EXPERIMENTAL INVESTIGATION OF GEOPOLYMER COMPOSITE WITH DYE SLUDGE

Mr. K. Harish[1], Mr. Amir Suhail P.T [2]

[1]Assistant Professor, Department of Civil Engineering, RVS Technical Campus –Coimbatore Coimbatore 641402, India
[2]PG Student, Department of Civil Engineering, RVS Technical Campus –Coimbatore Coimbatore 641402, India

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Abstract - *A new class of Geo-polymer composites, as materials substitute to traditional binders, was produced and its potentialities as refurbishment material in Cultural Heritage has been discovered. This material has been prepared through a reticulation reaction in mild circumstances of a met kaolin-based Geo-polymer mineral matrix and a commercial epoxy resin and dye sludge. The freshly prepared slurry displays a consistency, work ability and phototropic behavior that make it suitable to be spread on different substrates in restoration, renovation and reinforcement actions, flat on walls and ceilings. Applicability and compatibility tests on tuff and concrete substrates were accepted out and the micro structure of the samples in correspondence of the transition zone was examined by means of scanning electron microscope (SEM) remarks and energy dispersion spectroscopy (EDS) mapping. Our educations point out the creation of a continuous phase between the Geo-polymer composite and tuff and concrete substrates, highlighting a high compatibility of the Geo-polymer binder with different kinds of materials. These structures specify a large possible for applications of these ingredients in Cultural Heritage.*

***Key Words*: GeoPolymer, Dye, Sludge, Composite**

1. INTRODUCTION

Geo-polymer were first mentioned by Davidovits in the early 1970s to describe inorganic materials with polymeric Si-O-Al bonds obtained from the chemical reaction of alumino silicate oxides with alkali silicates. The network is made up with SiO4 and AlO4 tetrahedra linked alternately by sharing all oxygen atoms. The Al3+ in IV-fold coordination becomes a network forming but requires extra charge to compensate, which forces the presence of cations in the framework to balance the structure.

2. Literature Review

In this chapter, the works carried out by some of the earlier investigators on light weight aggregate and waste management concreate blocks are briefly given.

Ashutosh Das and Mukesh Goel (2015) Growing industrialization is producing numerous products and also lots of waste. Most of this waste causes risk of hazard to humans and the environment. As per USEPA, "Hazardous waste is waste that is dangerous or potentially harmful to our health or the environment. The degree of hazard may vary in addition to the quantity of the waste produced. By nature, hazardous waste complicates the process of collection, handling, treatment and disposal, and, of course expensive and risk involved. Typical example of such wastes include heavy metals such as Chromium, Mercury, Nickel, Cyanide, etc and oil and grease laden wastes with toxic metals.

Basavaraju Manu, Shrihari Surathkal and **Shrikant Jahagirdar (2015)** Study deals with reuse of textile mill sludge in making cement bases solid blocks which can be used in practice for bulk usage of sludge. Textile sludge and fly ash are analyzed by using XRF technique. Textile sludge is mixed with cement and later with combination of cement and fly ash to make solid blocks. Solid blocks are tested for compressive strength. To study the post effects of the sludge reuse, water used for curing (curing of water) is also analyzed for different parameters such as pH, EC, Solids, Hardness, chlorides etc by standard methods. Addition of fly ash reduces the leaching from the solid blocks. Compressive strength of cement and sludge blocks is 23.8 N/mm^2, whereas solid blocks made of sludge, cement and fly ash shown compressive strength of 29 N/mm^2. Reuse of textile mill sludge as building material will increase bulk usage of sludge in future, thus completely eliminating landfilling disposal option.

Chandak N. R. and **Amit Babu** The process of soil stabilization helps to achieve the required properties in a soil needed for the construction work. The attempt had been made to investigate the effect of lime sludge obtained from paper mill as waste on the strength and compaction of sandy soil with plasticity. The basic properties of soil like liquid limit, plastic limit, shear strength and MDD & OMC were determined before and after addition of lime sludge. The lime sludge was added at 3%, 6% and 9% by weight of soil and mixed with soil at optimum moisture content. The direct shear and compaction tests were conducted without curing of the specimens. It was observed that addition of lime sludge in sandy soil improves the shear strength.

Dr. Abhipsa R Makwana Treatment of textile wastewater or dye wastewater is little difficult suing biological treatment for wastewater like activated sludge process due to complex nature of the dye. This paper reports pre-feasibility study of activated sludge process for simulated dye waste removal. Activated sludge process involves biomass development, acclimatization if complex waste are to be treated. Here active biomass was developed from domestic sewage and then it was acclimatized for Navy Blue 3G dye and optimized

mix system of 70-30 ratio (Dye effluent –sewage) has been suggested with 20 hr as optimum detention time. Optimized system shows 91% of average dye removal.

Dr. Jayeshkumar Pitroda and **G I Joshi** Hypo Sludge or paper mill sludge or textile mill is a major economic and environmental problem for the paper and other industry. The material is a by-product of the deinking and re-pulping of paper. The million tons quantity of paper mill sludge produced in the world. The main recycling and disposal routes for paper sludge are land-spreading as agricultural fertilizer, producing paper sludge ash, or disposal to landfill, Hypo sludge is investigated for its use as a partial replacement for cement in cement mortar (1:3). The utilization of Hypo Sludge as cement replacement material in mortar or as additive in cement introduces many benefits from economical, technical and environmental points of view. Four sets of mixture proportions were made. First were control mix (without Hypo Sludge) with regional fine aggregate (sand)) and the other mixes contained Hypo Sludge obtained from J. K. Papers mill Pvt. Ltd, plant near Songadh, Tapi District in Gujarat State. The compressive strength has been obtained with partial replacement of Hypo Sludge with cement. Test results indicate the decreases in the strength properties of mortar with Hypo Sludge for strength at 7 &28 days as partial replacement with the cement in the cement mortar 1:3. So it can be used in non-structural elements in the low range compressive strength where strength is not required and low cost temporary structure is prepared.

Vaishali Sahu and **Gayathri V** The increased demand of drinking water and power has led huge generation of water treatment plant residue i.e. sludge and the thermal power plant by-product such as fly ash. Large quantities of sludge and fly ash are produced in India and disposed off by landfilling or dumping in and around sites. In this study fly ash and water softening sludge (lime sludge) has been utilized in mortar. Due to the variation of p^Hvalue causes skin problems and other disease. The led content mainly causes kidney function and have a chance to come kidney stones. The dumping of sludges in the water resources leads to change in the physical property such as color odour etc and chemical property's such as p^H,dissolved contents and other thinks are varies.

V. K. Kauthale, P. S. Takawale, P. K. Kulkarni and J. N. Danie He identified that 10% replacement of fly ash as bagasse ash in fly ash blocks give acceptable compressive strength which is almost same compared to normal fly ash blocks and It reduces the density and cost of blocks. The reuse of textile sludge to manufacture of blocks as building or construction materials is a popular idea to eliminate these waste materials from environment. Many studies have already been done to incorporate waste materials or sludge into the production of blocks or building materials. bending strength, bending modulus, impact strength and water uptake (%) is also increases. The effect of various combinations on strength has been varies with to the mix proportion.

S.Sudha Pranavi Singaraju,G.Prabhakaran Concrete is a composite construction material composed of aggregate, cement and water. There are many formulations that have varied properties. The aggregate is generally coarse gravel or crushed rocks such as lime stone or granite, along with a fine aggregate such as sand. The cement commonly Portland cement and other cementitious materials such fly ash and slag cement, serve as a binder for the aggregate. Various chemical admixtures are also added to achieve varied properties. Water is then mixed with this dry composite which enables it to be shaped and then solidified and hardened into rock-hard strength through a chemical process called hydration. The water reacts with the cement which bonds the other components together, eventually creating a robust stone-like material. Lime sludge is generated from paper, acetylene, sugar, fertilizer, sodium chromate, soda ash industries, and water softening plants. Approximately 4.5 million tons of sludge in total is generated annually from these industries. Fly ash is a naturally-cementitious coal combustion by-product.

V Palanisamy Over 300 million tones of industrial wastes are being produced per annum by chemical and agricultural process in India. These materials pose problems of disposal and health hazards. The wastes like phosphogypsum, fluorogypsum and red mud contain obnoxious impurities which adversely affect the strength and other properties of building materials based on them. Out of several wastes being produced at present, the use of phosphogypsum, fluorogypsum, lime sludge, hypo sludge, red mud, and mine tailing is of paramount significance to protect the environment. Paper making generally produces a large amount of solid waste. Fibers to join the waste solids. The shiny finish on glossy magazine-type paper is produced using a fine kaolin clay coating, which also becomes solid waste during recycling. Worse yet, some of the wastes are land spread on cropland as a disposal technique, raising concerns about trace contaminants building up in soil or running off into area lakes and streams. Some companies burn their sludge in incinerators, contributing to our serious air pollution problems. To reduce disposal and pollution problems emanating from these industrial wastes, it is most essential to develop profitable building materials from them. Keeping this in view, investigations were undertaken to produce low cast concrete by blending various ratios of cement with hypo sludge. This project is concerned with experimental investigation on strength of concrete and optimum percentage of the partial replacement by replacing cement via 10%, 20%, 30%, 40%, 50%, 60% and 70% of Hypo or dye Sludge.

3. Properties and materials used

3.1. Engineering properties of Fly Ash

Specific gravity	1.90-2.55
Plasticity	Non Plastic
Proctor compaction	0.90-1.60 gm/cc
Optimum moisture content	38.0-18.0%
Angle of internal friction	30^0-40^0
Cohesion	Negligible
Compression index	0.05-0.4
Permeability (CM/SEC)	10^5-10^3

3.2. physical and chemical properties of NaOH

The properties such as appearance, odour, solubility, specific gravity and etc are detailed below,

Appearance	White, deliquescent pellets or flakes.
Odour	Odorless.
Solubility	111 g/100 g of water.
Specific Gravity	2.13
pH	13 - 14 (0.5% soln.)
Boiling Point	1390C (2534F)
Melting Point	318C (604F)
Vapour Density (Air=1)	> 1.0
Vapour Pressure (mm Hg	Negligible.

3.3 Dye Sludge

Properties	**Value**
Formula mass	122.06
Melting point, °C	188 - 189
Boiling point, °C	102
Vapour pressure, mm_{Hg}	18
Density	1.37 g/cm^3
Solubility in water	very slightly soluble
Viscosity	10 P (1088 °C)
Refractive index	1.512 - 1.514

4. CONCLUSIONS

- A Geopolymer-dye sludge composite is successfully obtained from the fly ash and Geopolymer and dyeing industry effluent treatment plant sludge.
- Bricks can be manufactured from the composite with strength of second class bricks.
- New composite aggregate Geopolymer-dye sludge composite is projected as environment friendly building material with less leaching property and comparable strength vis-à-vis cement based products.
- For adding dyeing industry effluent treatment plant sludge up to 10% in the Geopolymer-dye sludge composite with out affecting its strength.
- The dyeing industry effluent treatment plant sludge was also giving economical benefits.
- **Inference from compressive strength test** Geopolymer-dye sludge composite with silica gel shows appreciable reduction of compressive strength with increase in dyeing industry effluent treatment plant sludge, but Geopolymer-dye sludge composite without silica gel shows decrease in compressive strength up to 10% of dyeing industry effluent treatment plant sludge but for 15% of dyeing industry effluent treatment plant sludge and 20% of dyeing industry effluent treatment plant sludge the compressive strength increases

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