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"PARTIAL REPLACEMENT OF COARSE AGGREGATES IN CONCRETE WITH LIGHTNING INSULATORS"

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ABSTRACT: The project aims to partially replace the coarse Aggregate which is going rare these days with Lightning Insulators which is discarded in landfills and are not environmentally friendly either. A lightning arrester is a device used on electrical power systems and telecommunications systems to protect the insulation and conductors of the system from the damaging effects of lightning. The typical lightning arrester has a high-voltage terminal and a ground terminal. When a lightning surge (or switching surge, which is very similar) travels along the power line to the arrester, the current from the surge is diverted through the arrestor, in most cases to earth. If protection fails or is absent, lightning that strikes the electrical system introduces thousands of kilovolts that may damage the transmission lines, and can also cause severe damage to transformers and other electrical or electronic devices. Lightning-produced extreme voltage spikes in incoming power lines can damage electrical home appliances or even produce death. These insulators thus represent a residue from electric poles. These insulators after used, are waste for the environment and so recycling or locking up of this waste is very crucial from the environmental point of view too. The main advantage of this type of concrete over the conventional ones is the reduction in the quantity of coarse aggregates and thus to minimise the initial cost. The results of this study indicate that the Lightning Insulators can be used as an ingredient in the range of certain limits to improve expanded concrete. As a result, it can be said that the usage of the arrestors in concrete, decreases its detrimental environmental effect. Moreover, the insulators have some beneficial effect on concrete properties. Therefore, the results of this investigation result into lots of benefits for industrial growths in eco-friendly way.

Key Words: compressive strength, insulators, coarse aggregate, water, cement,

1.INTRODUCTION:

In its simplest form, concrete is a mixture of paste and aggregates, or rocks. The paste, composed of Portland cement and water, coats the surface of the fine (small) and coarse (larger) aggregates which hardens over time. Mostly used concrete is the lime-based concrete which is the Portland cement concrete. In Portland cement concrete (and other hydraulic cement concretes), when the aggregate is mixed together with the dry cement and water, they form a fluid mass that is easily molded into shape. The cement reacts chemically with the water and other ingredients to form a hard matrix which binds all the materials together into a durable stone-like material that has many uses. Often, additives (such as pozzolans or super-plasticizers) are included in the mixture to improve the physical properties of the wet mix or the finished material. Most concrete is poured with reinforcing materials (such as rebar) embedded to provide tensile strength, yielding reinforced concrete. Concrete has relatively high compressive strength, but much lower tensile strength. For this reason it is usually reinforced with materials that are strong in tension (often steel). The elasticity of concrete is relatively constant at low stress levels but starts decreasing at higher stress levels as matrix cracking develops. Concrete has a very low coefficient of thermal expansion and shrinks as it matures. All concrete structures crack to some extent, due to shrinkage and tension. Concrete that is subjected to long-duration forces is prone to creep. Different mixes of concrete ingredients produce different strengths. Concrete strength values are usually specified as the compressive strength of either a cylindrical or cubic specimen, where these values usually differ by around 20% for the same concrete mix.

1.2 COMPOSITION OF CONCRETE

There are many types of concrete available, created by varying the proportions of the main ingredients. In this way or by substitution for the cementious and aggregate phases, the finished product can be tailored to its application with varying strength, density, or chemical and thermal resistance properties. Aggregate consists of large chunks of material in a concrete mix, generally a coarse gravel or crushed rocks such as limestone, or granite, along with finer materials such as sand.

Cement, most commonly Portland cement, is associated with the general term "concrete." A range of materials can be used as the cement in concrete. One of the most familiar of these alternative cements is asphalt concrete. Other cementitious materials such as fly ash and slag cement, are sometimes added as mineral admixtures either pre-blended with the cement or directly as a concrete component and become a part of the binder for the aggregate.

To produce concrete from most cements (excluding asphalt), water is mixed with the dry powder and aggregate, which produces a semi-liquid that workers can shape, typically by pouring it into a form. The concrete solidifies and hardens through a chemical process called hydration. The water reacts with the cement, which bonds the other components together, creating a robust stone-like material.

On a human timescale, small usages of concrete go back for thousands of years. Concrete-like materials were used since 6500 BC by the Nabataea traders or Bedouins who occupied and controlled a series of oases and developed a small empire in the regions of southern Syria and northern Jordan. They discovered the advantages of hydraulic lime, with some self-cementing properties, by 700 BC.

Fineness test

S. no	Wt of cement (g)	Wt of 90 micron sieve	Wt of sieve + cement	Wt of cement retained	% of cement retained
1.	300	270	290	20	6.66
2.	300	270	280	10	3.33
3.	300	270	270.057	0.57	0.19

For 300gms of cement the fineness of cement is 3.39%
A lightning arrester is a device used on electrical power systems and telecommunications systems to protect the insulation and conductors of the system from the damaging effects of lightning. These prevent the flow of the normal power or signal currents to ground, but provide a path over which high-voltage lightning current flows, bypassing the connected equipment. Their purpose is to limit the rise in voltage when a communications or power line is struck by lightning or is near to a lightning strike.

If protection fails or is absent, the lightning that strikes the electrical system introduces thousands of kilovolts that may damage the transmission lines, and can also cause severe damage to transformers and other electrical or electronic devices. Lightning-produced extreme voltage spikes in incoming power lines can damage electrical home appliances or even produce death.

1) Lightning Insulators are Ceramic. Lightning insulators are made from glass, porcelain or composite polymer materials and are covered with a smooth glaze to shed water. The Insulators represent a residue from electrical poles. For the purposes of the project we have used Silicon Nitride (Si_3N_4) Insulators.

2) Si_3N_4 has the strongest covalent bond properties next to silicon carbide it is used as a high-temperature structural ceramic due to its superior heat resistance, strength and hardness. It also offers excellent wear and corrosion resistance. Various types are available (sintered, CVD, HP), and they are used for different purposes. Main applications include heat exchangers, rotors, nozzles, bearings, valves, chemical plant parts, engine components and armour.

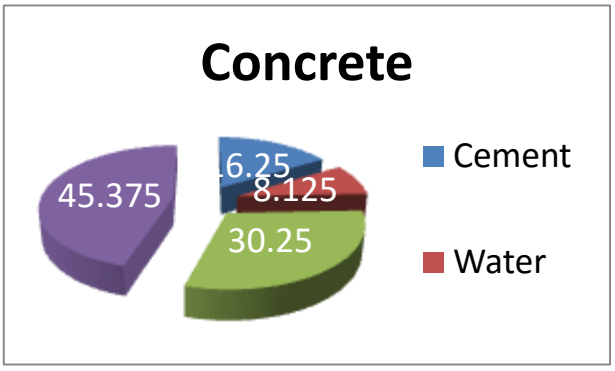
A Few properties of Lightning Insulators

3) Properties	4) Units	5) Test	6) Value
7) PHYSICAL			
8) Chemical Formula			11) Si_3N_4
12) Density	13) Kg/m 3	14) AST M C 20	15) 3310
16) Crystal Structure			19) Hexagonal (alpha & beta)
20) Water Absorption		22) AST M C 373	23) 0
24) MECHANICAL			
25) Compressive Strength	26) MPa	27) AST M C 773	28) 689-2760
29) Young's Modulus	30) GPa	31) AST M C 848	32) 317

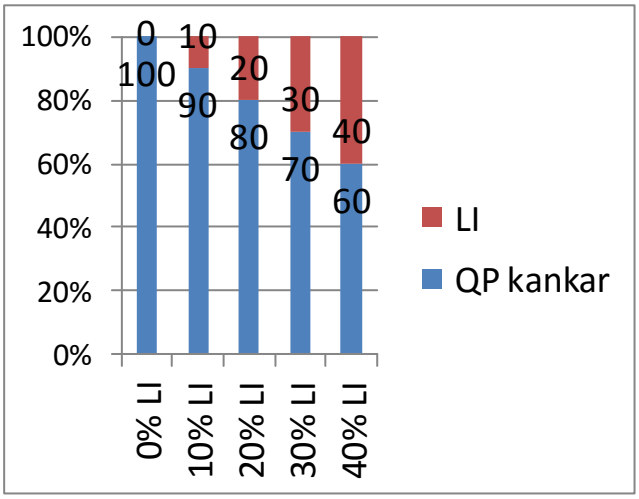
IDEA TO USE INSULATORS IN CONCRETE

Aggregates are the most mined materials in the world and are used in the production of concrete as the coarse aggregates to provide strength. Being the main ingredient of the concrete all over the world, there is a need in production of high amounts of kankar (Coarse Aggregate) which may lead to the extinction of the same. As, So a replacement of kankar in concrete the lightning insulators which are no less in strength than kankar are used to check the various properties of the obtained concrete. And they became as a perfect replacement, if needed in the production of the concrete. The results of this produced concrete are studied thereafter.

33) The main advantage of this type of concrete over the conventional ones is the reduction in the quantity of coarse aggregates and thus to minimise the initial cost. These insulators, after used are waste for the environment and so recycling or locking up of this waste is very crucial from the environmental point of view too.



LIGHTNING INSULATOR CONTENT IN COARSE AGGREGATES



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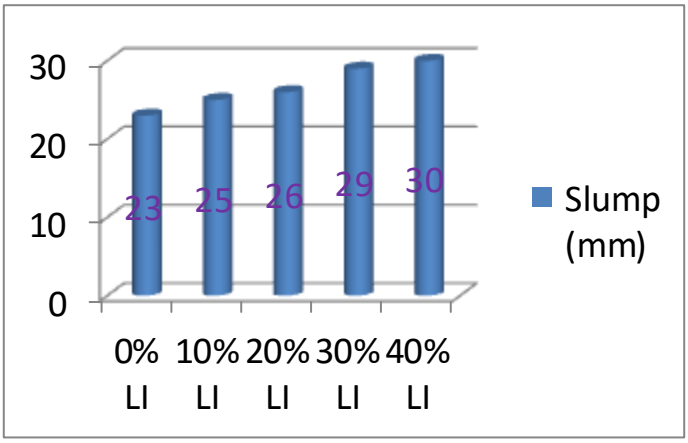
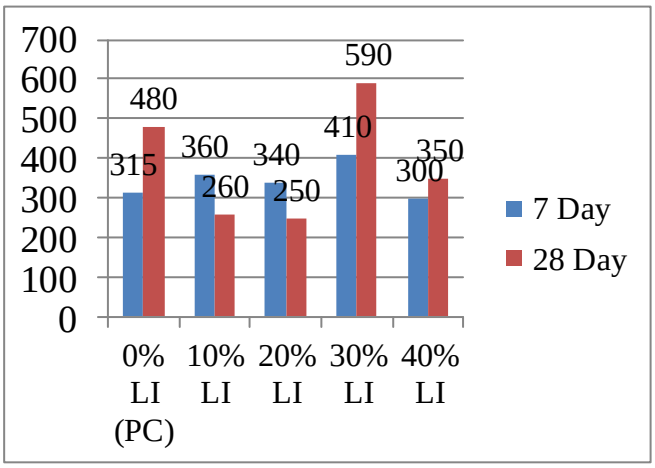
SLUMP TEST RESULTS



COMPRESSIVE STRENGTH

Mix ID	LI (%)	Compressive Strength (MPa)	
		7 Days	28 Days
LI0	0	315	480
LI10	10	360	260
LI20	20	340	230
LI30	30	410	590
LI40	40	300	330

RELATION BETWEEN COMPRESSIVE STRENGTH AND THE INSULATOR CONTENT



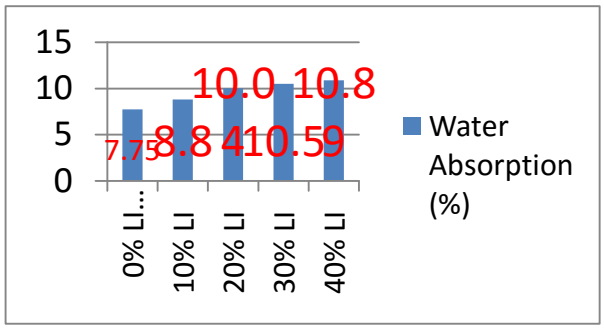
Permeability test

The permeability properties of concrete samples were evaluated by measuring the water absorption capacity

WATER ABSORPTION RESULTS

Mix ID	Mix Design Label	W/CM	Water Absorption(%)
1	LI0	0.50	7.75
2	LI10	0.50	8.8
3	LI20	0.50	10.04
4	LI30	0.50	10.5
5	LI40	0.50	10.89

RELATION BETWEEN WATER ABSORPTION AND INSULATOR CONTENT



3. CONCLUSIONS

In this project, the objective was to investigate the mechanical and chemical behavior of new concrete type obtained by adding lightning insulators. The main tasks performed during the project can be listed as the tests on lightning arrestors, determination of the properties of fresh and hardened insulator added concrete. The following conclusions were drawn as a result of this experimental program. The compressive strength value and permeability properties of concrete increases with increasing lightning arrestors content. Curing effect on the strength gain of insulator added Concrete should be further studied.

- The new insulated Concrete has relatively high compressive strength.
- The density of concrete varies, but is around 2,400 kilograms per cubic metre (150 lb/cu ft).
- The ultimate strength of concrete is influenced by the water-cementitious ratio *(w/cm)*, the design constituents, and the mixing, placement and curing methods employed.
- Compressive strength is widely used for specification requirement and quality control of concrete.
- Compressive strength is widely used for specification requirement and quality control of concrete.
- Strength gain depends on the type of mixture, its constituents, the use of standard curing, proper testing by certified technicians, and care of cubes in transport, if necessary.

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