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CHLORIDE PENETRATION ON GROUND NUT SHELL ASH CONCRETE UNDER ACIDIC ENVIRONMENT

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ABSTRACT

Groundnut shell ash is one of the important pozzolanic materials containing that can be mixed with ordinary Portland cement for the manufactured of long durable and good valuable product. The present experimental evaluation is rapid chloride permeability test (RCPT). The effect of hydrochloric acid (HCL) on properties of replaced ground nut shell ash concrete is taken as research area. However at 20% replacement level of ground nutshell ash more resistance to 3% Hydrochloric acid attack.

Key words

Ground nut shell ash, compressive strength, rapid chloride permeability, deterioration

1. INTRODUCTION

The deterioration of concrete is the primary source of cement industries to release CO_2 level approximate 5% of the global CO_2emission. Concrete durability is defined as ability to resist the good performance of various exposure conditions for with stand over an intention period with minimum cost of maintenance. In this problem related embedded steel corrosion change the size and shape of concrete structures, cracking, carbonated, scaling and spalling of concrete. Utilisation of various cement supplementary materials has become a common used in the civil construction field in these cement supplementary materials are various industries and agricultural by products of waste. Fly ash, Bagasse ash, rice husk ash, silica fume and blast furnace slag can be sited as an example. Ground nut shell ash has also been used as such pozzolanic property. Egbe –Ngu Ntui Ogork et-al(2014) in their research a study on ground nut husk ash concrete under acid attack, experimental investigated the partial replacement with ground nut husk ash 0%,5%,10%,15%,20%,30% and 40% on M_{20} grade of concrete. The strength at the age of 3, 7, 28, 60 and 90 days were obtained and compared to the conventional concrete. After the durability study of 28 and 90 days immersion of 20 days cured concrete specimens in 10% diluted $H2SO_4$ and HNO_3showed that losses in mass are 16.3% and 17.3%respectively the study concluded that the compressive strength of concrete (decreased with increase in GNHA content) were attained in the range of 10% replacement level and more over good resistance in H_2SO_4environment.

The present experimental research, ground nut shell ash was mixed with OPC at different percentage by replacement method and practically analysis of the deterioration resistance characters has been made in addition strength and durability properties of acidic environment and the experimental results were compared with normal ordinary Portland cement concrete.

2. MATERIALS & EXPERIMENTAL PROCEDURE

Ordinary Portland cement 43 grade confirming to Indian standard IS 8112-1989 used for this research as shown in table – 1 [1]. Fine aggregate from locally available river graded 1.18 sieve passing with fineness modulus 3.7 and specific gravity of 2.62 was used as a fine aggregate confirming to IS - 383 – 1970[5]. Coarse aggregates are available hard granite Brocken stone 20 mm passing and 12.5 mm retained on sieve with fineness modulus 5.51 and specific gravity 2.76 as per IS383 – 1970 [5]. GNSA – The ground nut shell ash collected from peanut industries at kovilpatty, Tamil Nadu, India. It was further burnt 700^{o}c for 1hr under controlled conditions to removal of excess carbon and making fine powder. The properties of GNSA as shown in given table (1).

Table-1 Chemical analysis and physical properties ordinary Portland cement and GNSA

Details	OPC	Ground nut shell ash
Fineness (retained on 90 µm sieve)	6.25	1.2
Normal consistency	27%	-
Initial setting time (min)	45	-
Final setting time (min)	420	-
Specific gravity	3.05	2.84
SiO_2	22.8	34.36
$Fe_2 O_3$	4.5	4.76
$Al_2 O_3$	6.08	12.73

Ca O	56.9	15.8
Mg O	5.6	4.86
SO_3	2.1	5.86
K_2O	0.83	1.53
Loss on ignition (950ºC)	2.4	0.704

2.1 SEM analysis for Cement & Ground Nut Shell Ash

Fig -1a and Fig -1b describes the scanning electron micro graph of cement and ground nut shell ash calcined at 800°C and 900°C. The black flack appears for un burned carbon and the whitish appears indicate for silica .The unburned carbon combusted and white silica aggregate are disappear in ground nut shell ash calcined at 800°C to affected the structure of silica grains particles.

Fig. (1a) SEM Image of Cement

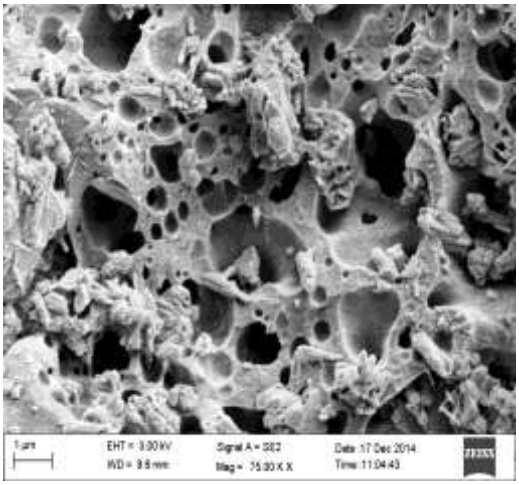
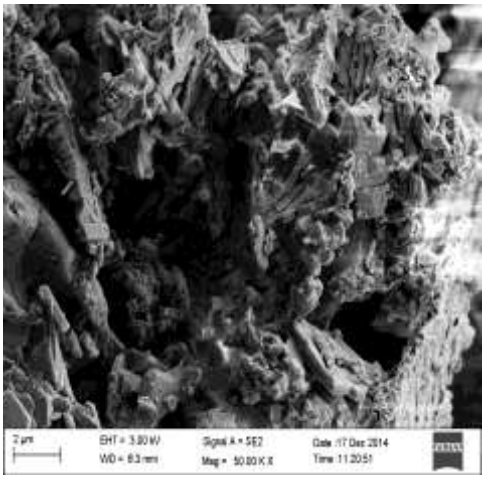


Fig. (1b) SEM Image of Ground Nut Shell Ash



2.2 MIX DESIGN AND MIX PROPORTION

The concrete mix design conforming to IS 10262 – 2009 performed for M20 grade of concrete for reference mix and the cement is replaced with ground nut shell ash in 5% interval upto 30%.

3. METHODOLOGY

Water absorption test according to ASTM C 642 – 972 is performed and Rapid chloride penetration test (RCPT) performed as per ASTM C1202- 94.

4. RESULTS AND DISCUSSION

4.1 WATER ABSORPTION AND COEFFICIENT OF WATER ABSORPTION TEST

As per ASTM C 642-972 the triplicate concrete specimen size 80mm diameter and 50mm thick used for water absorption and coefficient of water absorption with and without ground nut shell ash (GNSA) in different replacement level like 0,5%,10%,15%,20% and 25% in casted after 28 days water curing the concrete specimens are taken in to dried up in 24 hours for open atmosphere . After drying the concrete specimens were immersed in 3% hydro chloric acid solution for 365 days. Over the period of acid curing the test specimens are oven dried in to 24 hrs at the temperature 105 ºc ± 5 ºc .The average test values were recorded for water absorption and coefficient of water absorption are calculated as bellows.

% of water absorption = $[(W_2- W_1)/ W_1] X 100$

Where, W_1=oven dry weight of cubes in grams; W_2= after 24 hours wet weight of cubes in grams

Table - 2 Water absorption and coefficient water absorption

Sl. No.	GNSA replacement in %	Saturated water absorption in %		coefficient of water absorption (m^2/sec)	
		28 days	365 days	28 days	365 days
GS1	0%(control)	3.14	3.87	$1.49X10^{-11}$	$2.23X10^{-11}$

GS2	5%	2.82	3.68	$1.18X10^{-11}$	$2.03X10^{-11}$
GS3	10%	2.63	3.51	$1.03X10^{-11}$	$1.84X10^{-11}$
GS4	15%	2.45	3.33	$0.90X10^{-11}$	$1.66X10^{-11}$
GS5	20%	2.28	3.14	$0.78X10^{-11}$	$1.49X10^{-11}$
GS6	25%	1.98	2.97	$0.56X10^{-11}$	$1.33X10^{-11}$
GS7	30%	3.52	3.85	$1.84X10^{-11}$	$2.23X10^{-11}$

From the table 2 shows that coefficient of water absorption of conventional concrete (OPC) and various percentage replacement level of GNSA concrete after 28 and 365 days. In this experimental value obtained that the coefficient of water absorption of ground nut shell ash replaced concrete at 25% replacement level is found to be lesser value when compared to conventional concrete. The coefficient of water absorption percentage value will be reduced after 28 days and 365 days (62% and 42%).

5. Rapid chloride permeability test

As per ASTM C1202- 94. The test was carried out the triplicate concrete specimen of size 100 mm diameter and 50 mm thickness with mix ratio 1:1.44:3.16 with water binder ratio 0.5.The cement concrete specimen with OPC concrete (conventional) and ordinary Portland cement replaced by ground nut shell ash (GNSA) in different replacement level like 0,5%,10%,15%,20% and 25% in casted. In fabrication of concrete cubes were mechanically vibrated. After 24 hours, the demoulding of cubes to immerse water curing for 28 days. After that the concrete specimens for taken out and dried into 24 hours open atmosphere. After drying the concrete specimens were immersed in to 3%HCL solution for 365 days. In this test two halves of the concrete specimens are sealed with plastic container of 110mm .one portion of the container is filled with 3% sodium chloride solution (Nacl) the another portion of the container is filled with 0.3N NaOH solution .The test cell was connected for Nacl in negative charge and NaOH in positive charge of 60 V power supply. The potential of current is measured at every 30 minutes interval up to 6 hours. During the period the temperature of the solution was maintained and monitored. In this experimental results using current and time interval chloride penetration is calculated in terms of charges of the Columbus at the 6 hours duration period[3].

Fig 6 Rapid chloride permeability setup

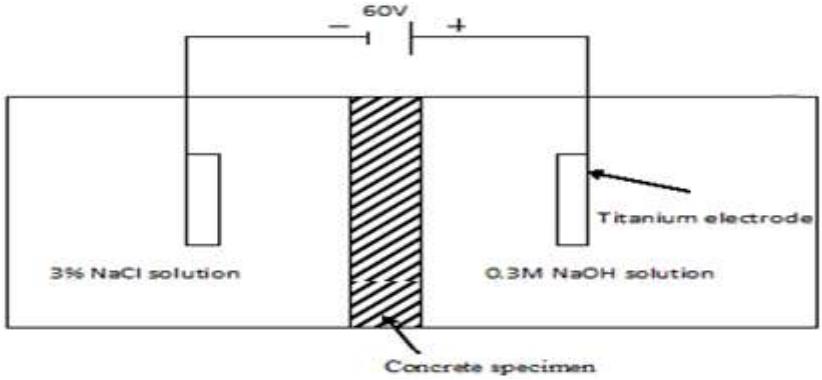


Table –3 Rapid chloride permeability test of GNSA partial replacement concrete after 28,180 and 365 days HCL 3% solution curing

Sl.No.	Replacement of cement in %	Total charge passed in coulombs		
		28 days	180 days	365 days
P1	0%(control)	2810	2600	2430
P2	5%	2595	2320	2200
P3	10%	2180	2110	2010
P4	15%	1940	1890	1806
P5	20%	1800	1745	1700
P6	25%	2020	2102	2182
P7	30%	2500	2415	2605

From the table 3 the chloride ion penetration test result of ground nut shell ash in different replacement level increases the electrical charged passed reduces. The replacement of GNSA was drastically decreased Coulombs values. At the replacement up to 25% of GNSA and 30% GNSA there is an increase the value is increases but compared to lower of control concrete value .In this experimental observation true for 28, 180 and 365 days concrete cured specimens. In this result indicated that permeability of chloride ion is considerably reduced by partial replacement of cement with GNSA. The total electrical charged value for 20% of GNSA mixing concrete considerably lower for 28,180 and 365 days (30%) cured concrete.

5. Conclusion:

From the experimental research, it can be obtained that including of ground nut shell ash up to 20% replacement reduces the water absorption, co efficient of water absorption chloride ion penetration and improved the strength and deterioration resistance characters. From this research concluded that the cement replacement level of GNSA is up to 20% recommended.

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