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REVIEW ARTICLE

UTILIZATION OF SLATE POWDER INTO VALUE ADDED PRODUCT: A REVIEW

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ABSTRACT

Gagging With the increasing demand of natural resources, industrial exploration has extended. The slate pencil industry is the industry that produces a big volume of slate powder. The waste generated is highly hazardous in nature and has the possibility to serve adverse effect on flora and fauna along with living species. The paper concepts is with the thorough survey of the slate pencil manufacturing unit, the flow sheet, the source of generation of pollution and probable treatment methods for pollution abatement. The main aspiration of this assignment is to convert the waste in some useful product so as to increase the economic cost of waste, simultaneously reducing the pollution load generated due to these industrial manufacturing units.

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INTRODUCTION

Slate is formed from the alteration of materials such as clay grained, polyeted consistent stone obtained from sedimentary rock and type of rock, casting of clay or ash from volcanic eruptions. This is generated through a low grade geological process. India's history back to 3200 BC slate is produced mostly from open quarries and in exceptional cases from underground mines. India is a prime country in the analysis, digging of commercial rock stakes and in installing a compact base for stone industry. About a million tones of slate are mined every year in India. Processing of slate stone produces about 0.3 tonnes of slate powder per ton of slate stone processed. Of the 300 variations of slate that is being exchanged in the world market with approximately half of these are from India. Commercially viable slate and other rock pledges are recorded from Madhya Pradesh, Andhra Pradesh, Gujarat, Bihar, Karnataka, Maharashtra, Rajasthan, Orissa, Uttar Pradesh, Tamilnadu, Telangana etc. Slate pencil manufacturing industry is one of them which is located in Mandsaur district, Madhya Pradesh in India. Slate trade is the trade associated with the quarrying, extraction, processing and mining of slate stone.

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Slate is used in building material, flooring material, electrical insulation, roofing slates, roofing tiles, control board, black board, writing slates etc. Slate waste powder may be used in the manufacturing of concrete blocks in cement industry used for building construction. Today industry's disposal of the slate waste powder is one biggest environmental problem around the world. During the methods of quarrying slate mass is forfeit by 30% in the mode of dust. The dust hazard known as pneumoconiosis and if exposed for long time silicosis (is a critical disease of the lungs) occurs which lead to a fatal death of the victim or species. Cases of vision and skin disorders have also been observed. Such a giant amount of waste slate powder requires a big area to dump. Dumped powder is entrained in the environment and causes severe problems on land creatures and in water bodies. The slate powder adversely affects the animal kingdom, mankind an environment. The pollution level bet on waste quantity, precipitation intensity, waste characteristics, river debility and soil permeability. It is almost necessary to find out safe uses of slate waste powder, so that pollution load and dumping ground requirement may be reduced. The waste generated from the slate pencil industry causes serious environmental problems. Hence the restate of waste material has to be emphasized, to convert in useful material low cost, reduction disposal and pollution problems due to generation of slate waste. The aim of the environmental

pollution laws and environmental impacts should be on diminishing the waste generation and convert this waste into valuable products.

Other utilization of slate

The areas where the utilization of slate waste powder needs to be explored as a alternate for conventional raw material are as follows:

Filler material may be for embankments and roads: Being an inert material stone powder may be mixed with definite types of soil for the preparation of embankment resulting a saving of valuable soil. Mixing of stone waste with sandy soils and slity and compaction of the mix result in better strength of the base layer over which water bond, macadam can be led.

For construction of bricks: Stone waste is utilized in brick manufacturing as fine aggregate using cement as filler. The physical properties of the brick are generated by this method exceeds normal bricks. Stone waste, cement slurry, bricks can be built by using slurry sand and cement in different proportion and moulding by vibrant compaction technique.

Manufacturing of Portland cement: Stone waste may be utilized to replace live stone in Portland cement manufacturing.

Manufacturing of ceramic tiles: Stone waste slurry may be used as a basic material for the creation of ceramic tiles.

Manufacture of Thermo set resins: To explore the probability of transforming stone waste slurry into resin composites.

Manufacture of lime: Stone waste is used in place of limestone in the stabilization of soil.

Manufacturing of activated calcium carbonate: Stone waste may be used for the manufacturing of activated calcium carbonate.

Hollow Blocks manufacturing: Stone waste may be processed in hollow blocks for building construction.

Use of stone waste slurry as a substitution for limestone as follows: in synthetic agglomerated stone wastes, in manufacturing of glass, in plastic manufacture, in chemical manufacture etc.

Literature Review

The literature review is considered a crucial stage in structuring a research area. It helps in developing a firm base for advancement. In the former decade, analysts have noted that stone waste can be effectively used as an alternative building material. Some investigator proposes that slate waste can efficiently replace a part of cement can also be substituted by slate waste powder. The literature was reviewed from journals dealing with concrete technology, construction materials and sustainable development. Some of the research works carried out in this field is as follows:

In the year (2017) R. Mahadevi et al studied the utility of waste of marble powder and dust as a sectional reinstatement of cement. The parameter in this study includes the consequences of quarry dust and marble powder on the strength and workability of concrete. It was noted that using different percentage of the replacement does not reduce the strength on the applicability of concrete. This paper deals with the advanced construction technique in concrete technology replaced by different waste materials. Some studies have been observed in the utilization of slate powder along with baggase gathered from the sugar industry.

A.R. Prashant et al (2017) studied the possibility by using sugarcane baggase and recycled aggregate as a sectional reinstatement of particular constituents in concrete. The parameter included were compressive strength, complete strength, flexural strength etc of concrete by adding different percentage of sugarcane baggase ash and recycled aggregate. It was noted that the addition of sugarcane baggase and recycled aggregate increased the mechanical properties of cement with optimum water cement ratio. Sugarcane baggase contains about 68 mass% of SiO_2 therefore it is classified a good pozzolanic material and may be used as an auxiliary cementitious perceptible due to its pozzolanic property.

In the year (2017) T. Subramani et al considered the utilization of fake snow powder to fabricate waterproof cement. The parameter is included into this investigation was affected on the permeability of concrete, water effect and mechanical properties by utilizing waterproofing specialized. It was observed that compressive, flexural and tensile strength with the expansion of fake snow powder. Waterproofing admixtures in water sealing concrete brought about increment quality because of expansion of fake snow powder without changing the water cement extent.

Deepankar kumar Ashish considered the utility of waste marble powder in concrete as a sectional restoration of cement and sand amalgam in the year (2017). The parameters included in this study were ultrasonic speed, mechanical properties, carbonation and microstructure properties. It was noted that ideal strength and mechanical properties can bring about by utilizing 20% marble powder. Marble powder goes about as filler instead of concrete.

Dinesh A et.al, (2017), reviewed the adjustment of soil utilizing strong waste. The dirt examples were tried by Atterberg limits, compaction qualities, swelling, shear quality, CBR esteem, building properties and a list. It was found that strong waste can be adequately utilized as a substitute material in the adjustment of soil.

In the year 2017 Y. Saini et.al studied on the feasibility of utilizing industrial waste in the stabilization of clayey soil. The objective of the study was to find out the effectiveness of slurry waste and cement to stabilize the clayey soil. The parameters included were strength, direct shear, compaction and CBR test. It was found that addition of stone slurry waste and cement increased the stabilization of clayey soil. Result indicates that stabilization of clayey soil by using stone slurry waste and cement varied with moisture contents of soil sample with different percentages of additives.

In the year (2016) M. Singh et al studied the consequences of waste marble slurry on concrete by replacing the cement partially. The parameter in this study includes impact of size on compressive strength.

It was observed that mechanical equities of concrete with dried marble slurry replaced up to 15% (marble slurry), increases the quality, bond strength and compressive strength of reinforced concrete. A compressive strength guess model was developed using artificial neural network (ANN) for experimental trial on reinforced concrete with dehydrated marble slurry and it shows the experimental difference between evaluated compressive strength v/s predicted compressive strength.

In the year (2016) S. Ghannam et al studied the possibility by using iron powder and granite powder waste as a sectional reinstatement of sand in concrete. The parameter includes the tensile strength, compressive strength and flexural strength by adding of iron powder and granite powder. It was found that substitution of 20% of sand with iron powder and 10% of granite powder contributed to an expansion in compressive and flexural strength of the concrete. This research shows that addition of granite powder and iron powder as a sectional reinstatement of sand will reduce the utilization of sand in the cement industry, so preserving natural resources. Recycling of these byproducts and using them in concrete and will reduces health hazard and impact on the environment of these waste materials. Some studies have been observed application of industrial waste obtained from slate industry.

A. Baby et al, (2016), investigated the outcome of distinct waterproofing compound on durability and water permeability of concrete. The parameters used for the study were water absorption, porosity, permeability, sorptivity and strength. It was observed that waterproofing compound may be used to upgrade the porous structure of concrete and cut down the water permeability of concrete. Natural polymer compared with synthetic polymer proved to be a better waterproofing agent in concrete, since the natural polymer is economical, easily available and not harmful to health.

L.B. Pahhares et al studied the settling role of aqueous suspension of slate with citric acid in the year (2016). The parameters included were distinct concentrations of citric acid and varying percentage of solid in aqueous suspensions. It was observed that the settling nature of slate powder with citric acid lowers the settling rate, better stability and compact sediment bed. The light scattering technique was used to analyze the settling rate, aggregates and sediment bed density. Large amount of stones sludge is produced during the process of stone production. The research work was carried out by J. Mehta et al in the year (2016) to utilize the Kota stones sludge as reinstatement of marble slurry waste in brick manufacturing. The parameters in this study were flexural strength, compressive strength, tensile strength, porosity etc. It was noted that the stones sludge can be used as a replacement of brick and other aggregate manufacturing without affecting the properties. Stone sludge can be used in the formation of bricks, tiles, as fillers in the construction industry. The stone waste and other waste generated from a mining operation can be used in the stabilization of soil as seen in literature.

In the year (2016) Nabil Al Joulani studied the stone slurry waste stabilization with accession of portland cement and soil. The parameter in this study includes cement ratio, stone powder ratio, curing times, compressive strength and tensile strength. It was noted that highest compressive strength was attended by 20% Portland cement and 80%stone slurry after 28 days.

In the year (2015) G. LU et al investigated the work impact of active chemicals on cementitious capillary crystalline waterproofing coating. The parameters included were mechanical properties such as flexural strength, compressive strength and tensile strength. It was noted that the addition of 60% cement increases the strength, fineness and impermeable pressure strength of coatings.

T. Subramani et al studied the behavior of sectional reinstatement of glass, cement with fly ash and sand with bottom ash in the year (2015). The parameter includes compressive strength, split pressure, flexural strength of fortified cement by including an alternate level of the above material. It was observed that the expansion of added substances enhances the execution of cement. Diverse sorts of admixtures can be utilized for expanding the quality of the cement industry.

T. Subramani et al, (2015), studied the supplementing of the characteristic coarse total with consumed block counterweight. The parameter includes slump, compressive strength and cost. It was noted that by decreasing the water-cement proportion, the compressive quality of squashed over consumed blocks expanded by in excess of 30%. Literature saw that investigation of cement in the crisp state and in addition in the solidified state might be the criteria to assess distinctive properties of cement. It contributes in the sheltered transfer of waste materials.

Comparable investigations have led by T. Subramani et al in assessing the achievability of marble waste as a substitution of concrete in the year (2015). The parameter is included in this study were the compressive strength, split elasticity and so on of concrete. It was observed that supplanting of 10% of the cement with waste marble powder builds the compressive and rigidity of the concrete. Marble waste powder might be utilized as filler material in cement or fine totals while getting ready to cement.

T. Subramani et al, (2015), studied the practicality of utilizing glass powder as an incomplete substitution of cement. The parameter in this examination incorporates compressive strength, flexural strength and rigidity of cement by including an alternate level of glass powder. It was noted that to counteract alkali silica response glass powder of size under 75 micrometers can be utilized as a part of the substitution of cement.

In the year (2015) T. Subramani et al studied the potential utilization of paper waste for creating the blocks. The parameter used for the study includes the impact of papercrete block upon compressive quality, unit weight and water composition. It was found that waste materials like fly ash, paper waste and so on can be utilized as a part of the fabricate of eco well-disposed blocks that are called papercrete blocks and may successfully use for development purposes. The compressive strength of this block was noted to be half of the ordinary block.

A. K. Singh et. al, (2015), studied the functionality and compressive strength of solid utilizing stone residue as fractional substitution of Normal Stream and sand. The parameter included were a compressive strength, usefulness and so on of portland pozzolana concrete with the expansion of stone residue and fine total.

It was noted that by supplanting 60% of the fine total with stone residue solid gives most extreme compressive strength.

In the year (2015) Atul Salgili studied the opportunity of utilizing waste marble dirt in stabilizing soil. The parameter is included in this study had been direct shear, unconfined compressive energy, microstructural evaluation, swelling traits, chemical and mechanical residences of soil. It was observed that the addition of marble dirt advanced the shear strength and decreased the swelling characteristics of the soil.

Z. Song et.al studied the waterproofing structure of inorganic sodium silicate primarily based concrete sealer in the year (2015). The parameter is included in this study had been waterproofed function tested with the aid of hardness trying out, FTIR spectroscopy determines the surface region and x-ray diffraction microscopy for porosity analysis. It was mentioned that the floor hardness of the concrete sampling impregnated with sodium silicate based concrete sealer increases through 12% relative to the fresh concrete specimens. Sodium silicate based concrete sealer improves the waterproofing overall performance of the concrete structure. It improves the concrete compactness due to diminished micro void, micro pore and micro crack sizes in the concrete structures.

S. Dharkar et.al (2015) reviewed the stabilization of soil by way of the software of lime, fly ash, cement, rice husk, accelerated polystyrene, geofoam and waste paper sludge. The parameters like electricity, compressibility, workability, swelling ability and volume modified tendency were reviewed. It become discovered that stabilization improves the houses of construction cloth, resistance to corrosion, reduces floor deflection and will increase elastic moduli.

In the year (2014) R. Lakhani et al worked on the use of stone waste as a partial non pozzolanaic replacement for sand in mortar and urban. The parameter consists of a one-of-a-kind share of stone waste to decrease portland cement, sand intake, probably environmental harm and to enhance the durability houses of mortar and urban which contain pozzolanic and non pozzolanic fabric. It became located that stone waste can be utilized by different properties as an internal filler to growth the pore shape and resistance of concrete with admixtures.

T. Subramani et al reviewed the adjustments in properties of concrete by means of using mineral admixtures fly ash, silica fumes, ground granulated blast furnace slag, metakaolin and rice husk ash in the yr (2014). The parameter includes in this study were heat of hydration, settling time, bleeding and reactivity of admixtures. It turned into concluded that chemically active mineral admixture decreases workability and settling time of concrete, but increases the heat of hydration and reactivity whereas micro filler admixture increases workability and settling time of concrete, however decreases the warmth of hydration and reactivity of concrete.

B. Rai et al, (2014), studied the impact of adding of quarry dust into concrete. The parameter includes the compressive power and transverse energy through adding the extraordinary percent of quarry dirt. It was observed that blended used of quarry rock dust and fly ash inhibit superb performance due to green micro filling potential and pozzolanic interest. Mechanical properties of concrete can also boom by using fiber in civil industry.

In the year (2014) A. Carbonell Verdu et al synthetic the thermoplastic strengthened composite by using using excessive density polyethylene (from sugar cane) and slate fiber (from slate waste). The parameter in this observe includes have been compressive strength, tensile strength, flexural strength and effect of fibers. It changed into cited that 30 weight% slate fibers dealt with with propyltrimethoxy silane increases the tensile energy and flexural strength up to 16% and 18%.

M. Frias et.al, (2014), studied the chemical homes of combined cement organized with 10% and 20% of slate ash. the parameter is blanketed in this look at were chemical, mineralogical and mechanical homes of blended cement. It became cited that activated slate waste as a pozzolanic fabric in combined cement is technically viable.

In the year (2014) H.E. Elyamany et.al studied the impact of pozzolanic fillers and non pozzolanic fillers of the sparkling and hardened residences of self compacting concrete and probable concrete. The parameters studied were unit weight, porosity, water absorption and dice compressive electricity for specific chances of fillers. It was observed that non pozzolanic fillers improves segregation and bleeding resistance and have negligible impact on concrete compressive power.

In the year (2013) S. Farhana et al studied the feasibility by the usage of stone waste chips in concrete manufacturing as a partial substitute of natural aggregates in Indian context. The parameter includes value, intake of industrial waste, reduces volume of concrete and environmental influences. It turned into stated that the partial alternative to concrete via coarse combination does now not effect the general properties of concrete and decreases the value. The us of stone chips aggregate in concrete might also shop stone disposal value and bring greener concrete for production.

In the year (2013) X. Peng et al studied the impact of slate powder on the alkali activity of slate aggregate. The parameter includes the particle length and percent of slate powder in the growth of combination. It was observed that up to 20% of content of powder in slate aggregate it does not suppress the alkali aggregate reaction, but it affects the particle size and reduced the growth of specimen and while the content material is less than 10% it does no longer have a negative effect on the expansion of specimen.

A.D. Rawal et al (2013) worked as the conduct of concrete whilst replacing with the aid of ceramic waste with an extraordinary share in concrete. The parameters studied were distinct percent of ceramic waste in concrete and its impact on mechanical properties, compressive strength and value. It was found that the maximum compressive strength may be performed by using replacing 30% of cement with ceramic. Ceramic wastes may be used inside the construction enterprise, material improvement etc.

In the year (2013) L. Zang et al studied the substitution of alkali activity observed in slate powder using fly ash. The parameter included in this study were it consists of the proportion of slate powder, temperature and phase. It was found that up to 15% of addition of slate powder in fly ash the maximum alkali pastime of slate powder is reduced. Beyond this percent of slate it suppresses the characterization of combination.

Mortar bar take a look at approach turned into used to maximize use of slate powder. Mineral admixture containing energetic SiO2 enhances alkali silica reaction.

Prof. P.A. Shirule et al, (2012), studied the feasibility of usage of marble waste as a substitution for cement. The parameter includes of compressive strength, flexural strength and tensile strength with the addition of marble waste. Waste which comes from stone industry operations, which includes mining, extraction, sawing and so forth exerts a pollution load on the surroundings. It was noted that physical, chemical and mechanical properties of concrete, regularly increase as much as a positive limit than gradually decreases. Different kinds of components and industrial waste can be used as a substitution for cement to lessen the environmental pollution load.

In the year (2012) Nabil Al Joulani studied the effect of additives (stone powder and lime) on the properties of pleasant grained soil. The parameter is included in this study were direct shear, CBR properties and compaction test of soil. It was found that the addition of 30% components will increase the CBR properties of soil.

In the year (2010) T. D .J. Merkely et al studied the hydrophobicity and durability characteristics of cellulose fiber treated with natural resins. The parameters include in this study were characteristics of water absorption, water migration and water permeability. It was noted that the remedy of the cellulosic fiber with organic resins boom the hydrophobic characteristics of fiber strengthened cement composite cloth without any loss in the dimensional balance, power , pressure or toughness. Diverse approach of treating cellulose fibers with chemicals changed into evaluated to grow the fiber hydrophobicity for programs in the fiber strengthened cement composite materials.

In the year (2009) M. Kumar et al proposed the effect of waterproofing agent on the hydration of cement the usage of krystol internal membrane (KIM). The parameter includes settling time, non evaporable, water content material and free lime. It was observed that krystol inner membrane can be used as a waterproofing agent to increase the compressive strength and decrease the water percolation of cement. Kim has a retarding impact all through the hydration may be used because the waterproofing cloth in cement and concrete. Water seepage is a main trouble in construction industries. Waterproofing compounds containing hydrophobic organization are effective in fixing this hassle.

F.M .Barrior et al, (2005), worked at the rheological traits of ceramic binder within the injection moulding manner. The parameter consists in this study were flexural strength, shrinkage porosity and slate waste content. It was noted that 60% ceramic and 40% binder ratio with injection moulding increases the strength of cement and recovered the slate waste.

W. Labib et al (2005) reviewed that the usage of slate waste as an alternative aggregate in concrete. The parameter consists of the effect of particle shape, length grading, floor texture on workability, energy and the sturdiness of concrete. It was found that the flaky particle form of slate powder waste can be used as an aggregate in concrete. The usage of industrial wastes such as slate waste, fly ash, marble waste powder and so forth in concrete and form an aggregate. This conserves natural resources and decreases the distance wanted for landfill disposal.

In the year (2004) J. Hanna et al performed research work with the addition of admixture in the concrete blend and analyzed chemical residences of cement grout resulting from the presence of admixtures. The parameter in this study includes the effect of action between lignosulfates and naphthalene primarily based admixtures on the waste water. Differential thermal analysis, x ray diffraction approach and chemical analysis had been used for the willpower of solid substances in water. It was observed that the probability of sulfates and alkali compounds had been higher than the brink fee. Further studies work in the location of super plasticized concrete aggregate has been located in the literature in the region of impact of exquisite plasticizer on concrete enterprise, the complexity of the generation, price of fabric, life cycle price and environmental friendliness product.

In the year (2002) A. K. Suryavanshi et. al evaluated the physical and mechanical traits of mild weight mixes like ceramic lightweight aggregate, fillers, portland cement, aggregates and chemical additives. The parameters included in this study were compressive power, water repellent characteristics, porosity, water absorption of cement content within the mix. It was noted that including chemical additives into the mixes with ceramic microspheres generates lightweight concrete with a huge variety of densities, compressive power and water repellent characteristics. Calcium stearate a waterproofing compound improves the residences of the mix containing foaming agent and remedy the loss in compressive power.

In the year (1999) P.K. Mehta et al worked on the improvement of amazing plasticized concrete mixtures which give fluidity at rather low water content. The parameter in this study includes a fee of material, durability of concrete and occasional water content material. It was noted that to attain the low porosity and excessive strength products along with macro disorder unfastened cements and chemically bonded ceramic may be used in the vicinity of the antique technical approach.

In the year (1998) M. Paolini et. al overviewed the hydration of admixture cement at the properties of concrete with regard concrete. The paper deals with the chemistry and mechanism of action of these admixtures on the homes of concrete in regards concrete. It was found that adding the stabilizer in concrete does no longer have an effect on the durability and properties of concrete. Recycling of waste way is to lessen the quantity of waste within the manufacturing and use of concrete.

In the year (1996) Dr. A. K. Soni viewed a case look at for usage of slate mine waste into cost added products (bricks). The parameter includes compressive strength, tensile strength, flexural strength, porosity etc. It was observed that the manufacture of bricks the usage of slate mine waste may be applied in constructing construction, specifically in hilly areas in which conventional bricks are not effectively to be available.

In the year (1992) Eric Goulden studied the feasibility of use of slate waste combination in road construction. The parameter in this study includes the effect of particle length on water permeability, moisture-density relationship and frost susceptibility.

It was found that the mechanical and chemical properties of the slate aggregates from other sources are regular and can be used as an unbound granular layer in the road woks.

Conclusion

Slate pencil industries produce solid waste called slate powder that is generated during stone mining, quarrying, cutting, sawing, extraction etc activities. The waste generated from this industry accounts about 30% of the product formed. The characteristics of the waste show that it is highly hazardous in nature and causes severe non curable disease in human being called silicosis resulting in fetal death. Most of the research work seen in literature correlates the conversion or admixture of this waste in civil construction works. From the research work it seems that the waste may be used as filler in different types of products where fillers are added to produce desired properties. Similarly, it may be used as an ingredient in manufacturing waterproofing agents. The field related to bulk consumption of slate powder waste is to be identified and its feasibility to be evaluated. There is an urgent need for the renovation in technology, conversion of waste into any useful product and identification of the areas where this slate waste can be consumed safely so as to reduce the adverse effect on the environment.

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