White paper on Fast-setting applications of the Advanced geopolymeric formulations developed by the AGS.

What are Geopolymer:

Geopolymers are inorganic aluminosilicate polymeric material produced by polymerization of aluminosilicate precursors derived from natural resources and also using industrial wastes, with alkaline activators solutions, which inherently set very fast and harden at ambient temperatures.

The alkaline solution commonly used are a combination of NaOH or KOH and Na2SiO3 or K2SiO3 respectively and additional additives to impart desired functionality. Since the aluminosilicates raw materials used for making geopolymer are of geological origin and involves inorganic polymerization for their formation and therefore they are termed as "Geopolymer". The other raw materials which are used for making geopolymer are waste or by products materials such as blast furnace slag, fly ash, rice husk ash, etc. The unique features of geopolymer includes less hydration heat, fast setting due to early gaining strength and higher compressive strength, higher chemical resistance and thus imparting corrosion resistance and excellent freeze and thaw resistance etc.

Need of Fast setting Geopolymer based inorganic binder/resin for making mortar and concrete useful for broad application spectrum and the role played by Advanced geopolymer formulations for specific use appropriately is as mentioned below:

AGS capability:

There is an urgent need to develop and use sustainable advanced materials, which are essentially fast setting, cost effective, sustainable and environment friendly and **this is what exactly being pursued** over the years at Alchemy Geopolymer Solution (AGS) to ensure availability of "Know -How" for developing smart, better and multifunctional advanced geopolymer materials useful for broad application spectrum and specially for repairing the existing reinforced concrete infrastructure namely fast setting runways and bridges and to construct new ones.

Techno-economic feasibility:

The concern of sustainability and durability of infrastructure across in all the field, is posing a great challenge all over the world and the most crucial factor responsible is corrosion of reinforcement which is vital for the maintaining uncompromised engineering properties. **To surprise, about $2.5 trillion is being spent globally** to assess, mitigate and to repair the corrosion

of infrastructure. The AGS has developed novel geopolymeric formulations which are appropriately responsive and user friendly and capable of preventing corrosion of steel by means of creating inherently **a chemical bonding with steel reinforcement** leading to form a passive coating useful for inhibiting corrosion significantly to achieve sustainability of millions of years and will thus leads to save unimaginable, and the "unavoidable expenses" otherwise necessary to be incurred in the areas of infrastructure maintenance and construction.

Need of fast setting geopolymer formulations:

1. The repair of existing and construction of new fast setting runways is of immense importance from **the strategic as well as commercial point of views.**
2. The repair of existing and construction of new bridges used for heavy traffic can only be ensured using fast setting geopolymer formulations.
3. The geopolymer formulations are inherently fast setting materials and possess high early strength.
4. The fast-setting characteristics, a novel and unique feature of the geopolymer helps in reducing project duration, labor cost which ultimately leads to overall saving of Money in totality.

What AGS Offers:

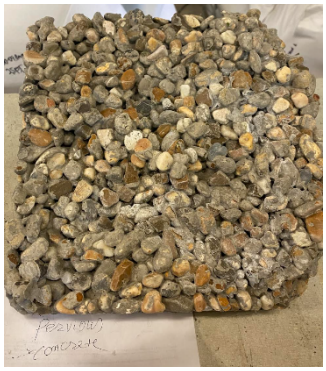
To address the above-mentioned concern, AGS has developed several geopolymeric formulations:

a) Which are not only fast setting within a period of 30 minutes itself, but also can be designed functionally for the rehabilitation of a variety of reinforcement and conventionally used cement concrete materials.
b) The geopolymer formulations provide strong chemical bonding with metals and concrete and therefore enables high compressive up to 10, 000 psi.
c) AGS has evaluated the formulations and products made using them for respective ASTM standards for specific applications.
d) The geopolymeric formulations also provides superb corrosion resistance to the structures and thus will have unparalleled sustainability and saving on frequent maintenance.
e) The cost of geopolymer formulations is about 15-20 percent less in comparison to conventional concrete and or organic polymeric formulations in use.
f) The formulations can be used "on -site "and "in-situ" for the repair of existing structures and for constructing new ones.
g) The formulations are sustainable, environment friendly and cost effective.

Additional Information on expertise of the AGS:

The unique scientific and technical expertise of the AGA is ready with the know-how for making advanced applications useful for broad application spectrum as mentioned below.

1. Advanced **Pervious concrete** for coastal area application to **address flooding**.



2. Advanced geopolymer formulations for addressing hazardous nuclear waste management **specially "on -site" and "in-situ" remediation**.
3. Advanced EMI and X-ray, Gamma radiation and neutron radiation shielding **simultaneously** - for use in a) making Diagnostic X-ray and CT scanner room, b) **Shielding Concrete** for nuclear power plants, **bunkers, and other strategic applications**.

4. Advanced geopolymer for **Space applications** as inorganic binder.
5. Advanced **sprayable geopolymers for the repair of existing concrete infrastructures.**
6. Advanced functionally graded geopolymer concrete possessing solid as well as porous concrete structure.

7. Light weight geopolymer concrete

8. Advanced geopolymeric formulations for maintenance free coating on wood substates and making plywood - for **heat and fire- resistant infrastructure** near fire prone areas

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