International Journal of ChemTech Research
CODEN (USA): IJCRGG ISSN: 0974-4290
Vol.8, No.1, pp 178-183, 2015

# Effect of Partial Replacement of Cement with Neem Gum on the Strength Characteristics of High Performance Concrete

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**Abstract:** In this paper the purest kind of Neem Gum, extracted from Azadirachta indica trees is used in concrete mixes as a natural enhancer. it is crushing and used in the form of powder which was dissolved in water to get the liquid of this additive .In this study Neem gum was added to concrete mixes at various radios (0.1%, 0.2%, 0.4%, 0.6%, 0.8%, 1.0%, 1.2% & 1.5%) by weight of cement content. The result showed that the addition of Neem Gum to the concrete mixes has a clear effect of concrete. The compressive strength was measured at ages of 7, 21 &28 days and it was found that decreases slightly with an increase in the proportion of Neem gum in concrete mixes. The concrete mixes prepared using modified gum in its liquid state by reducing and added gum as percentage of cement content showed a clear and significant change in the properties of concrete .These ratios resulted in high compressive strength concrete with good workability.
**Keywords**: High performance concrete, Neem gum, compressive strength, tensile strength.

## 1. Introduction

Concrete is a man made building material that looks like stone. Combining cement with aggregate and sufficient water makes concrete. Water allows it to set and bind the materials together. Different mixtures are added to meet specific requirements. Concrete is normally reinforced with the use of rods or steel mesh before it is poured into moulds. (1-3) The Neem tree has been known as the wonder tree .It has become important in the global context today because Neem fruits , seed , oil, leaves , bark and roots have such uses as general antiseptics, antimicrobials, treatment of urinary disorders , diarrhea , fever and bronchitis skin diseases, ect. its main chemical composition is titerpenes and lemonades are effective inhibiting , limonoids are abundant in Neem gum.

**Figure 1 Neem Gum(Azadirachta indica tree )**

In general local additives have been studied by many researchers such as Ashraf Mahmoud Saleh (2001), investigated the effect of Gum Arabic liquid in concrete mixes to obtain high compressive strength concrete and good workability. (4)

Osman User Dabluk was presented a thesis on the use of porcelain an excavated from the mountain in bavoda desert many materials are used to manufacture to get high strength and reduce the cost by using locally available material concrete .(5) In the present investigation of concrete were designed, prepared and tested in the laboratory. At first tests were carried out on the components of concrete mix (cement , Coarse aggregate, Fine Aggregate). Then several concrete mixes were prepared using neem gum at ratios0. 1%, 0.2%, 0.4%, 0.6%, 0.8%, 1.0%, 1.2% by weight of ordinary Portland cement. The results of laboratory experiments were analyzed and discussed to investigate the influence of neem gum additive on the workability of fresh concrete and compressive, split tensile, flexural strength of hardened concrete.

## 2. Materials Characteristics

### 2.1. Neem Gum (Azadirachta indica )

Collection of Neem gum samples, their purification and the preparation of the aqueous solution were earlier reported by Ramakrishna et al

**Figure 2 Neem Gum**

**Figure 3 Neem Gum Powder**

### 2.2. Cement

In the most general sense of the word, cement is a binder, a substance that sets and hardens independently, and can bind other materials together. Ordinary Portland cement was used in this research work. Chemical composition accompanied by some important physical and mechanical properties of the cement are given in Table (1-2)

### 2.3. Properties of Cement

**Table- 1 Chemical Composition of cement**

| Materials | Composition (%) |
|---|---|
| Fe2o3 | 3 |
| $Sio_2$ | 20.6 |
| $Al_2O_3$ | 5.2 |
| CaO | 60.5 |
| MgO | 1-3 |
| So3 | 1.6 |
| Insoluble residue | 1.9 |
| Loss on ignition | 2.8 |
| Lime saturated factor | 0.65 |

**Table- 2 Physical properties of cement**

| S.No | properties | Values |
|---|---|---|
| **1** | Fineness | 4% |
| **2** | Specific gravity | 3.15 |
| **3** | Initial Setting Time | 105min |
| **4** | Final Setting Time | 375min |
| **5** | Standard Consistency | 30% |

## 3. Experimental Details

### 3.1. Mixing Proportioning

Coarse aggregates of size 20 and 10 mm of quartzite origin were used in the ratio of 1.78:1 to satisfy the overall grading requirement of coarse aggregate .(6-7) Land quarried sand passing through ASTM sieve No. (4.57mm) conforming to zone II classification of ACI method was used as fine aggregate. The sand has a fineness modulus of 2.5. Tap water was used for the preparation of specimens. All the concrete mixes were designed for similar workability with slump of 30-60 mm. The water was kept constant to 230Kg/m3 for the desired slump in all the mixes to have similar workability. The water – cement ratio (w/C) used to be 0.45. The fresh density of concrete was then obtained as per guidelines specified by the British method of mix selection to be 2380Kg/m3.Mix design as shown in Table -3

**Table-3 concrete mixing proportions**

| Water(Kg/m3) | Cement(Kg/m3) | Concrete mix proportions water-cement Ratio (w/c) | Fine Aggregate(Kg/m 3) | Coarse Aggregate(Kg/m3) |
|---|---|---|---|---|
| 230 | 511 | 0.45 | 623 | 1016 |

### 3.2. Preparation of concrete specimens

Concrete cubes of size 150 x150 x 150 mm, were cast for compressive strength tests and Cylinders, 100 x 300 mm, were cast for splitting tensile strength test and to determine the flexural strength, 100 x 100 x 500 mm prisms were cast. All specimens were remolded 24 hours after casting, and then cured for 28 days

## 4. Results and Discussion

The experiment was conducted to find the difference in increased compressive strength and split tensile strength; when Neem gum is replaced with fine aggregate. The tests were conducted on 7th, 14th and 28th days. (8-10)

### 4.1. Compressive strength

The compressive strength of concrete is one of the most important properties of concrete. Comparative strength if M43 grade of concrete for the full replacement of sand by crushing was found. In this test 150x150x150mm concrete cubes were cast, by using 43 Mpa concrete. The compressive strength of concrete cubes with 0.1%, 0.2%, 0.4%, 0.6%, 0.8%, 1.0%, 1.2% &1. 5% replacement with steel slag aggregate were determined The mixing was done by cubes were remolded and placed under water and cured for 28 days. Then the cubes were tested for their crushing strength at 7, 14 and 28 days.

**Table. 4 Compressive strength for concrete**

| S.No | Percentage of Neem Gum | 7 days in Compressive strength in Mpa | 14 days in Compressive strength in Mpa | 28 days in Compressive strength in Mpa |
|---|---|---|---|---|
| 1 | 0.10% | 40.23 | 46.48 | 52.6 |
| 2 | 0.20% | 43.58 | 48.52 | 58.1 |
| 3 | 0.40% | 47.77 | 55.03 | 61.99 |
| 4 | 0.60% | 53.93 | 61.81 | 64.92 |
| 5 | 0.80% | 57.68 | 60.46 | 66.74 |
| 6 | 1.00% | 59.66 | 65.25 | 70 |
| 7 | 1.20% | 62.74 | 68.51 | 72.84 |
| 8 | 1.50% | 58.77 | 64.89 | 70.43 |

The result of the compressive strength test indicated that the additions of neem gum increased the compressive strength of concrete when compared to the control specimen. These results show that there was an increase of 40.23 to 72.84 Mpa in the strength of concrete by adding name gumwithin the exposure period of 7 to 28 days

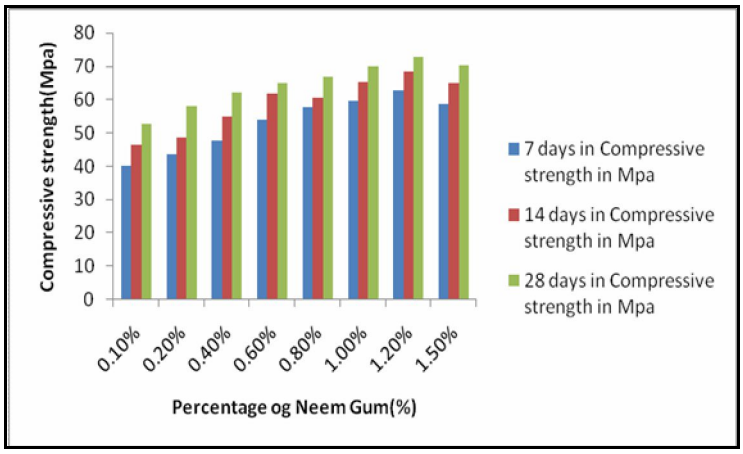


**Figure 4 Comparisons of Compressive strength in Concrete**

### 4.2. Split Tensile Strength

The tensile strength of concrete was obtained indirectly by split tensile test, where the compressive line loads were applied along the opposite generators of a concrete cylinder placed with its horizontal axis between the platens of compressive testing machine. Due to such applied line load, a fairly uniform tensile stress is induced over nearly two-third of the loaded diameter . The stress induced will split the cylinder vertically into two halves. The magnitude of tensile strength was calculated using the Equation 1.

$\Sigma_{Sp} = 2P/\square DL$ ---------- (1)
$\Sigma_{Sp}$= split test strength of concrete in N/mm2
P = crushing load in N
D = diameter of the cylinder in mm
L = length of the cylinder in mm

The concrete with sodium Neem gum admixture revealed an increase in splitting tensile strength by about 0.1% to 1.5% of concrete specimens of admixture by weight of cement respectively.

**Table 5 Split Tensile Strength of Concrete**

| S.No | Percentage of Neem Gum | 7 days in Compressive strength in Mpa | 14 days in Compressive strength in Mpa | 28 days in Compressive strength in Mpa |
|---|---|---|---|---|
| 1 | 0.10% | 40.23 | 46.48 | 52.6 |
| 2 | 0.20% | 43.58 | 48.52 | 58.1 |
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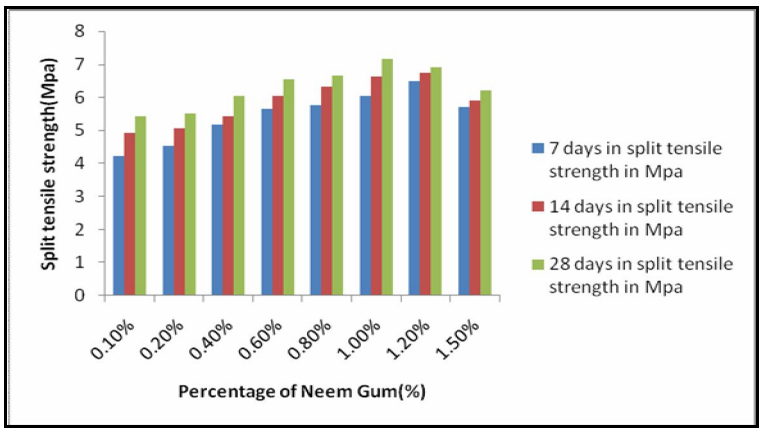


**Figure 5 Comparison of Split Tensile Strength in Concrete**

### 4.3. Flexural strength test:

The flexural strength test was conducted on beam specimens by manual flexural strength testing machine. The beams were tested on 7, 14, 28 days after curing in fresh water at 27°C. The variation of flexural strength with different percentage of replacement of cement by different admixtures. The value of flexural strength for different level of replacement of cement is given in table and the graphs are given in Figure 6 is respectively.

**Table 6 Flexural Strength in Concrete**

| S.No | Percentage of Neem Gum | 7 days in Compressive strength in Mpa | 14 days in Compressive strength in Mpa | 28 days in Compressive strength in Mpa |
|---|---|---|---|---|
| 1 | 0.10% | 40.23 | 46.48 | 52.6 |
| 2 | 0.20% | 43.58 | 48.52 | 58.1 |
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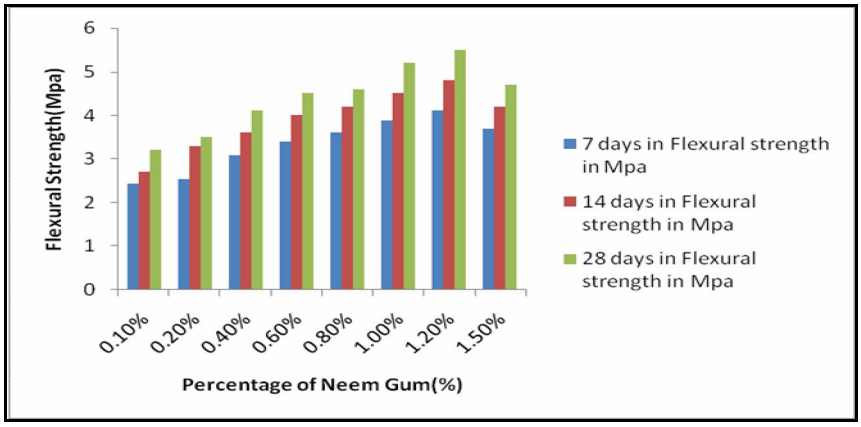


**Figure 6 Comparison of Flexural Strength in Concrete**

## 5. Conclusion

By the above testing results following conclusions are made:

1. The influence of high strength Neem Gum performances has been verified, by using the slump flow, U-tube tests and other tests on fresh concrete achieved consistently.
2. Neem Gum offers compressive strength significantly greater than normal concrete.
3. By varying the Neem Gum content as 0.1% to 1.5% the optimum amount of Neem Gum was found as 1.2% by tests at the age of 7& 28 days.
4. When 1.5% Neem Gum is added the Strength properties suddenly decreases.

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