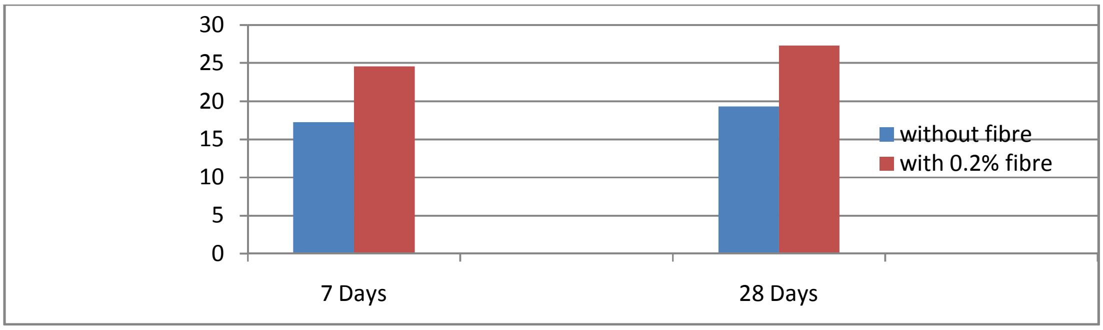
Sr. no.	Days	Compressive strength (N/mm^2)				Result (N/mm^2)	
		Without fibre mix		With fibre mix		Without fibre	With fibre
1.	7 Days	1.	17.55	1.	20.42	17.28	20.50
		2.	17.28	2.	20.58		
		3.	17.01	3.	20.50		
2.	28 Days	1.	19.40	1.	22.63	19.33	22.65
		2.	19.26	2.	22.65		
		3.	19.33	3.	22.67		



Bar chart showing compressive strength for 0.15% of fibre for 7 & 28 days

B) With Adding 0. 20% of fibre& without adding Fibre

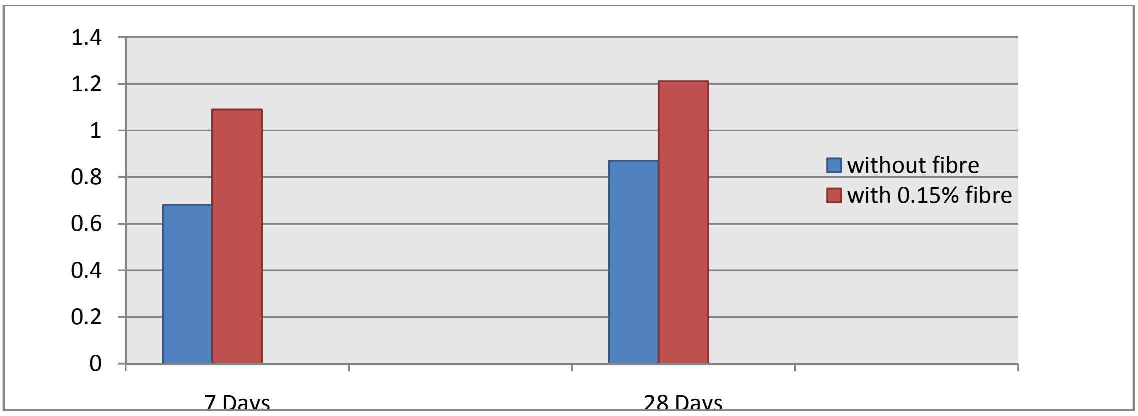
Sr. no.	Days	Compressive strength (N/mm^2)				Result (N/mm^2)	
		Without fibre mix		With fibre mix		Without fibre	With fibre
1.	7 Days	1.	17.55	1.	24.60	17.28	24.60
		2.	17.28	2.	24.57		
		3.	17.01	3.	24.63		
2.	28 Days	1.	19.40	1.	27.35	19.33	27.33
		2.	19.26	2.	27.31		
		3.	19.33	3.	27.33		



Bar chart showing compressive strength for 0.20% of fibre for 7 & 28 days

2) Flexural strength Test –
A) With Adding 0.15% of fibre& without adding Fibre

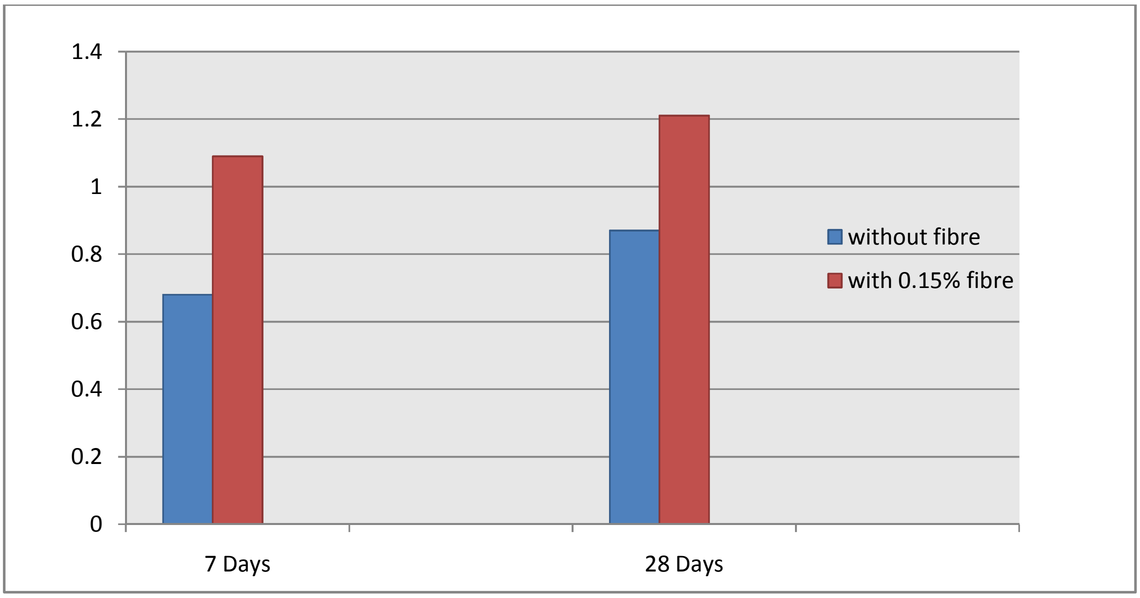
Sr.no.	Days	Flexural strength (N/mm²)				Result (N/mm²)	
		Without fibre mix		With fibre mix		Without fibre	With fibre
1.	7 Days	1.	0.68	1.	1.0	0.68	1.09
		2.	0.72	2.	1.09		
		3.	0.64	3.	1.18		
2.	28 Days	1.	0.80	1.	1.20	0.87	1.21
		2.	0.87	2.	1.22		
		3.	0.94	3.	1.21		



Bar chart showing flexural strength for 0.15% of fibre for 7 & 28 days

B) With Adding 0.20% of fibre& without adding Fibre

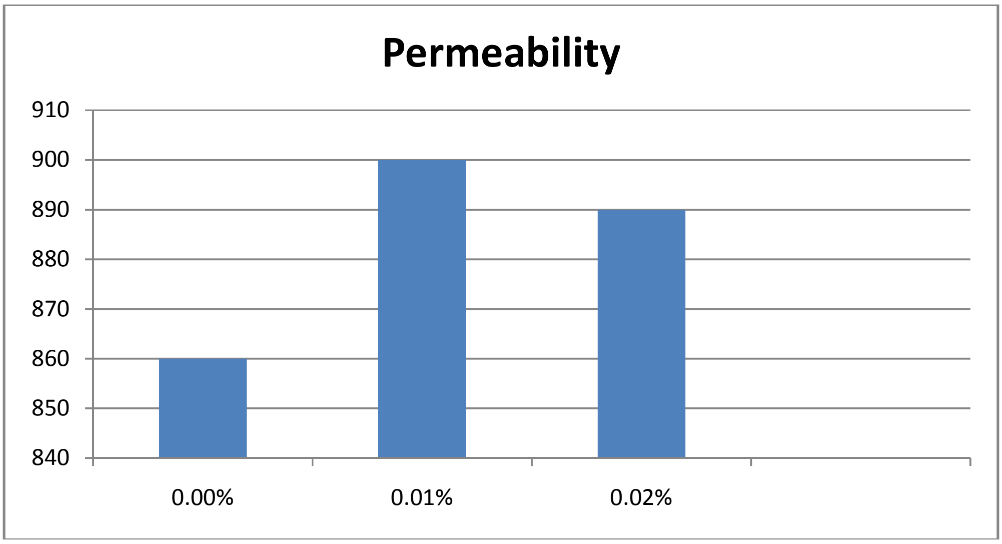
Sr.no.	Days	Flexural strength (N/mm^2)				Result (N/mm^2)	
		Without fibre mix		With fibre mix		Without fibre	With fibre
1.	7 Days	1.	0.68	1.	1.21	0.68	1.21
		2.	0.72	2.	1.16		
		3.	0.64	3.	1.27		
2.	28 Days	1.	0.80	1.	1.42	0.87	1.50
		2.	0.87	2.	1.58		
		3.	0.94	3.	1.50		



Bar chart showing flexural strength for 0.2% of fibre for 7 & 28 days

3) Permeability Test –

Sr.no.	%of fibre mix	Permeability about 1000ml Water retained in pan		Result in ml
1.	0.00%	a.	850	860
		b.	870	
2.	0.15%	a.	910	900
		b.	890	
3.	0.2%	a.	885	890
		b.	895	



Bar Chart Showing Permeability of Concrete in Ml with Different % of Fibres to Water Retained In Pan

H) RESULT ANYSYSIS SHEET

SR. No	TEST CONDUCTED	RESULTS
1)	Specific gravity of fine aggregate	**2.66**
2)	Specific gravity of coarse aggregate	**2.78**
3)	Crushing value of Coarse aggregate	**24%**
4)	Abrasion value of Coarse aggregate	**25.5%**
5)	Aggregate Impact value of Coarse aggregate	**28%**
6)	Fineness Test on fine aggregate	**2.66**
7)	Test for Soundness of Coarse aggregate	**14%**
8)	Mix design used	**1:2:4**
9	Slump Value of fresh concrete without fibres	**160 mm**
10)	Slump Value of fresh concrete with fibres	**110 mm**
11)	Flexure strength test on hardened concrete without Geosynthetic	**0.86 N/mm^2**
12)	Flexure strength test on hardened concrete with Geosynthetics	**1.2 N/mm^2**
13)	Compressive Strength in alternate orientation on hardened concrete without Geosynthetics	**19.23 N/mm^2**
14)	Compressive Strength in alternate orientation on hardened concrete with Geosynthetics	**22.65 N/mm^2**
15)	Permeability of concrete without fibre	**860 ml**
16)	Permeability of concrete with fibre	**890 ml**

I) CONCLUSIONS

(1) The of slump is noticed with increase in fibre content, especially beyond 0.15 % dosage, the mix becomes fibrous which results in difficulty in handling.

(2) The Compressive strength and flexural tensile strength tests gives that , the strength were increased directly with the increase in volume ratios of Polypropylene Fibres with about to them without fibres used in concrete.

(3) The maximum increase in Compressive strength was 17% and Flexural tensile strength was 39% compared to the mix without fibres.

(4) The samples with fibres of 0.15 % showed better results in Comparison with any other that is with and without using fibre samples.

(5) From the apart study the handing cost of canal lining can be minimize. So that economical construction can be done.

(6) The Permeability can be decreased upto adding 0.15% of ppl fibre, as compare to without mixing the ppl fibre in the concrete.

J) FUTURE SCOPES

1. For future work in addition of effect of high Volume Geosythetic fibre can be studied.
2. Design of different grade of concrete with Geosythetic fibre can be studied.
3. Shrinkage properties of Geosythetic fibre can be studied.
4. Various types of fibre can be added of the research can be further studied.
5. The chemical admixture and mineral admixture can be added in different proportion and can be studied for the future use.
6. This concrete can be used for different element of building and can be studied.

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