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A Scientometric Review of Na2SiO3/NaOH Versus SiO2/Na2O is above 2.85: 1 Alkaline solution Activated Geopolymer Concrete

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Abstract

The term geopolymer is a sustainable binder refers to the study of waste materials containing silicon (Si) and aluminum (Al), which create an alternative binder formed by a complex repeated chain by geopolymerization process. Hellacious materials alternation is mandatory to see the construction as a beautiful infrastructure as there are limited natural resources to produce quality concrete. Alternative binder and aggregates created by using industrial waste should be used to reduce the disadvantages of conventional concrete. The Na2SiO3 / NaOH ratio activated geopolymer concrete has been well documented by researchers. The ratio of these solutions to the field geopolymer concrete production is not suitable for structural geopolymer concrete because it is not possible to provide a temperature greater than 60 degree centrigrade in the field. The Na2SiO3 / NaOH ratio should be mixed 24 hours before airing the samples. Researchers have used a single alkaline solution simply instead of water when mixing concrete. In this review paper clearly compared and analyzed difference between the Na2SiO3/NaOH activated geopolymer concrete versus neutral grade sodium silicate (NGSS) laboratory-based field construction geopolymer concrete. NGSS is a neutral grade of SiO2: Na2O. This solution is the only single neutral grade solution with 2.92 silica modulus, produced directly by the company to create the geopolymer.

1. Introduction

Day by day the consumption of cement is increasing, expected to reach 500 million tons by 2030. The OPC binder used in traditional concrete releases approximately 8% of CO_2 which affects the ozone layer and human health and creates climate problems. To overcome this need to plant 2.62 billion acres of forest land which is equal to island and cement is highly energy-intensive. The available limestone to make the OPC is sufficient for the next 50 years only. The need for concrete is increasing exponentially day by day in line with the rapid development of the world's attractive infrastructure. In 2014, 16208.6 cubic meters of concrete was poured at the Wilshire Grand Center in Los Angeles, which was the highest concrete used that year. In 2015, 19624 cubic meters of concrete was laid for the foundation of Lakhta Center Tower. The prestigious Polavaram Dam project in the state of Andhra

Pradesh has set a world record for the use of concrete weighing 32315.5 cubic meters to 1141211.1 feet in a single day, aiming to provide irrigation and electricity to the region. Based on the Knight Frank India-2021, 76000 buildings were commissioned in the first half of the year, an increase of 38% over the previous year. Points show that the global use of concrete (GUC) using natural materials such as cement and aggregate is increasing day by day. The use of industrial waste materials such as fly ash, ground granulated blast furnace slag (GGBS), metakaolin and silica fume should be initiated to prevent and overcome the impact of conventional concrete. Those substances are activated with alkali solution called Geopolymer concrete. Geopolymer is a strong alternative durable binder; in this paper I used a single alkaline solution called Neutral Grade Sodium Silicate, also known as Geoactivator. The geo activator used by researchers in these papers to overcome adversity is not a field construction geopolymer, but a combination of solutions used by many researchers, such as going to oven curing, mixing and formulating solutions 24 hours before using them. The paper has successfully studied the production of field structures of geopolymer mortar or concrete with a single alkaline solution instead of water, and the combination of solutions Na2SiO3 / NaOH activated geopolymer concrete, both to evaluate and determine which is better for future geopolymer concrete.

2. Constituents of geopolymer concrete

2.1. Sodium hydroxide

To naked eye sodium hydroxide flakes or the cartridges are almost white. In general it is accessible with levels different immaculacy content. Its price also varies depending on the immaculacy of the material. Since our geo-polymer binder concrete is correlative or equivalent in nature and the material is also immaculacy and its main function is to activate sodium Silicate, so it is recommended to use a level of purity 93% to 97% means low cost or economical sodium hydroxide.

2.2. Sodium silicate

Physically or intellectually it looks like a liquid gel also known as liquid glass or water glass. It's an important in the alkali solution; Differential percentage geo-polymer strength of Na2O Concrete varies. With 8 to 10% Na2O in sodium silicate gives a best result, i.e. about 45MPa Curing temperature 45^0C.

2.3. Necessity of geoactivator or neutral grade sodium silicate

Physically NGSS is a yellow gel liquid which is also known as neutral grade sodium silicate. In industry, liquid sodium silicate grades are classified by their SiO2 /Na2O silica modulus (weight ratio). Ranges from 2: 1 and 3.75: 1. Grades with SiO2:Na2O ratio. Those above 2.85: 1 are classified as neutral and proportionate Less than this is called alkaline. Activator used in the current research is a neutral grade sodium silicate solution Silica modulus SiO2:Na2O (Ms) = 2.92: 1 with 28.97% SiO2,9.92% Na2O Weight and pH collected by 12.90 From Kiran Global Limited, Chennai, India.

Geopolymer is usually a mixture of silicon and aluminum rich materials that form a geopolymer binder with alkaline solutions. Geo-polymer is primarily a product of the principle of zeolites in a geographically systematic structure. In that process zeolites are the crystalline structure of molecules consisting of aluminum, silicon, and oxygen, which are in a repetitive chain and the materials on their pores. Geo-polymers are the amorphous semi-crystalline and crystalline structure of an Al-C cell with an oxygen bridge.

The geopolymerization process is so complex that it involves six steps: alkalinization, depolymerization, oligo-cial gel and polycondensation, reticulation networking, and geopolymerization to form a complete 3D geopolymer chain in Figure 1. The combination of hardeners must follow strict rules 1.selection of precursor, 2. Amount of aluminosilicates (Al203) of your Fly ash or GGBS and 3.Calculating the formula with ratio K, Na/Al=1, 4. Ratio Si/Al=2 for a rigid 3D macrophages. it is necessary to follow all the rules to get better strength, eventually it will become confusing and very expensive. Also the use of a combination of solutions is not sufficient for field construction and economics.

Therefore using a single alkaline-based hardener called Neutral Grade Sodium Silicate with Silica Modulus 2.92 is effective to deliver high power at short room temperature at low curing time; we must use Geo Activator made for Geopolymer. In the industry sodium silicate is generally widely classified in liquid form based on their silicon oxide to

sodium oxide ratio and ranges from 3.85: 1, which is called the silica modulus, which is taken as a weight ratio. This silica modulus 2: 1 is called neutral grade sodium silicate.

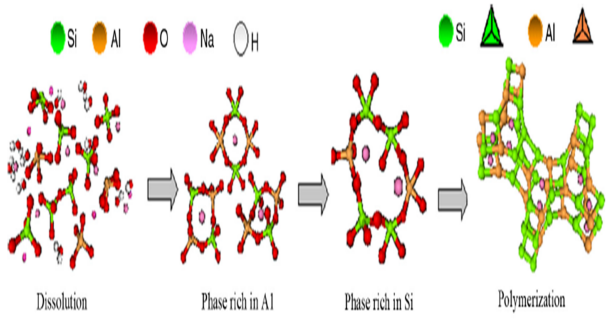

FIGURE 1. Geopolymerization process

3. Advantages of geoactivator based geopolymer concrete

Geopolymer is a strong reaction between silicon & aluminum (fly ash, GGBS, silica fume, XT ...) + alkali solution (sodium or potassium based), initiating a reaction called geopolymerization process = geopolymer binder.

- Earth friendly binder was produced
- The best alternative binder to 'conventional cement'.
- The use of waste materials in a useful way is increasing due to the creation of geopolymer.
- To reduce CO2 emissions (reducing 1 ton of cement by replacing cement with geopolymer reduces 1 ton of Co2).
- Geopolymer is a strong, durable binder.

4. Results and Discussions

4.1. Review on effect of Na2SiO3/NaOH and SiO2/Na2O is above 2 85: 1 solution

The (Davidovits) Studies on geopolymer concrete are a by-product of inorganic composite polymer produced from the alkaline chemical reaction of aluminosilicate compounds, which further polymerize these monomers to render Si-O-Al repetitive semi-crystalline 3-D structures. Forms a rigid three-dimensional (3-D) structure of silicates and aluminates (Albitar et al.) this study the author produced geopolymer concrete with combination of granulated lead smelter slag and flyash. Designed 32 mixes with fly ash replacement by slag and washed river sand replaced by slag as a filter. In this study author concluded that low alkaline to binder ratio the geopolymerization reaction is very low but if this ratio is more the polymerization process is also very fast but increasing alkaline content is increase the total cost of the project. The molar concentration of sodium hydroxide (NaOH) plays a Geopolymerization plays an important role in the synthesis of the gel GPC (Puertas et al.). The geopolymerization gel is formed together Reaction of Na2O, Al2O3, SiO2 and H2O (N-A-S-H). In Geopolymerization reaction, Na + ions are used Balancing charges to form alumina and silicate networks in the mixture (Sathonsaowaphak, Chindaprasirt, and Pimraksa). Approximately 5 to 7% of global carbon dioxide (CO_2) emissions can be attributed to Ordinary Portland Cement (OPC), which has traditionally been used as the primary binder in concrete (Shoberi et al.). It will ultimately give the result the high compressive strength of the final product of GPC (Safari et al.). Na2SiO3 or K2SiO3 and NaOH mixture or widely used source of KOH activation mate-Real for the fabrication of GPC (Hardjito et al. Rangan Bondar et al.). Ratio of Na2SiO3 / NaOH is another important component in GPC Compressive strength plays a key role in development of the geopolymer matrix. In (Gugulothu and T. D. G. Rao) the study conducted ggbs based alkali activated slag concrete with different solution / binder ratios of 0.50, 0.55, 0.65 and, 0.7, 0.75, and different binder content of 400,500 and 600kg / m3. Experimental work is being done to understand the working capacity and strength properties of concrete by geoactivator. Working capacity ranges from 80 to 110 slumps. AASC has applications capable of working through an alkaline combination but good performance is produced by the geoactivator in this paper. Increasing the silica modulus increased the strength in front of the researchers, which slightly increased to 2.92 in this paper, which resulted in better strength. Hence the binder to solution increased the working capacity better. In (M. Rao and Anil) the experimental results of this study will clear the production of ambient cured geopolymer concrete with a single alkaline solution geoactivator with a combination of fly ash, GGBs and different alkaline to binder ratios. Geo activator was used instead of water, finally achieving strength mortar, which works well at normal room temperature. (Jagandas, G. M. Rao, and Venu) In this paper

the researchers strongly relied on and produced laboratory-based field-based geopolymer concrete activated with a geoactivator at room temperature. Fly ash was taken at a ratio of 70-30 and 50-50 ggbs with steel and glass fibers at 0.5, 1, and 1.5% and 0.25, 0.50 and 0.75, and 0.25, 0.50 and 0.75 general and fiber reinforced field geopolymer concrete was produced, comparing all results. Finally concluded from strength test results Fly ash-ggbs based geopolymer concrete with activated neutral grade sodium with silicate Silica modulus 2.92 or geoactivator successfully produced laboratory based field construction geopolymer concrete. (Hu et al.) GRAC's initial setting time slightly improved. The Content of the RA (SSD), which can be justified by an existence excess volume of free water, also soluble sugars / organic. The materials in the RA also have consequences coming up on the setting like hardening of geopolymer matrices. (Amran et al. Ismail and El-Hassan) the main binder used for the production of lightweight concrete Commonly Portland Cement (OPC). OPC manufacturing industry Responsible for most of the CO2 released into the atmosphere, It is reported to be responsible for approximately 6–8% globally Emissions

5. Application of geopolymer concrete

In a nutshell, geopolymer concrete is useful for bridges such as precast prestressed concrete elements and deck slabs. It also benefits structural retrofits using fiber composite structures. Geopolymer binder or concrete science precast is one of the most advanced in precast concrete applications and the high temperature control required for many upcoming structures geopolymer requires at ambient curing. Some other advantages for geopolymer are bricks, precast pavers and slabs for paving.

6. Conclusion

Sodium silicate / sodium hydroxide replaced by NGSS. Geoactivator used instead of water. Geopolymer mortar or concrete produced by NGSS at normal room temperature. Increased silica modulus increases the strength of concrete. NGSS Alkaline based concrete produces good working concrete. The combination of solutions Na2SiO3 / NaOH activated geopolymer concrete is incomplete in producing field construction geopolymer concrete because temperatures above 60^0C are required. According to the literature review, it is a bit difficult to mix alkaline solutions 24 hours before laying the samples. A skilled worker needed to mix Na2SiO3 / NaOH, is produce heat that is harmful to workers. Increasing the molarity increases the final cost of construction but the geoactivator is used instead of water as it is the only alkaline solution made by the company with good silica modulus percentage, improved silica modulus in the geoactivator leads to better strength and better performance.

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