# A Composition of Castable and Curable Magnetic Cement and a Process for Making It in Indian Road

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## ABSTRACT

A castable and curable magnetic cement composition with strong magnetic characteristics is the subject of the current research invention. The mechanical and magnetic properties of cement were improved by the addition of magnetic particles. An aluminosilicate particle in the range of 32-46%, a cement particle in the range of 0.00272 vm, a magnetic or magnetizable particle in the range of 32-96%, a binding modifier in the range of; and v) a surface-active dispersing agent in the range of 0.1-4% by weight are all components of the castable and curable magnetic cement composition. The stages involved in creating the cement composition are as follows: i) homogenising the mixture by combining the particles with a dispersion agent; and ii) adding a silica-bearing additive.

**Key word: - Concrete, Magnet, Cement, Magment, mechanical and magnetic properties.**

## BACKGROUND

Research involves slabs made with magnetizable concrete instead of just the plain concrete that we all know. There's an embedded coil, and we circulate a high-frequency current, and we generate a magnetic field. That field is then picked up by a compatible coil on an electric vehicle—so that vehicle's retrofitted with a coil and converts it back to electricity and that can power the motor directly or charge the battery … The goal is to bring the charge to the vehicles, rather than the vehicle stopping at charging stations.

In this research we can reduce the size of the battery, and that will immediately reduce the cost, which is very important—both for private and also commercial vehicles. But specifically for commercial vehicles, smaller batteries will help them carry more cargo— so, that means more revenue. And if we end up building this electrified roadway infrastructure that is shared among all vehicle classes, that would really benefit electrified long-haul trucking and will bring additional benefits in terms of economic development, quality reductions, and so forth."

We already have initial results on the financial feasibility of this technology that I know a lot of people have been asking about. Our results indicate that, long term, the investment is feasible both for public and private owners and operators—direct benefits to both. But also, indirect benefits to the broader economy and society; communities benefiting by reduced pollution; improved quality of life; and economic development, especially for rural and underserved areas.

Cement is one of the most frequently utilized building materials. Because of the growing need for functional structures, the functional qualities of certain building materials have gained more attention. Cement's useful characteristics can be achieved by including appropriate fillers into cement-matrix composites. Sensing (strain, damage, temperature), thermal control, vibration reduction, electromagnetic shielding, and 10 energy harvesting are some of the applications of functionalized cement composites. Water plays an important role in achieving the desired cement characteristics. Water regulates the cement hydration process. The use of magnetic fluids allows the fluid ions to swiftly reach the cement pieces, allowing for a more complete hydration cycle and boosting the hydraulic strength of the concrete. Such outcomes can be substantially 15 influenced by the strength of the magnetic field. The induced hydration processes driven by the mixing water are crucial to achieving design strength. The reaction of cement compounds with water produces heat. Concrete is typically made with drinkable water. The annual usage of concrete reaches one billion tones. Furthermore, concrete mixes including magnetized water lower cement content by about 5%. They have 45%greater slump values and 18 % higher compression strengths than control concrete. A recent study considers substituting cement, M-sand, and aggregates with industrial byproducts. Few researchers attempted to substitute potable water in concrete with magnetic water. Water can be magnetized under the correct conditions by passing it through a magnetic field formed by an everlasting magnet of a certain size. The features of the

elements in concrete mix compositions, for the most part, have a strong association with concrete fracture parameters. In fact, water is one of several components that cause significant changes in the properties of concrete. Moreover, the findings demonstrated that the magnetizing period and the strength of the magnetic field influenced the structural build-up of the cementite paste. When continuous magnetic fields were applied, the liquid-like behavior changed quickly, followed by the solid-like qualities changing. The unexpected increase in magnetic fields, as well as the sudden reduction in magnetic fields, resulted in a large decline in data modules. The steady increasing magnetic field caused a modest increase in storage modulus and more fluid-like behavior. The systemic build-up was improved after the magnetic field was linearly reduced from 0.5 T to approximately 0.25 T. In the 1980s, several researchers had discovered a link between increased magnetic susceptibility and heavy metal content in a variety of circumstances. The study discovered a linear relationship between the concentration of magnetic particles in urban dust and the concentration of metals such as Pb, Cu, Zn, and Cd. Furthermore, the use of discarded plastics in road construction is a relatively new concept, and no highways have been built solely from plastics. However, according to one review, recycled plastic can either replace aggregates or act as a binder modifier. Waste plastic has the potential to be used in bituminous road construction because its addition in small doses (about 5-10% by weight of bitumen) significantly improves the stability, strength, fatigue life, and other desirable properties of bituminous mixes, resulting in improved pavement longevity and performance.

Several studies investigated and reported on the applicability of magnetic water and its influence on concrete attributes such as workability, strength, durability, and porosity. Curing using magnetic water has also been investigated. However, depending on the physiochemical properties of the water and the strength of the magnetic field under certain situations, the properties of magnetic water have differed slightly, resulting in undesired cracks when applied with cement composition.In order to overcome the aforementioned drawbacks, there is a need in the art to provide a cement composition that incorporates magnetic particles to enhance workability as well as reduce cracks.

**OBJECTS OF THE INVENTION**

The principal object of the present invention is to overcome the disadvantages of the prior art.

An object of the present invention is to provide a magnetic cement composition to provide a road having vehicle charging capability. Another object of the present invention is to provide a cement composition having increased compressive strength and workability. Another object of the present invention is to reduce the dosage of super plasticizer, thereby increasing the required strength and durability When water is magnetized, its surface tension decreases and its flowability increases. Magnetized water has few physical differences when it reaches magnetic strength, but when exposed to a magnetic field, it undergoes a dramatic shift in water properties. Another object of the present invention is the cement composition employing waste plastic, indicating to be environmentally friendly. The foregoing and other objects of the present invention will become readily apparent upon further review of the following detailed description of the embodiments as illustrated in the accompanying drawings.

**SUMMARY OF THE INVENTION**

The present invention relates to the fabrication of cobalt magnets using a cementitious route to provide concrete with better compressive strength and durability. According to an embodiment of the present invention, a castable and curable magnetic cement composition, comprising, i) magnetic or magnetizable particle in the range of 32% to 96%, ii) cement particles in the range of 0.0027 to 2 vm; iii) aluminosilicate particle in the range of 32% to 46%; iv) a binding modifier in the range of 20% to 30%; and v) a surface-active dispersing agent in the range of 0.1% to 4% by weight. The magnetic particle is more preferably samarium cobalt. The aluminosilicate particle is admixtures of iron, sodium, potassium, and magnesium. The surface active dispersing agent is selected from a group which includes but not limited to sodium stearate, 4-(5-dodecyl) benzenesulfonate, dioctyl sodium sulfosuccinate and alike. According to another embodiment of the present invention, the method for

preparing the cement composition comprises the following steps, i) mixing the particles with dispersing agent to obtain a homogeneous mixture; and ii) blending the mixture with silica-bearing additive, followed by addition of potable water to obtain the cement composition. The silica-bearing additive contains quartz sand and waste silica. While the invention has been described and shown with particular reference to the preferred embodiment, it will be apparent that variations might be possible that would fall within the scope of the present invention.

**BRIEF DESCRIPTION OF DRAWINGS**

So that the manner in which the above-recited features of the present invention can be understood in detail, a more particular description of the invention, briefly summarized above, may have been referred by embodiments, some of which are illustrated in the appended drawings. It is to be noted, however, that the appended drawings illustrate only typical embodiments of this invention and are therefore not to be considered limiting of its scope, for the invention may admit to other equally effective embodiments. These and other features, benefits, and advantages of the present invention will become apparent by reference to the following text figure, with like reference numbers referring to like structures across the views, wherein:

Fig. 1 illustrates a saturation magnetization of the four sections after rheological test;

Fig. 2 illustrates a saturation magnetization of cementitious composition in parallel plate after constant shearing at (a) 40 $s^{-1}$ and (b) 240 $s^{-1}$

**DETAILED DESCRIPTION OF THE INVENTION**

While the present invention is described herein by way of example using embodiments and illustrative drawings, those skilled in the art will recognize that the invention is not limited to the embodiments of drawing or drawings described and are not intended to represent the scale of the various components. Further, some components that may form a part of the invention may not be illustrated in certain figures, for ease of illustration, and such omissions do not limit the embodiments outlined in any way. It should be understood that the drawings and the detailed description thereto are not intended to limit the invention to the particular form disclosed, but on the contrary, the invention is to cover all modifications, equivalents, and alternatives falling within the scope of the present invention as defined by the appended claim. As used throughout this description, the word "may" be used in a permissive sense (i.e., meaning having the potential to), rather than the mandatory sense, (i.e., meaning must). Further, the words "a" or "an" mean "at least one" and the word "plurality" means "one or more" unless otherwise mentioned. Furthermore, the terminology and phraseology used herein are solely used for descriptive purposes and should not be construed as limiting in scope. Language such as "including," "comprising," "having," "containing," or "involving," and variations thereof, is intended to be broad and encompass the subject matter listed thereafter, equivalents, and additional subject matter not recited, and is not intended to exclude other additives, components, integers, or steps. Likewise, the term "comprising" is considered synonymous with the terms "including" or "containing" for applicable legal purposes. Any discussion of documents, acts, materials, devices, articles, and the like are included in the specification solely for the purpose of providing a context for the present invention. It is not suggested or represented that any or all these matters form part of the prior art base or were common general knowledge in the field relevant to the present invention.

In this disclosure, whenever a composition or an element or a group of elements is preceded with the transitional phrase "comprising", it is understood that we also contemplate the same composition, element, or group of elements with transitional phrases "consisting of", "consisting", "selected from the group of consisting of, "including", or "is" preceding the recitation of the composition, element or group of elements and vice versa.

The present invention is described hereinafter by various embodiments with reference to the accompanying drawing, wherein reference numerals used in the accompanying drawing correspond to the like elements throughout the description. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiment set forth herein. Rather, the embodiment is provided so that this disclosure will be thorough

and complete and will fully convey the scope of the invention to those skilled in the art. In the following detailed description, numeric values and ranges are provided for various aspects of the implementations described. These values and ranges are to be treated as examples only and are not intended to limit the scope of the claims. In addition, several materials are identified as suitable for various facets of the implementations. These materials are to be treated as exemplary and are not intended to limit the scope of the invention.

The present invention relates to magnetic cement composition comprising magnetic particles which impart strength and discarded plastic to improve resistance to deformation.

A castable and curable magnetic cement composition, comprising, i) magnetic or magnetizable particle in the range of 32% to 96%; ii) cement particles in the range of 0.0027 to 2vm; iii) aluminosilicate particle in the range of 32% to 46%; iv) a binding modifier in the range of 20% to 30%; and v) a surface-active dispersing agent in the range of 0.1% to 4% by weight.

Samarium cobalt is the magnetic particle employed in the composition. The addition of strong magnetic particles to cement mixtures increases the mechanical qualities of cement pastes. Magnetic cement (cementitious magnet) forms complicated structures of the samarium cobalt magnet using a simple and inexpensive cement method. The cement matrix contains a homogeneous distribution of samarium cobalt particles. The density and compressive strength of the magnetic cement composites rose as that the samarium cobalt concentration increased. Magnetization (stable for one year) rose with samarium cobalt powder

Herein, discarded plastic is used as a binding modifier. Utilizing waste plastic in bituminous mixes increases durability and resistance to deformation and waterinduced damage, which contributes to user satisfaction and accident reduction indirectly. The use of waste plastic into the bituminous mix reduces bitumen usage, resulting in cost savings. Using discarded plastic in road construction also helps to extend the life of the road.

Moreover, the aluminosilicate particles used herein are admixtures of iron, sodium, potassium, and magnesium. The surface-active dispersing agent is selected from a group which includes but not limited to sodium stearate, 4-(5-dodecyl) benzenesulfonate, dioctyl sodium sulfosuccinate and alike. The method for preparing the cement composition, comprises the steps, mixing the particles with dispersing agent to obtain a homogeneous mixture; and further, the mixture is blended with silicabearing additive containing quartz sand and waste silica, followed by addition of potable water to obtain said cement composition.

**EXAMPLE**

Different magnetic compositions i.e., M1, M2, M3 & M4 are prepared with variable amount of magnetic particle i.e., 80%, 68%, 56%, 42%. The magnetic properties of compositions i.e., M1, M2, M3 & M4 are analyzed using a vibrating sample magnetometer to confirm the mechanisms of migration of nanoparticles in cement paste under the synergistic influence of an external magnetic field and shearing.

Referring to figure 1, the saturation magnetization of the powder in M4 was substantially lower than that of the other sections, indicating that the paste disc in M4 contains the least amount of samarium cobalt particles. This could be because of M4's low magnetic flux density, low curvature, and high shear rate. M3 has a higher saturation magnetization than M1 and M2.

Referring to figure 2 a, b shows the saturation magnetization of cementitious compositions in four sections after 120 seconds of exposure to a constant shear rate of 40 $s^{-1}$ (low-rate) and 240 $s^{-1}$ (high-rate).

Further, while one or more operations have been described as being performed by or otherwise related to certain modules, devices or entities, the operations may be performed by or otherwise related to any module, device or entity. As such, any function or operation that has been described as being performed by a module could alternatively be performed by a different server, by the cloud computing platform, or a combination thereof.

Further, the operations need not be performed in the disclosed order, although in some examples, an order may be preferred. Also, not all functions need to be performed to achieve the desired advantages of the disclosed system and method, and therefore not all functions are required.

Various modifications to these embodiments are apparent to those skilled in the art from the description and the accompanying drawings. The principles associated with the various embodiments described herein may be applied to other embodiments. Therefore, the description is not intended to be limited to the 5 embodiments shown along with the accompanying drawings but is to be providing the broadest scope consistent with the principles and the novel and inventive features disclosed or suggested herein. Accordingly, the invention is anticipated to hold on to all other such alternatives, modifications, and variations that fall within the scope of the present invention and appended claims.

## Final Results :

**1)** A castable and curable magnetic cement composition, comprising:

**i)** magnetic or magnetizable particle in the range of 32% to 96%; **ii)** cement particles in the range of 0.0027to 2 vm; **iii)** aluminosilicate particle in the range of 32% to 46%; **iv)** a binding modifier in the range of 20% to 30%

; and **v)** a surface-active dispersing agent in the range of 0.1% to 4% by weight.

**2)** The composition as claimed in claim 1, wherein said magnetic particle is more preferably samarium cobalt.

**3)** The composition as claimed in claim 1, wherein said aluminosilicate particle is admixtures of iron, sodium, potassium, and magnesium.

**4)** The composition as claimed in claim 1, wherein said surface-active dispersing agent is selected from a group which includes but not limited to sodium stearate, 4(5-dodecyl) benzenesulfonate, dioctyl sodium sulfosuccinate and alike.

**5)** The composition as claimed in claim 1, wherein said binding modifier is more preferably plastic waste.

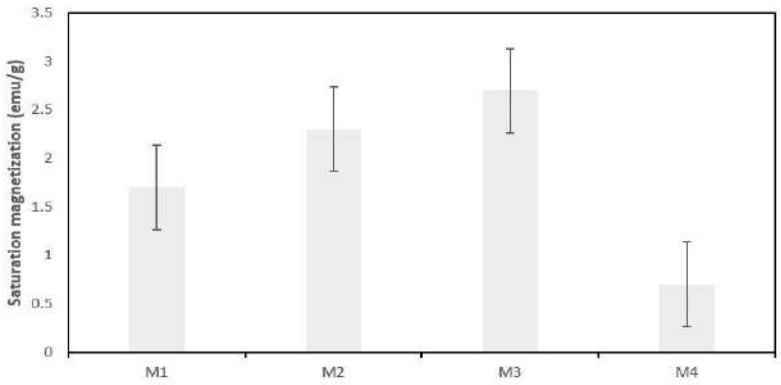
**6)** The method for preparing said cement composition as claimed in claim 1, comprises the following steps.

**i)** mixing said particles with said dispersing agent to obtain a homogeneous mixture; and

**ii)** Blending said mixture with said silica-bearing additive, followed by addition of potable water to obtain said cement composition.

**7)** The method as claimed in claim 6, wherein said silica-bearing additive contains quartz sand and waste silica.

11 **Figure 1**



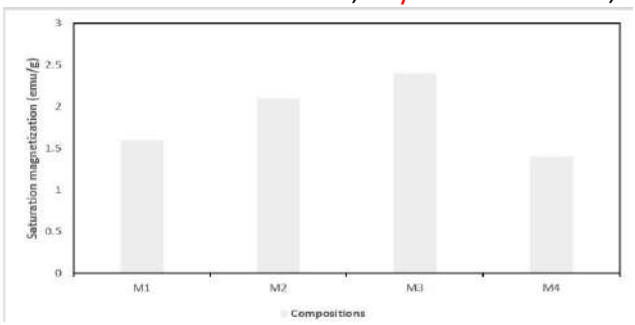



**Figure 2 a**

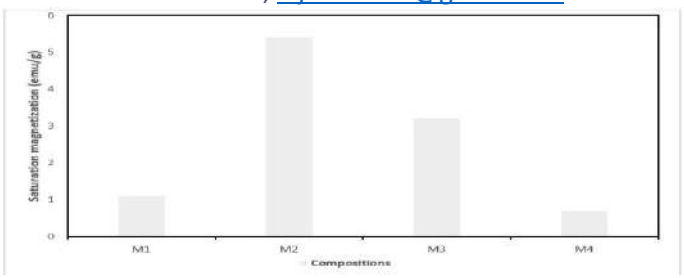



**Figure 2 b**

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