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Dimensional Stone Waste Characterization in Rajasthan and Suggesting their possible Remedies

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ABSTRACT: Rajasthan is located in northwestern part of India. It's endowed with one of the largest reserve of dimensional stones like Granites, Marbles, Kota Stone etc., also available in different variety and texture. This makes it suo motu one of the largest stone industrial hub of the country. With time as the demand of these stone increased in the market, their mining also increased exponentially which in turn increased the amount of waste production at various manufacturing stages of these dimensional stones. From the inception of the mining and manufacturing of these dimensional stone, no proper care were taken to control, reduce or recycle the waste produced, leading to accumulation of these waste in nearby ecological areas and disturbing ecosystem. In this paper an attempt is been made to critically examine the different stages of this waste production, their effects on flora-fauna and possible remedies to manage the waste in a sustainable way.

Key Words: Dimensional Stone, Waste management, sustainable development, green construction, Query waste, slurry waste.

I. INTRODUCTION

Rajasthan is located in northwestern part of India having an area of 3,42,249 sq. kms. making it largest state of the country. The State is bounded between Latitude 23°03'-30°12' N and Longitude 69°29'-78°17'E. There are 33 districts in the State. Every facet of Rajasthan is unique and fascinating. Geologically speaking, its rocks range from one of the oldest (more than 3,500 million years) to recent, displaying a wide diversity of mineral deposits. According to Mineral Policy Report, 2015 it was stated that mining and smelting of base metal deposits are also amongst the oldest in world dating back to more than 2,500 years. Rajasthan is enriched with large reserve of dimensional limestone like marble, granite and Kota stone (limestone, named after local area of origin) in different colours and texture. There smooth and shiny appearance make them popular for furnishing and decorative purposes in houses and offices worldwide. Due to huge amount of reserve of limestone present in Rajasthan and popularity of these stones among buyers and sellers, mining of these dimensional stone is increasing exponentially year after year. Data's published in a report published by Mining and Mineral Static Division of India for year 2013-14 stated that mining of limestone increased from 2,32,950 thousand tones in 2009-10 to 2,78,735 thousand tones in 2013-14, increasing production value from 324 crore to more than 468 crore respectively. The report also highlighted that the export of these dimensional stone followed the same trend.

II. MANUFACTURING PROCESS AND WASTE GENERATION

With increase in demand of Dimensional stones, the mining of the product has also increased exponentially. New mining site have emerged over past decade. In his work Rana *et al.,* 2016 summarized mining process used in the region of Kota and Jhalawar district of Rajasthan. The mining is carried out first by breaking up the rocky reserves into spilttable quality material using explosives. A pre-planned pattern of about 40 to 50 horizontal holes are drilled for the dimensions of 2 inches wide by 12 to 14 feet deep.

The rocks are then lifted via haul trucks which transport it to temporary storage area from which they are transferred in bulk quantity to cutting and polishing sites for processing into slabs and tiles of different shapes and sizes.

During the processing of these stone a huge amount of waste is generated. In a report published by Department of Industries, 2015 it's estimated that after mining almost 58% of the dimensional stone ends up as waste. The various stages in which waste is generated are:

a) Quarry waste produced during in-situ mining.

A major part of mined material is discarded as they are deemed to be unfit for commercial use. The shape and size of the mined rock do not fit to be carved into desired size of slab and tiles. These boulders are left on site or are dumped in nearby area.

b) During polishing of stone.

In processing of the stones, diamond blades are used and a constant stream of water is thrown over the blades, while cutting is in progress to cool the blades and to remove the dust produced during cutting operation. The waste water from this operation is in a considerable large quantity and highly alkaline in nature.

III. ENVIRONMENTAL HAZARD

Over the years continuous mining of dimensional stone has led to severe environmental issues. It has effected both flora and fauna in adverse ways. Due to mismanagement and unplanned dumping of mining waste, huge piles of discarded mining and cutting waste can easily be seen around mining areas. A report published by Desert and Environment Geology Division stated that the overstretched waste, generated from the mines and slurry produced from the crusher are being disposed along dry streams and these are being carried through surface runoff to the towns and villages occurring in the downstream areas leading to serious health problems and contaminating water source. In another study conducted by Geological Survey of India, high quantity of total dissolved solids and sulphates have been found in areas like Keshavganj, Naya Sanwara, Jhadoli near Sirohi district of Rajasthan which lies within radius of dumping site of these mining waste. Similar situation is seen in areas of Kota and Jhalawar district of Rajasthan, where excessive mining has caused an ecological imbalance. Due to unplanned and mismanagement in disposal of mining waste, the mining owner bought the rich fertile land of area near mining site and started disposing mining waste on the fertile land, leading it to turn barren. It has been noted (Leikin *et. al.,* 2009) that People working on mining sites and residents close to mining sites have reported many respiratory diseases like Silicosis, asthma, bronchitis.

IV. POSSIBLE USAGE

A wide amount of literature is available on utilizing the mining waste, slurry waste and limestone dust to study the mechanical properties of concrete. Among non pozzolanic fillers, limestone and dolomite fines are most often utilized to increase the content of fine particle in self compacting concrete. With same water cement ratio, and same type of cement used, the concrete with higher limestone filler content with suitable size of aggregate is found to have improved strength characteristics. Ferreira *et al.,* 2004, have revealed that the physical and chemical characteristics of granite sludge match well with the requirements needed in brick and roof tile formulations. Thus, their incorporation results in negligible changes in the properties of the final products. Similar studies were conducted by Menezes *et al.,* 2002, on the use of granite sludge in production of bricks. Al-Zboon *et al,* 2010, utilized stone cutting sludge waste in the manufacture of building bricks. The results indicated that the mixtures of aggregate with added amount of sludge (<50 %) were used successfully in producing non-load bearing bricks. A similar study by Dhanapandian and Gnanvel, B., 2009, marble and granite waste material was successfully used to replace clay material, result showed that up to 50% replacement there was no effect on mechanical properties. With reference to waste utilization in tiles and porcelain production there are research work done which illustrate the suitability of granite sludge to produce porcelain tiles with superior properties, in terms of water absorption and bending strength. Sludge usage had negligible effect on density, shrinkage, and plasticity during all stages of the tile-production process. Research work done by Segadaes *et al.,* 2005, showed that up to 30% stone waste can be added to an industrial clay mixture, for production of floor tiles, with no major reduction in the properties of the final product. Also, the study showed the possibility of using lower firing temperatures with significant energy savings.

Also, many researchers used waste from cutting process in concrete mixes. Almeida et al., 2007, used natural stone slurry to replace fine aggregates in concrete mixtures. They found that the mechanical properties of the produced samples are adequate for concrete requirements. In experimental study conducted by O.M. Omar *et al.,* 2012, to study the influence of partial replacement of sand with limestone waste, as an additive on the concrete properties. The replacement of sand with limestone waste was studied between 25-75%.

The effects of limestone waste as fine aggregate on several fresh and hardened properties of the concrete was investigated. The investigation included testing of compressive strength, indirect tensile strength, flexural strength, modulus of elasticity and permeability. It was found that Using Lime stone waste up to 50% replacement increase the compressive strength about 12% at 28 days, limestone waste as fine aggregate enhanced the slump test of the fresh concretes. But the unit weight concretes were not affected. However, the good performance was observed when limestone waste as fine aggregate was used in presence of marble powder. Javad *et al.,* 2014, in his study, investigated the effects of partial replacement of Portland cement with wood fiber waste (WFW), rice husk ash (RHA), and limestone powder waste (LPW)for making lightweight concrete block as a building material. The results show the effect of 25 weight percentage replacement of RHA and LPW with Portland cement do not exhibit a sudden brittle fracture even beyond the failure loads, indicates high energy absorption capacity, reduce the unit weight dramatically. The increase of the RHA content induced the reduction of bulk density of the concrete blocks. The optimum replacement level of WFW, LPW, and RHA was 25% by weight; this replacement percentage resulted in good physico-mechanical properties.

V. CONCLUSION

The production of stone waste is increasing exponentially year after year. The available research shows that stone waste can be used in making bricks, blocks, tiles, hot and cold bituminous mixes and concrete mixes. However need for a comprehensive study is felt due to limited studies on these local stones, to provide a clear understanding among its users. Various properties of hot, cold bituminous mixes, concrete mixes have been studied including compressive, flexural, indirect tensile strength, modulus of elasticity, permeability etc., yet durability testing for long lasting performance of this stone waste to be used as building material required to build confidence among its users. Review of above studies provides need to proceed with proposed project.

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