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Efficacy of Waste Foundry Sand and Glass Fiber on Stabilization of Clay Soil

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Abstract:- **Soil is a fundamental and essential part of a civil structure that carries the dead and live load. The word soil derived from the Latin (Solium). Which means the upper layer of earth or the surface which mostly grows plants or use for cultivation. Soil is the top surface that bears any kind load of human beings, animals, transportation, engineering structure, etc. it necessitates to bear without any failure. But in some cases or area soil does not produce resistance against the load which is applied to that area. In such cases, the process of soil stabilization accomplishes with different materials like cementitious materials (cement, lime, fly ah, etc.), rocks (stone or gravel), wooden materials, steel or fibers, industrial waste materials (foundry sand, plastic waste, glass powder waste, waste marble powder, limestone powder, etc.) and agriculture waste materials (rice straw ash, rice husk ash, sugarcane bagasse, etc.) utilized for stabilization of soil by many researchers. In this review paper foundry sand and glass fiber has been review for soil stabilization. Foundry sand is known us waste material that coming from ferrous and non-ferrous metal casting industries and Glass fiber is a substance that is produced from very fine fibers of glass. Glass fiber has tremendous high mechanical properties like high strength, flexibility, stiffness, good high temperature and resistance to chemical harm. Published literature has conducted the utilization of foundry sand and glass fiber in different percentages. The consequences of perusal reveal that foundry sand and glass fiber are appropriate and suitable materials for soil stabilization.**

Keywords: Soil Stabilization, Foundry Sand, Glass Fiber, CBR, MDD, OMC.

I. INTRODUCTION

Soil is an essential resource for the world, it producing many different crops. Like it serves to produce the human requirements of food with cultivation and also soil is a substance which plays the predominately important roles for any civil engineering structures such as highways, canals, and embankments occupy vast areas of land as they often stretch over several kilometers. Soil carries a load of these structures, clay Soil is the finest particles of all the particle soil, the size of clay soil is measured fewer than 0.002, this soil consists of microscopic and sub-microscopic particles which are derived from of rocks chemical decomposition. Clay is known as very fine-grained and cohesive soil. although clay is prepared for soil which has more than 25 percent off the clay in their combination because that clay soil holds a high amount of water and wet clay soil is very sticky it consists of very less amount of air in their combination. Clay expands when in contact with water and behaves like rocks and when dried the shrink creates in work like concrete. Which are generally round, particles of clay are very fine and thin, flat and covered with tiny plates. Organic clay is highly compressible and its strength is superb when it getting dry. In most cases, clay is utilized as a mud mortar for plastering purposes in construction industries. but in some cases, soil produces weak shear strength and lack of strength of soil against tensile forces, for improving strength soil bearing capacity many researchers have conducted studies on soil stabilization or looked after increasing the load-bearing capacity with some alternative materials or possible waste materials is as an ingredient, that can help soil to improve its bearing capacity strength and mechanical properties of soil. The waste materials for soil stabilization have become popular by considering the environment and economy. In this review paper foundry sand is high-quality size-specific silica sands for use in their molding and casting operations and several million tons foundries sand that can no longer be utilized for the production of metal casting molds and cores. This foundries sand is known as used foundry sand, in most cases, it goes for landfilling which generates anxiety to the environment and also increases cost also because it needs transportation, stuff, and machine. It can be a possible materials to utilizing as an ingredient to stabilized soil and glass fiber is produced from a very fine fiber of glass, glass fiber a superb mechanical properties like a very tensile strength, stiffness, and a flexibility, it is tremendous material for improving soil bearing capacity or CBR of soil have utilized for soil stabilization in most papers the result determines that foundry sand and glass fiber is superb material improve soil bearing capacity. A possible use for these materials is as an ingredient in manufactured soils.

II. LITERATURE REVIEW

Torase *et al.,* 2019 have experimental scrutiny on soil stabilization addition of foundry sand and rice husk ash in various proportion 10% Foundry Sand (5, 10, 15, and 20) % Rice Husk Ash. The outcome of this scrutiny reveals that with the addition of Foundry sand and Rice Husk Ash show an

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overall improvement in soil. it also one of the superb material for stabilization of soil[1].
Kuldeep and Tripti 2019 have done an experimental probe on soil stabilization with some waste material foundry sand and marble dust in different percentages. The utilization of foundry sand (13 to 22) % and marble dust (13 to 22) %. The maximum CBR value achieved in 16% of marble dust and 22% of foundry sand. These materials improve soil bearing capacity[2].

Naeethu and Johnson 2019 have done an experimental probe on soil, in this probe tried to evaluate the effect foundry sand on CBR characterization of soil. The outcome reveals that 20% utilization of soil is the best combination. It creates maximum MMD value[3].

Ajeet *et al.,* 2018 Have done an appraisal on soil stabilization with the utilization of foundry sand and fly ash in different proportions. The outcome of the evaluation shows that the best point of MMD is 1% fly ash and 0.25% foundry sand and also ¼ is the best addition for stabilization of soil[4].

Gowtham *et al.,* 2018 have utilized glass waste and plastic waste in (2, 4, and 6) percentage for stabilization of soil. The consequence of the evaluation shows that up to 4% and 6% of Glass and Plastic powder is beneficial to utilize for the improvement of geotechnical properties of soil[5].

Premlatha *et al.,* 2018 Examined on the utilization of plastic waste and foundry sand for soil stabilization. The consequence of examination conveys that 17.5 % plastic waste and 40% foundry sand produce superb stability and also reduce construction costs up to 10% compared to conventional material[6].

Matthew and Olusegun 2018 have done experimental scrutiny on the utilization of glass fiber for soil stabilization various percentages Glass Fiber at proportions of 0.4%. 0.8%, 1.2%, 1.6%, 2.0%, 2.5% and 3.0% by weight. The outcome of the inspection reveals that the addition of glass fiber increase CBR and maximum dry density with the peak influence show at (1.2 to 1.6) %[7].

Asadollahi and Dabiri 2017 examined the effect of Glass Fiber Reinforced Polymer on the geotechnical properties of clayey soil. The length of GFRP is selected 10 mm and the amount of GFRP is (0.2, 0.4, 0.6, 0.8 and 1%) that mixed randomly with clay. The result shows that up to 0.8% of GFRP is increasing the bearing capacity of the soil and further than that the resistance capacity starts decreasing[8].

Razvi *et al.,* 2017 Have done experimental inquiry on soil stabilization with foundry sand and fly ash. The consequence of evaluation reveals that foundry sand and fly ash are superb materials to utilize for soil stabilization to reduce the thickness of subgrade produce superb strength is more accurate as compared to conventional. Fly Ash also provides and soft and smooth surface[9].

Kumar *et al.,*2016 Have done experimental evaluation for soil stabilization with the utilization of foundry sand to replace the soil in different proportions from (0 to 20) percentages. The consequences of appraisal reveal that CBR increase from 8.9% to 18.21% with an increase of foundry sand. Foundry sand shows all-round improvement and is a superb material for soil stabilization[10].

Guas 2016 have examined the utilization of foundry sand and lime in different proportion for stabilization of soil. The outcome of appraisal reveals that foundry sand and lime is superb utilization for soil stabilization[11].

Patel and Singh 2016 have examined the utilization of glass fiber for soil stabilization in different proportions. The result of appraisal reveals that the CBR value has significant improvement with fiber contents the optimum is 0.75% and maximum overall improvement have been found in addition 0.75% of glass fiber[12].

Vivek *et al.,* 2015 have done experimental appraisal on soil stabilization with different lengths and percentages of glass fiber. The resulting exhibit that 5cm Glass Fiber is effective in all cases. 0.5% and length of 5cm are provided a superb UCC value[13].

Himadri 2015 has done an experimental inspection on the effect of glass fiber on red soil. In this, experimentally different proportions (0, 0.5, 1 and 1.5) % have been evaluated. The consequences of this examination show that the unconfined compressive strength of the sample with no reinforcement is around 146 Kpa. The value of unconfined compressive strength increased from 146 Kpa to 171 Kpa for the 0.5% fiber 180 Kpa 1% fiber 204 Kpa 1.5% Kpa. Dry density decrease with the increase of glass fiber[14].

Kulkarni and Patil 2014 have done an analysis of soil stabilization with the utilization of Blast Furnace Slag and Glass Fiber in different percentages. The consequences reveal that 25% of Blass Furnace Slag with 12mm Glass Fiber have better performance in soil stabilization[15].

Olufowobi *et al.,* 2014 have done an experimental probe on clay soil stabilization with the addition of glass powder in various proportions like (1, 2, 5, 10, 15) % Glass Powder by weight of Sample. The consequence of this analysis shows that Show Gradual increase up to 5% after 5% show decrease highest CBR values of 14.90% and 112.91% were obtained at 5% glass powder. this probe reveals that 5% of addition is a superb percentage for soil stabilization[16].

Mishra 2013 have done exploration on soil stabilization with the addition of foundry sand and iron turning in different proportion. The conclusion of research reveals that maximum dry density achieved in 20% foundry sand and 3% of iron turning. And 3% of iron turning reveals that California Bearing Ratio (CBR) Value increase from 7.20% to 20% for un-soaked condition and from 5.2% to 12% for the soaked condition is most foundry sand and iron turning is accurate material for soil stabilization[17].

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Kumar and Kumar 2012. Have done experimental exploration to stabilize clayey soil with waste material like Foundry Sand from (10 to 50) % and Fly Ash from (10 to 40) %. The result of perusal shows that maximum dry density achieved 40% of foundry sand and CBR value increase from (2.44% to 5.1%).it shows significantly increase with the utilization of foundry sand and fly ash in clayey soil[18].

Sezer *et al.*, 2006 Examined to stabilize the clay soil of Izmer of Turkey with the addition of high lime fly ash in different percentages (0, 5, 10, 15, 20)%. The outcome of examination shows with an increase of fly ash the optimum moisture content increase and is accurate to utilize fly ash up to 15% in clay soil[19].

III. RESULT AND ANALYSIS

Table- I: Result and Analysis of utilization of waste foundry sand and glass fiber for stabilization clay soil.

Author	Year	Name of Paper	Materials Used	Percentage of Glass Fiber	Result
Torase *et al.*	2019	Soil Stabilization by Using Foundry Sand and Rice Husk Ash	Foundry Sand Rice Husk Ash	(10% Foundry Sand (5, 10, 15, 20)% Rice Husk Ash	The outcome of this scrutiny reveals that with the addition of Foundry sand and Rice Husk Ash show an overall improvement in soil. it
Kuldeep and Tripti	2019	Experimental Study of Waste Foundry Sand and Marble Dust as a Soil Stabilizing Materials	Waste Foundry Sand Marble Dust	(13, 22)% Foundry Sand (13, 22)% Marble Dust	The maximum CBR value achieved in 16% of marble dust and 22% of foundry sand. These materials improve soil bearing capacity
Naeethu and Johnson	2019	Effect Of Foundry Sand On The C.B.R Characteristics Of Soil	Foundry Sand	(10, 20)% Foundry by weight of soil	The outcome reveals that 20% utilization of soil is the best combination. It creates maximum MMD value.
Ajeet *et al.*	2018	Stabilization of Soil by Foundry Sand Waste with Fly-Ash	Foundry Sand Fly Ash	1% FA + 0% FS 1% FA + 0.25% FS 1% FA+ 0.5% FS 2% FA + 0.5% FS 3% FA + 0.75% FS	The outcome of the evaluation shows that the best point of MMD is 1% fly ash and 0.25% foundry sand and also ¼ is the best addition for stabilization of soil.
Gowtham *et al*	2018	Stabilization of Clay Soil by Using Glass and Plastic Waste Powder	Glass Powder Plastic Waste Powder	(2, 4, 6)% Glass and Plastic Powder	The consequence of the evaluation shows that up to 4% and 6% of Glass and Plastic powder is beneficial to utilize for the improvement of geotechnical properties of soil.
Premlatha *et al*	2018	Utilization of Plastic Waste and Foundry Waste in Flexible Pavements	Plastic Waste Foundry Waste	(0, 20)% Plastic Waste and (20, 50)% Foundry Sand	17.5% +40% Plastic Waste and Foundry Sand give superb stability and the construction cost can decrease up to 10%
Matthew and Olusegun	2018	Investigation of Glass Fiber Potential in Soil Stabilization	Glass Fiber	Glass Fiber at proportions of 0.4%. 0.8%, 1.2%, 1.6%, 2.0%, 2.5% and 3.0% by weight.	The outcome of the inspection reveals that the addition of glass fiber increase CBR and maximum dry density with the peak influence show at (1.2 to 1.6) %.
Asadollahi and Dabiri	2017	Effects of Glass Fiber Reinforced Polymer on Geotechnical Properties of Clayey Soil	Glass Fiber Reinforced Polymer	Length GFRP is selected 10 mm GFRP is (0.2, 0.4, 0.6, 0.8 and 1%)	The result shows that up to 0.8% of GFRP is increasing the bearing capacity of the soil and further than that the resistance capacity starts decreasing
Razvi *et al*	2017	Stabilization of Soil by Foundry Sand with Fly-Ash	Fly Ash Foundry Sand	1% Fly Ash and 0.25% of foundry sand	The consequence of evaluation reveals that foundry sand and fly ash are superb materials to utilize for soil stabilization to reduce the thickness of subgrade produce superb strength is more accurate as compared to conventional.
Kumar *et al*	2016	Stabilization of Sub Grade Soil by Using Foundry Sand Waste	Foundry Sand Waste	(0, 5, 10, 15, 20)% Foundry Sand by weight of soil	The consequences of appraisal reveal that CBR increase from 8.9% to 18.21% with an increase of foundry sand. Foundry sand shows all-round improvement and is a superb material for soil stabilization.
Guas	2016	Stabilization of Black Cotton Soil Using Waste Foundry Sand & Lime	Waste Foundry Sand Lime	(20% Foundry Sand (0, 10)% Lime	The outcome of appraisal reveals that foundry sand and lime is superb utilization for soil stabilization.
Patel and Singh	2016	Investigation of Glass Fiber Reinforcement Effect on the CBR Strength of Cohesive Soil	Glass Fiber Reinforcement	(0, 0.25, 0.5, 0.75 and 1)% Fiber of dry weight of soil	The result of appraisal reveals that the CBR value has significant improvement with fiber contents the optimum is 0.75% and maximum overall improvement have been found in addition 0.75% of glass fiber.
Vivek *et al*	2015	Stabilization of Kaolinite Clay using Glass Fibers of Different Length	Glass Fiber	(0%, 0.1%, 0.3%, 0.5%, 0.75%, 1%). Glass Fiber	The resulting exhibit that 5cm Glass Fiber is effective in all cases. 0.5% and length of 5cm are provided a superb UCC value.
Himadri	2015	Effect of Glass Fiber on Red Soil	Glass Fiber	(0, 0.5, 1, 1.5)% in dry weight of soil	The unconfined compressive strength of the sample with no reinforcement is around 146 kPa. The value of unconfined compressive strength increased from 146

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					Kpa to 171 kPa for the 0.5% fiber 180 Kpa 1% fiber 204 Kpa 1.5% Kpa.Dry density decrease with the increase of glass fiber.
Kulkarni and Patil	2014	Experimental Study of Stabilization of B.C. Soil by Using Slag and Glass Fibers	Blast Furnace Slag and Glass Fiber	BFS (0, 5, 10, 15, 20, 25, 30)% and glass fiber length of (6 & 12)mm (0, 0.25, 0.50, 0.75, 1.00 and 1.25)% Glass Fiber	The consequences reveal that 25% of Blass Furnace Slag with 12mm Glass Fiber have better performance in soil stabilization.
Olufowobi *et al*	2014	Clay Soil Stabilization Using Powdered Glass	Glass Powder	(1, 2, 5, 10, 15)% Glass Powder by weight of Sample	The consequence of this analysis shows that Show Gradual increase up to 5% after 5% show decrease highest CBR values of 14.90% and 112.91% were obtained at 5% glass powder. This probe reveals that 5% of addition is a superb percentage for soil stabilization.
Mishra	2013	A Study on Characteristics of Subgrade Soil by Use of Foundry Sand and Iron Turnings	Foundry Sand Iron Turning	(0, 5, 10, 15, 20, 25, 30, 35, 40)% Foundry Sand 3% Iron Turning	The conclusion of research reveals that maximum dry density achieved in 20% foundry sand and 3% of iron turning. And 3% of iron turning reveals that California Bearing Ratio (CBR) Value increase from 7.20% to 20% for un-soaked condition and from 5.2% to 12% for the soaked condition.
Kumar and Kumar	2012	Compaction and Sub-grade Characteristics of Clayey Soil Mixed with Foundry Sand and Fly Ash	Foundry Sand Fly Ash	Foundry Sand (10 to 50) % with clay Clayey Soil (50 to 90) % with FS Fly Ash (10 to 40) % with optimum of Clay-Foundry Sand	The result of perusal shows that maximum dry density achieved 40% of foundry sand and CBR value increase from (2.44% to 5.1%).it shows significantly increase with the utilization of foundry sand and fly ash in clayey soil.
Sezer *et al*	2006	Utilization of a very high lime fly ash for improvement of Izmir clay	High Lime Fly Ash	Fly Ash (0, 5, 10, 15, and 20) % replaced soil.	)%. The outcome of examination shows with an increase of fly ash the optimum moisture content increase and is accurate to utilize fly ash up to 15% in clay soil.

IV. CONCLUSION

1. Result reveals that the foundry sand is a fine material for soil stabilization because foundry sand is consists of high silica which helps to improve the strength of materials.
2. MDD (maximum dry density) and OMC (optimum moisture contents) are tremendously effect by the utilization of Glass Fiber.
3. It creates maximum MMD value with 20% utilization foundry sand to the weight of soil, it is the best combination.
4. Waste Foundry sand is a superb combination with OMC in improving the mechanical properties of soil.
5. CBR values increase up to some percentage with the use of foundry sand and glass fiber.
6. The addition of glass fiber increases CBR and maximum dry density with the peak influence show at (1.2 to 1.6) %.
7. Show maximum MDD (maximum dry density) achieved with 1% fly ash and 0.25% foundry sand and also ¼ is the best addition for stabilization of soil.
8. MMD (maximum dry density) achieved 40% of foundry sand and CBR value increase from (2.44% to 5.1%).it shows significantly increase with the utilization of foundry sand and fly ash in clayey soil.

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M. Tech Research scholars, department Civil Engineering of Chandigarh University, I the undersigned solemnly declare that the project report **Efficacy of waste foundry sand and glass fiber on stabilization of clay soil** manuscript focus on utilization of waste foundry sand and glass fiber for soil stabilization for civil engineering industries. Waste foundry sand and glass fiber could be superb materials for improving the mechanical properties and durability of clay soil. It is based on our own works, which carried out under the supervision of (Amanpreet Tangri) Assistant Professor, Chandigarh University, and Punjab, India.

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