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The Effect Of Adding Iron Powder Waste On Soil Carrying Capacity Case Study Of Soil In Kedungpring District

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ABSTRACT
Land is useful as a support for building foundations and as a building material itself. Factors that affect the bearing capacity of the soil include: soil type, density level, water content, and others. Human activities in meeting their needs sometimes cause soil mobilization. For that, it is necessary to improve the shrinkage properties of the soil. The purpose of this study is to analyze the California Bearing Ratio (CBR) value of clay soil with the addition of iron powder waste as a mixture, which is expected to be able to strengthen the bearing capacity of the soil in the soil pavement layer. The purpose of this study was to determine how much influence the addition of iron powder waste to clay soil has on the California Bearing Ratio (CBR) value. The methods used are direct shear test and CBR test. By going through the stages of testing including, water content testing, soil specific gravity testing, wet volume testing, dry volume testing, plastic limit testing, liquid limit testing, free pressure testing, standard density testing, California Bearing Ratio (CBR) test, and direct shear test. It is known from the results of the CBR Test, the CBR value of the soil increased from normal soil testing by 2.65% to 3.48% after adding a mixture variation of 5% iron powder, to 3.10% after adding a mixture variation of 10% iron powder, and there was a decrease after adding a mixture variation of 15% iron powder by 2.66% and for direct shear testing (Direct Shear Test) there was an increase of 12.7217 kg/cm2 in the 10% iron powder mixture variation.

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INTRODUCTION

Deep ground understanding technique is generally defined as material consisting of aggregates (grains) of solid minerals that are not cemented (chemically bound) to each other and of weathered organic materials (which are solid particles accompanied by liquids and gases that fill the spaces). empty space in between particles congested the) (Baskara, Aribudiman dan Tjerita, 2015). Bearing capacity analysis studies the ability of the soil to support the load of the foundation of the structure located above it. Bearing capacity states the shear resistance of the soil to resist settlement due to loading, namely the shear resistance that can be exerted by the soil along its shear planes. (Hardiyatmo 1996).

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Powder iron is results from remainder piece or remainder turning iron pour which is results use in industry . There are three type iron pour a lot used that is iron pour gray (grey cast iron), iron pour tenacious or iron nodular cast iron , and iron pour white (white cast iron), third type iron pour This have composition almost chemistry The same . Usage iron industry produce waste waste form powder iron which is results direct from remainder turning and cutting iron . (Purwanto and Cakra Wardani, 2020).

Recently Already Lots done study about efforts For stabilize land with various modification materials used among them research conducted by Palar, et al (2013) shows that results addition lime and tras can increase Power support land . So are research conducted by Pretty, et al (2013) shows that clay stabilized expansion with using cement in variations of 0%, 5%, 10%, 15% and 20% shows exists enhancement Power support land and subsidence index sufficient plasticity significant . Use powder Polyvinyl chloride (PVC) is also one addition substance in stabilizer land because PVC is results from polymerization of vinyl monomer chloride with rock catalyst . (Desnelli , Miksusanti , 2010). Cai, Y, et all (2006) also did study with use mixed lime with PP fiber with percentage PP fiber 0.05 %; 0.15% and 0.25% and percentages lime 2%, 5%, and 8% of heavy land . Research result show that enhancement percentage from PP fiber causes enhancement strong press land and potential shrinkage .

Village Road Gunungrejo District Kedungpring Regency . Lamongan is located in rice field area , this road section uses concrete pavement . Concrete pavement depends on good soil structure. Before starting to build road pavement, the need to improve the soil structure must be considered . And of course soil is a basic factor in network damage . Village Road Gunungrejo was built on a mound of land in a rice field area which naturally holds a lot of water and influences it the stability of the roads in this area , which results in many potholes and bumpy roads . Lots of it waste powder The iron found in Gunungrejo Village was obtained from results activity industry Dua Jaya Welding Workshop is also felt Enough endanger Because content in powder iron That form oxide metal that can cause pollution environment .

Based on the existing problems , this research was carried out by adding iron powder as a soil stabilizer mixture to increase the shear value or compressive strength of the CBR of construction clay soil. road on top, in the hope that the clay soil can support the construction walk strongly and research hope with exists study This can reduce pollution that occurs in the area the . As for the goals you want achieved from study This is know influence addition waste powder iron in the soil clay as well as know the improvements mark stability land clay after given variation mixture waste powder iron with presentation addition 5%, 10%, and 15% reviewed from CBR test .

Clay soil is a type of cohesive soil, namely soil that has fine grains. This type of soil has a high potential for swell and shrinkage and has good bearing capacity for unsaturated conditions and poor bearing capacity for water saturated conditions .(Saleh dan Anggraini, 2019). Soil stabilization is an alternative to improve soil properties so that it can increase the bearing strength of the soil (Kusuma, Mina, & OM, 2015). The soil stabilization process involves mixing the soil with other soils to obtain the desired gradation with additional

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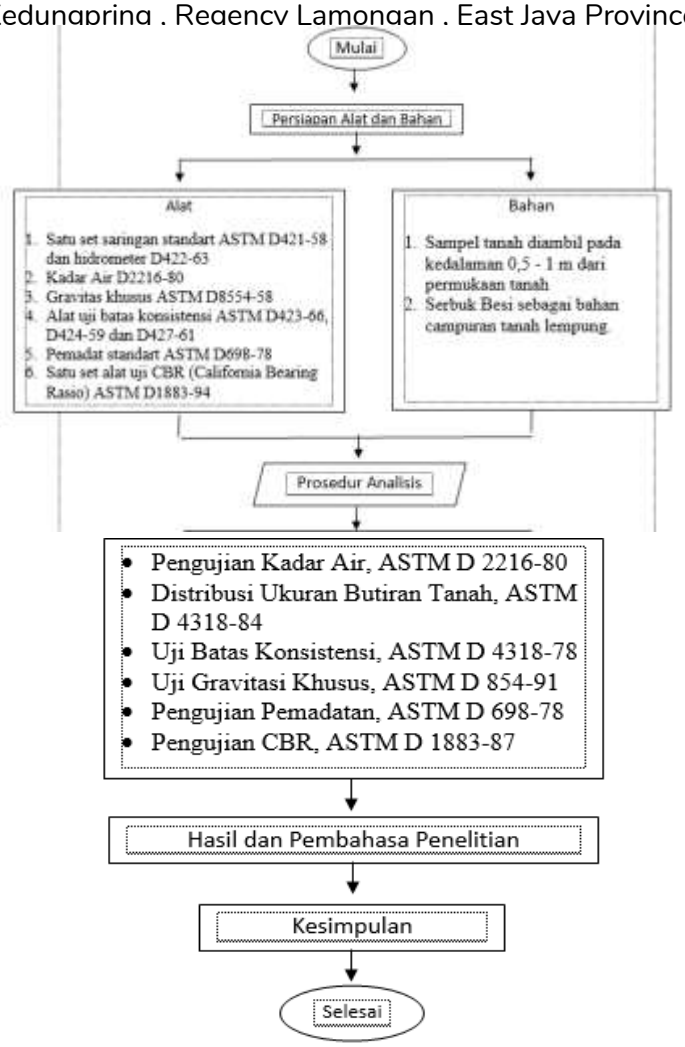
materials. so that the properties of the soil can be better. The stabilization methods that are widely used are mechanical stabilization and chemical stabilization. Mechanical stabilization is one method for increasing the bearing capacity of the soil by improving the structure and improving the mechanical properties of the soil, while chemical stabilization is increasing the strength and Strengthen the bearing capacity of the soil by reducing or eliminating the unfavorable characteristics of the soil type by mixing the soil with chemicals.

METHODS

In research with title THE EFFECT OF ADDING IRON POWDER WASTE ON SOIL CARRYING Capacity CASE STUDY OF SOIL IN KEDUNGPRING DISTRICT is research carried out on a laboratory scale, where this research was carried out in the Soil Mechanics laboratory at Lamongan Islamic University. Soil sample obtained from Gunungrejo Village , District Kedungpring , Regency Lamongan , East Java Province . And to sample Waste Powder Iron originate from Dua Jaya Welding Workshop which is also in Gunungrejo Village , District Kedungpring , Regency Lamongan , East Java Province .



Gambar 3. 1 *Flow Chart* Penelitian
Sumber : Hasil Penelitian, 2024

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RESULTS AND DISCUSSION

Soil Water Content (Water Content Test)

Inspection This intended For determine rate water land . What is meant by ground water content is: the ratio between the weight of soil water contained in land with heavy land itself and stated in percent. As has been carried out at the Lamongan Islamic University Soil Mechanics Laboratory which has been recorded and listed in the table above.

Dry Volume Weight and Wet Volume Weight

Intent of inspection This is For determine soil density in the field how to drive cylinder for relatively undisturbed soil (no disturbed) with method stabbing cylinder thin steel to in land via a special driving head . Test This only For type land with shallow depth) less from 1 meter or can be on the surface land just . This method No intended For sample very hard ground , which is not can stabbed with cylinder steel and also not For land that owns level plasticity low that can be taken with cylinder . The results of the data obtained from research on average water content are:

Normal soil water content	: 7.02%
Normal soil water content with a mixture of 5% iron powder	: 3.56%
Normal soil water content with a mixture of 10% iron powder	: 3.43%
Normal soil water content with a mixture of 15% iron powder	: 3.83%

Soil Specific Gravity

This examination of the specific gravity of the soil is intended For determine heavy type land Which have details past filter No.4 with picnometer. Heavy type Soil is the ratio between the weight of soil grains and the weight of distilled water with the same side on certain temperature. The results of the research obtained data on average soil density, namely:

Normal soil density	: 1.995%
Specific gravity of 5% iron powder	: 1.572%
Specific gravity of 10% iron powder	: 1.790%
Specific gravity of 15% iron powder	: 0.731%

And according to these averages, the soil is classified as organic clay.

Plastic Limit

The plastic limit is the minimum level at which a soil is still in a state plastic. So, this examination is intended to determine the water content minimum where a soil is at the plastic limit state. (plastic = soil Still can be rolled to diameter ± 3.1 mm or 1/8 inch). From the research that has been carried out, the average plastic limit data is obtained, namely:

Plastic Limit of normal soil	: 10.46%
Plastic Limit of normal soil with a mixture of 5% iron powder	: 8.98%
Plastic Limit of normal soil with a mixture of 10% iron powder	: 9.49%
Plastic Limit of normal soil with a mixture of iron powder 15%	: 5.10%

Liquid Limit

This examination is intended to determine the level of a soil liquid limit state. The liquid limit is the minimum water content in the soil can still flow under its weight or water content at the limit where something the soil changes from a liquid state to a state plastic.

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From the research that has been carried out, the average liquid limit data is obtained, namely:

Normal land liquid limit	: 30.00%
Liqut Limit of normal soil with a mixture of 5% iron powder	: 32.20%
Liqut Limit of normal soil with a mixture of 10% iron powder	: 28.13%
Liqut Limit of normal soil with a mixture of 15% iron powder	: 21.67%

Plastic Index (PI) inspection

This test aims to determine the value of the plasticity index (PI), which is the water content interval where the soil is still plastic. Therefore, the plasticity index shows the plasticity of the soil. If the soil has a high PI, it means the soil contains a lot of clay granules. If the PI is low, such as silt, a slight reduction in water content results in the soil becoming dry. The limits regarding the plasticity index, properties, soil type and cohesion are given by Atterberg in table 4.27

PI	Characteristic	Kind of land	Cohesion
0 < 7 7 – 17 **>17**	Non-plastic Plasticity Low Plasticity currently **Plasticity tall**	Silt Sand Clay silty **Clay**	Non cohesive Cohesive partly Cohesive **Cohesive**

From the research that has been carried out, the average PI data is obtained, namely:
Normal soil plastic index: 19.54% (high plasticity)
Plastic index of normal soil with a mixture of 5% iron powder: 23.22% (high plasticity)
Plastic index of normal soil with a mixture of 10% iron powder: 18.64% (high plasticity)
Normal soil plastic index with a mixture of 15% iron powder: 16.57% (medium plasticity)

Unconfined Compression Free Press Inspection

Inspection This intended For determine magnitude of power press free soil samples And rock Which nature cohesive in original or artificial (remolded) condition. What is meant by strength press free is big axial unity wide per moment object test experience failure or when the axial strain reaches 20%. The results of the research that has been carried out show the following qu values:

Soil sample code (A)	
Normal soil qu value	: 0.427%
Qu value of 5% iron powder mixture	: 0.342%
Qu value of 10% iron powder mixture	: 0.427%
Qu value of 15% iron powder mixture	: 0.548%
Soil sample code (B)	
Normal soil qu value	: 0.411%
Qu value of 5% iron powder mixture	: 0.274%
Qu value of 10% iron powder mixture	: 0.285%
Qu value of 15% iron powder mixture	: 0.411%

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Standard Density Check

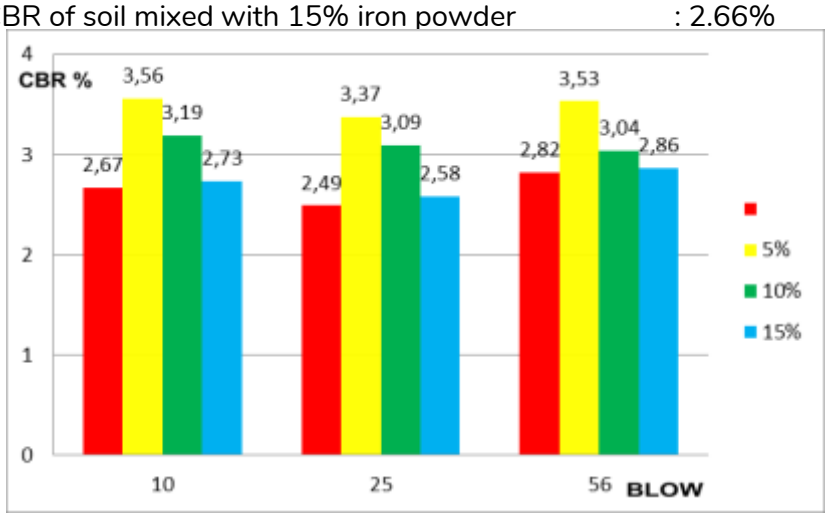
Inspection This intended For determine connection between water content and density land with method compact inside print use tool pounder weighing 2.5 kg and tall fell 30 cm (12"). In the standard density test (Commaction Test) normal soil reaches an optimum state when the soil is mixed with 200 ml of water, while a mixture of iron powder reaches an optimum state when mixed with 300 ml of water. From the research that has been done If carried out, standard density data is obtained as follows:

Normal soil standard density	: 13.55%
Standard density of 5% iron powder mixture	: 26.22%
Standard density of 10% iron powder mixture	: 28.89%
Standard density of 15% iron powder mixture	: 29.40%

CBR check

Inspection This intended For determine price of CBR soil and mixture land compacted aggregate in the laboratory at a certain water content . CBR is comparison between burden penetration something material standard with depth and speed the same penetration . CBR prices are comparison between strength example land with density certain to strength of crushed stone graded meeting as material standards with CBR value . From the research that has been carried out, the average CBR value is obtained as follows:

Normal soil CBR	: 2.65%
CBR of soil mixed with 5% iron powder	: 3.48%
CBR of soil with a mixture of 10% iron powder	: 3.10%
CBR of soil mixed with 15% iron powder	: 2.66%



According to Bowles (1992), land with CBR values < 3% were classified as land with low CBR , 3-7% as land with low CBR until medium , 7-20% as land with moderate CBR , and > 20% as land with good CBR . So from The results obtained above are the CBR values experienced increase in mixture powder still 5% iron classified as land with low CBR until currently . Soil with CBR 3.48% after still stabilized Not yet Can made land base road (subbase) Because Still classified Bad in classification listed in table 4.78 above.

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Direct Shear Test (Direct Shear Force)

Inspection This intended For look for strength parameter value land namely Cohesive of Soil (c = kg/cm 2), angle shift depth and strength slide (s). From the research that has been done done so obtained mark corner shift in as following :

a. Angle value shift in normal ground is 21.91° with cohesion (c) = 0.1565 and strength shift amounting to 22.066 kg/cm 2.
b. Angle value shift in land with mixture powder 5% iron of 4.83° with cohesion (c) = 0.2087 and strength shift amounting to 5.0387 kg/cm 2.
c. Angle value shift in land with mixture powder 10% iron at 12.5° with cohesion (c) = 0.2217 and strength shift amounting to 12.7217 kg/cm 2.
d. Angle value shift in land with mixture powder 15% iron of 1.85° with cohesion (c) = 0.3521 and strength shift amounting to 2.173 kg/cm 2.

For robust parameter comparison shift land to test samples that use mixture powder iron and value cohesion (c) more small than a test sample without use mixture powder iron .

CONCLUSIONS

CBR test results after do addition of powder material iron in the soil clay , as following :

- Clay soil + 5% iron powder obtained an average CBR value = 3.48%.
- Clay soil + 10% iron powder obtained an average CBR value = 3.10%.
- Clay soil + 15% iron powder obtained an average CBR value = 2.66%.

It turns out that clay mixed with iron powder can increase the bearing capacity of the soil in terms of the CBR test, namely:

No	Testing Activities	CBR Value (%)	Percentage increase in CBR value (%)
1	Normal Mixture (T. Clay)	2.65%	-
2	T. Clay + Iron Powder 5%	3.48%	(+) 31.32%
3	T. Clay + Iron Powder 10%	3.10%	(+) 16.98%
4	T. Clay + Iron Powder 15%	2.66%	(+) 0.37%

So the highest increase in CBR value (%) was achieved (+) 31.32% in the mixture of T. Clay + 5% Iron Powder. However, despite this, based on the results that have been obtained above, the CBR value which has increased in the 5% iron powder mixture is still classified as soil with low to medium CBR , because according to Bowles (1992) is as follows:

- CBR < 3% is classified as soil with low CBR.
- CBR 3-7% is classified as soil with low to medium CBR.
- CBR 7-20% as soil with medium CBR.
- CBR > 20% as soil with good CBR.

Clay soil that has been stabilized with the addition of iron filings waste still cannot meet the classification of soil as road base (subbase), which has been explained above that soil with a CBR of 3-9% is still classified as bad if used as road base (subbase).

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