

A Comprehensive Review on Lead-Zinc Tailings as An Alternate Material in Concrete

Kanakaraju Dandaboina^{1*}, Joshi Sreenivasa Prasad²

Abstract

Lead-Zinc Tailings are high volume wastages that are dumped in the open area of mine after extraction of minerals from ore. Tailings have high content of heavy metals that creates lot of environmental problems like air, water, land and also marine drainage along with it creates risk to human life, so tailings required better and safe management to overcome these problems. Now, this review begins with the utilization of Lead and Zinc Tailings as an alternate material in the concrete production by replacing Cement and Fine aggregate. The previous studies shows that tailings have been used as an alternate material for cement and sand, the compressive strength of the material with Lead and Zinc is increased while increasing curing days and the workability of material is reduced. So, the compressive strength of material is reduced when we are increasing the tailing content in the concrete. Finally, the results show that, the tailings-based concrete have better result to overcome environmental problems and also introduction of new materials in the construction industry. This review gives an overview about Lead-Zinc tailings and comprehensive understanding of utilization of tailings as an alternate material in the preparation of concrete. There is a possibility to conduct more research on behavior and properties of Lead-Zinc tailing based concrete that is durability properties, microstructural properties, thermal properties, mechanical properties, and also leaching properties of the concrete. So, by utilizing Lead-Zinc Tailings as a replacement material we can introduce more new materials in the construction field and also reduces the environmental problems.

Keywords: Tailings, Compressive Strength, Workability, Durability, Micro Structural Analysis

INTRODUCTION

Tailings are the waste material will get from Mining that is after extraction of main mineral; these are the solid waste remains after the extraction of minerals. The tailings contain heavy metals like Lead, zinc, copper and some other materials and it also have some similar characteristics like Cement. Tailings deposited in the open area due to open air deposition we are facing large number of problems which is related to environment, like marine drainage, water pollution and land pollution and also due to high temperature tailings produced large number of harmful gases into the atmosphere. So, by these humans are facing health related issues.

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Lead-Zinc Tailings are high volume wastages that are dumped in the open area of mine after extraction of minerals from ore. Tailings have high content of heavy metals that creates lot of environmental problems like air, water, land and also marine drainage along with it creates risk to human life, so tailings required better and safe management to overcome these problems. So, to overcome these problems researchers started

studying about these Tailings to utilize these tailings as by product in the Construction Industry materials like in the replacement of cement and also utilizing as Fine Aggregate and in the making of Geopolymers. The replacement of cement by Lead and Zinc tailings with GGBS, Fly Ash, Metakaolin etc... in the preparation of geopolymers can improve the density and strength properties of geopolymer. The tailings have good burnability characteristics that are High early strength of geopolymer, High temperature resistance, Preservative, Radiation resistant, Strong heavy metal curing ability, The preparation of building materials has low energy consumption, low cost and low carbon dioxide emissions, Now the study was conducted to investigate the properties of concrete that prepared with different ratios of Lead-Zinc Tailings and give a comprehensive review about the utilization of Lead-Zinc tailings in the construction industry and effective way to control the carbon emissions and make steps towards sustainability by utilizing these waste materials in the preparation of Cementitious materials, Geopolymers, and used as supplementary material in the construction industry, now this research give a comprehensive understanding about the Lead-Zinc Tailings and their properties along with the effective use of LZT's in the production of Cement supplementary materials and also Geopolymers. Now this study as follows,

Qing Liu et al. [1]: The main discussion on the preparation of geopolymers and foamed ceramics from lead-zinc tailings is given. The introduction of radiation proof building material prepared with the Lead and Zinc Tailings. The Lead and Zinc Tailings based building materials have High Strength along with heavy metal curing and radiation protection. Finally, the author given theory and applications of Lead and Zinc tailings in the construction industry. Mifeng Gou et al. [2]. The potential utilization of tailings as a replacement for fine aggregates, as supplementary cementitious materials (SCMs) in mortar or concrete, and in the production of cement clinker. It was shown that the use of tailings as both Sand and Cement the workability of concrete is reducing but at consistent water and cement ratio the strength parameters are increased with tailings as a sand. So, finally the observations shows that the declining of strength parameter with rise of tailings content in the preparation of building materials. Alieh Saedi et al [3]. In this study, two different lead-zinc mine tailings (T1 with 0.4% and T2 with 19% sulphide content) were separately used as a cement substitution in concrete construction. The test results shows that the strength parameters were increased with increasing the curing days along with that the leaching parameters are good with increasing the curing days.

So here we can say from observations we cannot use more than 20% of tailings as a replacement material in the preparation of concrete because more than this percentile the concrete undergoes sulphite attack due to heavy metals present in the tailings. Xiang He et al. [4] this study provides in depth about Mine tailing based geopolymers and the applications of mine tailings based geopolymers in the construction industry. Finally, here we can be discussed about economic benefits and Carbon foot print of mine tailings based geopolymers in the construction industry. Ziyi Yin et al [5]. In this study, lead-zinc tailings-based cementitious materials were prepared by using lead-zinc tailings, fly ash, and ordinary Portland cement, and the effects of four factors on the mechanical properties of lead-zinc tailings, as well as fly ash content, cement content, and water-binder ratio were studied by orthogonal experiments. The study was conducted to understand the relation between the properties of the cement materials along with that the observation was done on the leaching ratio of cement materials that prepared with the mine tailings. Haojie Wang et al. [6] the study conducted to stabilize the heavy metals which are present in tailings that is Cadmium, chromium, led by utilizing solid waste that is Fly Ash, Rice Husk, Ground Granulated Blast Furnace Slag (GGBS) and also Metakaolin. So, from the observation we can say by mixing of RHAs with tailings we control the led and by utilizing GGBS we can stabilize the Cr and also by using both GGBS and RHAs we can reduce the amount of Cadmium in the tailings. So, here we can conclude that by using solid wastes we can stabilize the heavy metals which are present in the Mine tailings. Zhongtao Luo et al. [7]. This paper investigated the properties and heavy metal stabilization/solidification of blended cement containing different replacement ratios of ground LZTs. So, from the results we can say that the tailings reduce the strength of blended cement and the optimum number of tailings is only 10% in the blended cement more than this effects the

hydration products and also demote the formation of ettringite in the cement. Finally, we can conclude from this study we cannot use more than 10% of tailings in the preparation of cement materials. Alieh Saedi et al. [8] In this study, lead–zinc mine tailings (LZTs) were used and their reactivity were improved through mechanical activation. The test results shows that the strength parameters were increased with increasing the curing days along with that the leaching parameters are good with increasing the curing days. So here we can say from observations we cannot use more than 20% of raw tailings as a replacement material in the preparation of concrete but we can use 40% of activated tailings in the making of concrete because more than this percentile the concrete undergoes sulphite attack due to heavy metals present in the tailings. and also shows effects on the strength parameters of concrete. Rui Li et al. [9] This paper reviews the progress of utilizing lead–zinc tailings as building materials and mainly summarizes the status of lead–zinc tailings in cement, geopolymer, concrete, building brick, and foam ceramics. From the studies the tailings have high amount of silica and alumina oxides which plays a key role in the cement production. From this study we can say we can use tailings in the production stage of cement. Mifeng Gou et al. [10]. The potential utilization of tailings as a replacement for fine aggregates, as supplementary cementitious materials (SCMs) in mortar or concrete, and in the production of cement clinker. It was shown that the use of tailings as both Sand and Cement the workability of concrete is reducing but at consistent water and cement ratio the strength parameters are increased with tailings as a sand. So, finally the observations shows that the declining of strength parameter with rise of tailings content in the preparation of building materials.

CONCLUSIONS

As per the reviews studied in the introductory part, the following conclusions were obtained

- The Lead and Zinc Tailings contains heavy metals like Cd, Cr, Pb, Mg etc... so, these tailings require proper and safe management to overcome all these problems. So here researchers suggesting that with these tailings we can produce Green Building materials in the name of turning Garbage to Treasure
- The Machine Grinding of Tailings improve the characteristics of concrete and also, we can replace the concrete material up to 40% by total weight with activated Tailings.
- The use of tailings as a Fine Aggregate will reduce the workability of the material that prepared with Lead and Zinc Tailings, but the strength parameters are increased. Here the studies recommending we can use up to 40% of activated tailings and 20% of raw tailings in the preparation of concrete. More than this percentile, concrete may face some chemical attacks.

From the above studies, it is understood that LZTs material will enhance the properties of the concrete like Compressive Strength, density, porosity and other properties and also overcome the environmental issues.

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