



The Effect of Lime Addition in Physical and Mechanical Soil Properties Due to Drying Process on Bengawan Solo River Embankment in Plangwot Area, Lamongan


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Outline

- Introduction
 - Methodology
 - Optimum Condition
 - Actual Dry Water Content and Drying Process
 - Physical Properties
 - Mechanical Properties
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Introduction



Dry Season

Decrease of
water level

Weather
The sun+ increase
in temperature

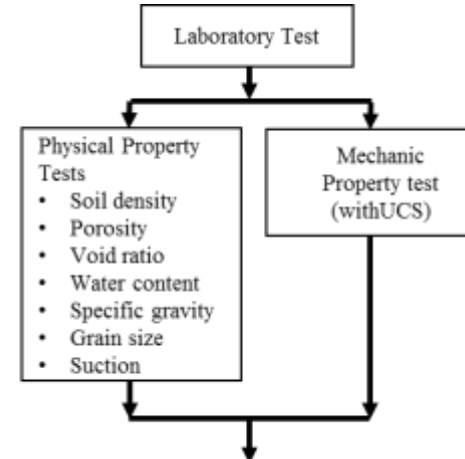
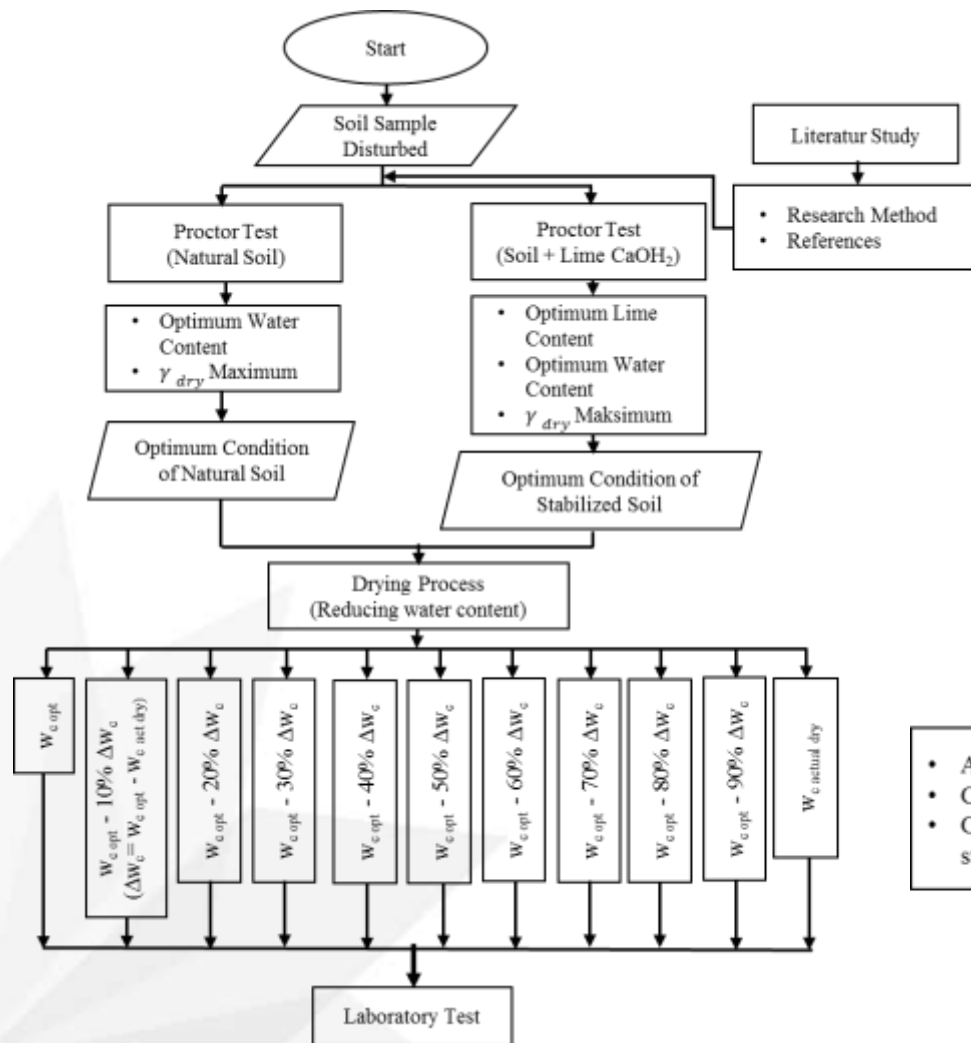
Soil on surface

Drying
(reduction of water content)

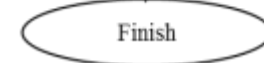
Negative pore water
preasure increased



Methodology

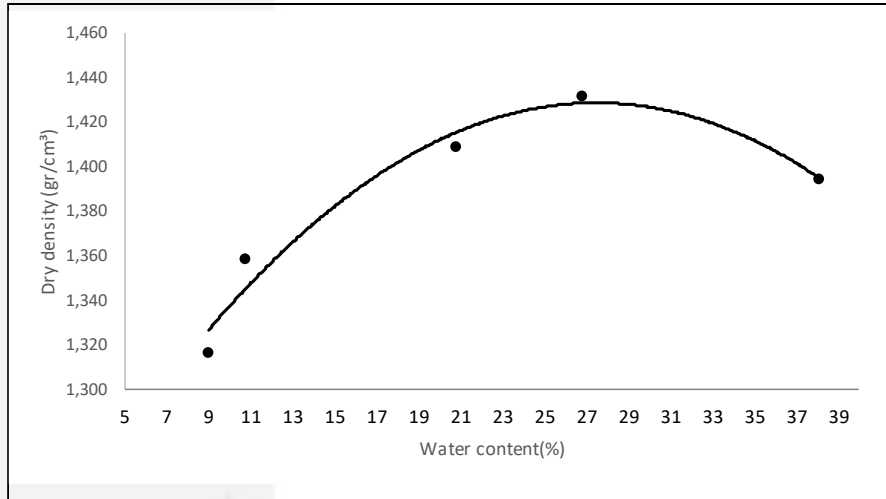


- Analysis of laboratory test results
- Compare the results of laboratory tests before and after the drying process
- Compare the results of soil stabilized laboratory tests with lime with no lime stabilization.



Optimum Condition

- Natural Soil



γ_{dry} maksimum = 1,432 t/m³

$w_{c\ opt}$ = 26,815 %

- Lime-Stabilized Soil

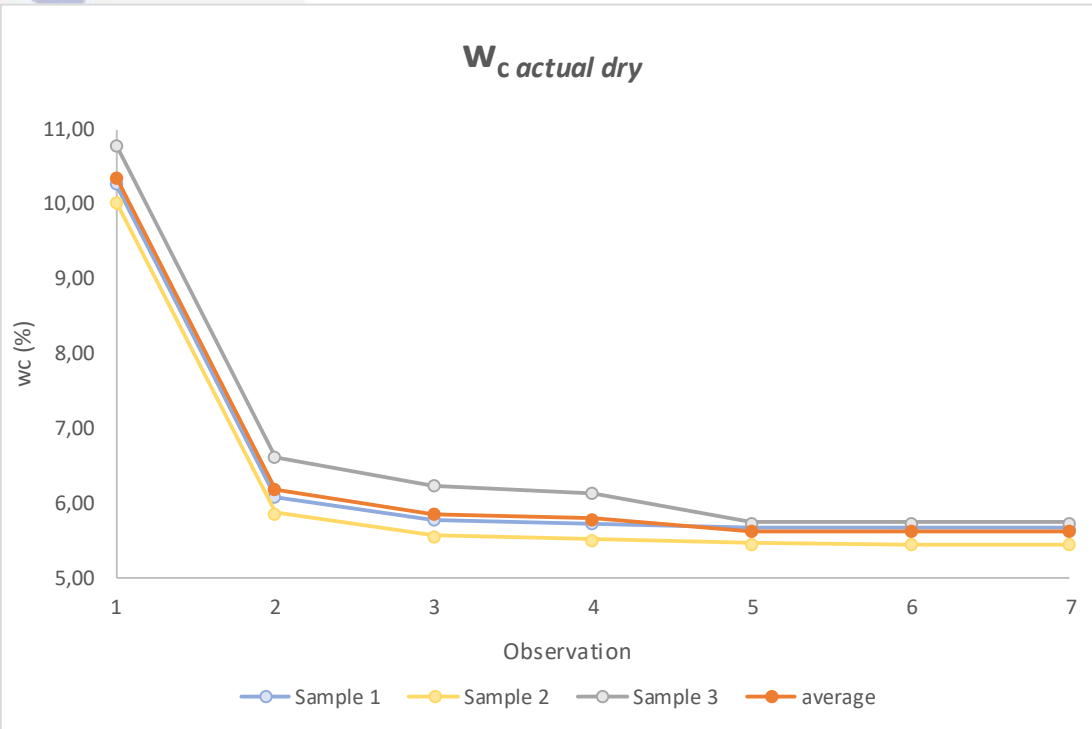
Lime Content (%)	Optimum Water Content (%)	Maximum Dry Density (t/m ³)
3	21,29	1,447
7	28,20	1,470
11	31,05	1,427
15	24,32	1,391

Lime content = 7%

γ_{dry} maksimum = 1,47 t/m³

$w_{c\ opt}$ = 28 %

Actual Dry Water Content and Drying Process



the dry conditions of the field →
the lowest groundwater content
if the soil is drained as the
actual condition → drying with
the help of the sun

$$\Delta w_c = w_{c \text{ optimum}} - w_{c \text{ aktual}}$$

$$\Delta w_c = 28,20\% - 6\%$$

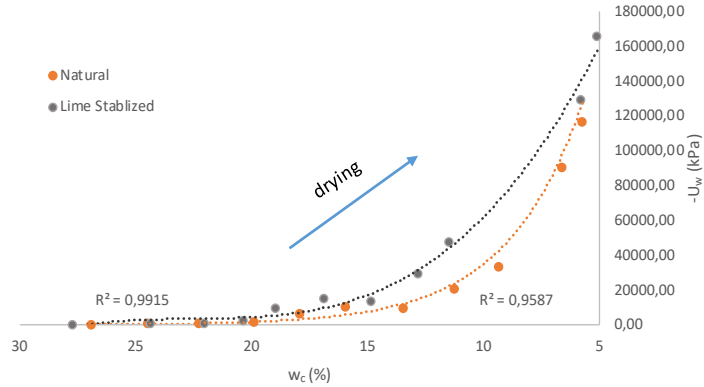
$$\Delta w_c = 22,20\%$$

$$10\% \Delta w_c = 2,20\%$$

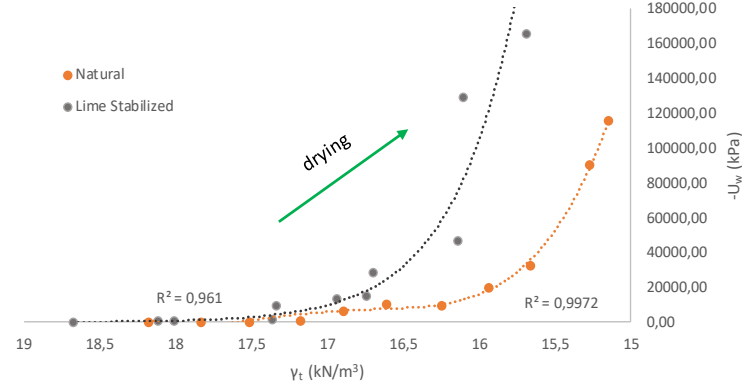
Physical Properties



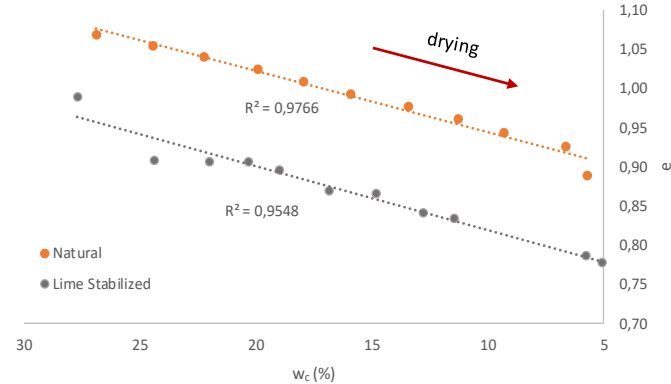
w_c vs suction ($-U_w$)



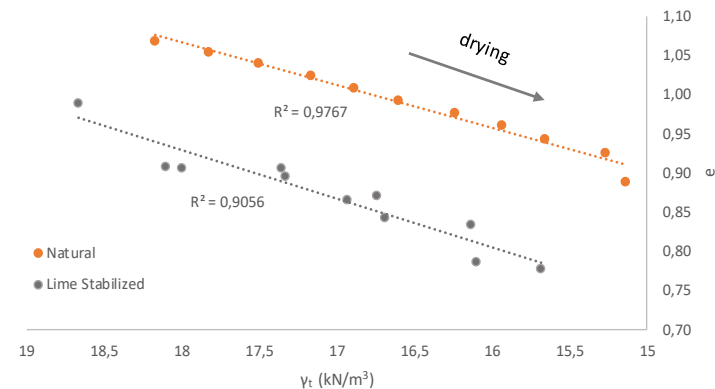
γ_t vs suction ($-U_w$)



w_c vs void ratio (e)



γ_t vs void ratio (e)



With 7% lime content

Specific Gravity
2,603 \rightarrow 2,651

Void ratio (e)
decrease by an
average 12,01%

Degree of saturation
decrease by an average
4,093%

weight volume of soil
(γ_t) increased by an
average 4,093%

Mechanical Properties

Both soil conditions, natural and stabilized soils, show the same tendency due to the drying process.

The reduction of moisture content results in the undrained cohesion value of the soil increasing.

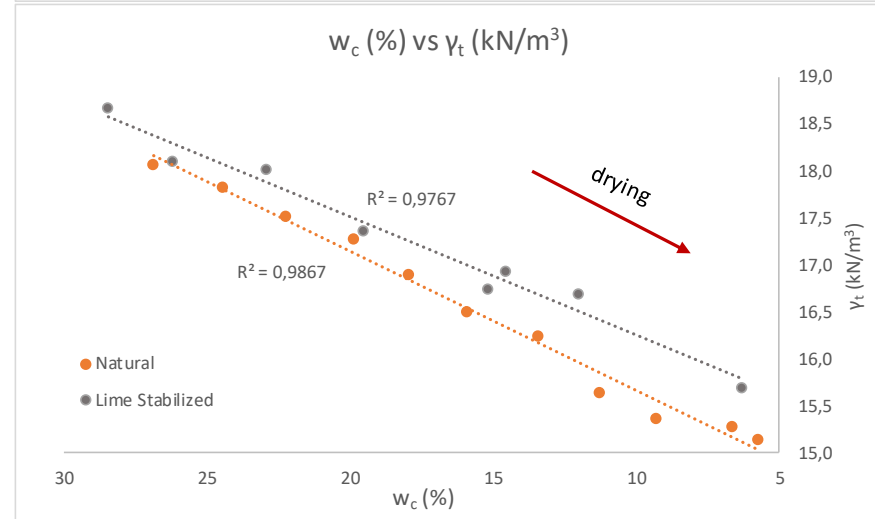
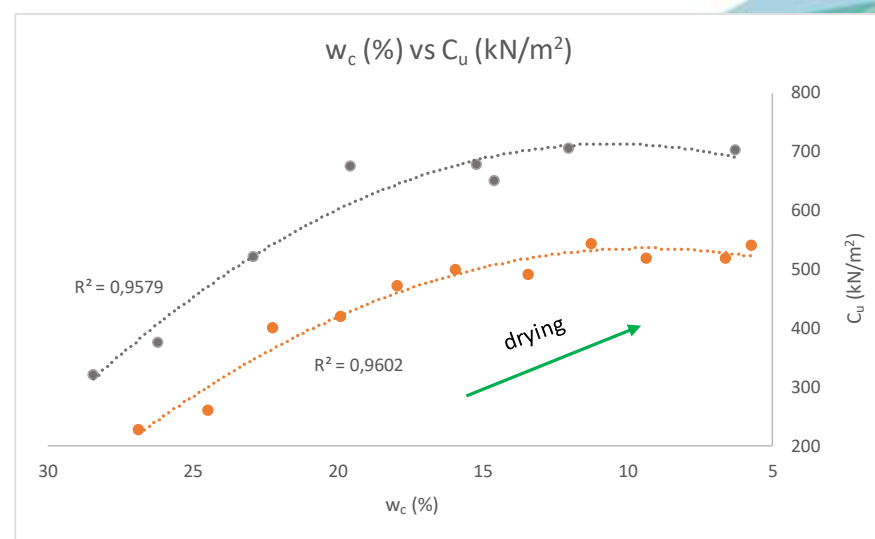
The weight of the soil volume decreased as a result of the reduction in water content.

Lime-stabilized soils have greater shear strength than natural soils.

Natural soil → maximum value of C_u is 540,6 kN/m² at $\gamma_t = 15,684$ kN/m³.

Lime-stabilized soil → maximum value of C_u is 705,967 kN/m² at $\gamma_t = 16,693$ kN/m³.

Addition of 7% lime → C_u increased by an average of 25,11%



Conclusion

- Natural soil has $w_{c\text{ opt}} = 26.815\%$ with $\gamma_{d\text{ max}} = 1.432 \text{ t / m}^3$. **Optimum lime-stabilized soil with 7% lime content** has and $w_{c\text{ opt}} = 28.20\%$ and $\gamma_{d\text{ max}} = 1.470 \text{ t / m}^3$.
- The average actual dry water content until the 7th day drying is 5.61%. In the initial process of draining the moisture content drops significantly. When water content of about 6% (2nd observation) decrease due to drying is not very significant. The actual dry water content is about 6%. **The reduction of water content is about 2.20%.**
- **With 7% lime content, $\gamma_{d\text{ max}}$ increased** from 1,43 t/m³ to 1,47 t/m³. **Gs increased** from 2,603 to 2,651. **Void ratio (e) decreased** by an average 12,01 %, **Sr decreased** by 8,672 %, **γ_t increased** by an average 4,093%.
- In lime-stabilized soils, the maximum value of C_u is 705,967 kN/m² at $\gamma_t = 16,693 \text{ kN/m}^3$. Due to the **addition of 7% lime, C_u increased** by an average of 25,11%.
- The addition of lime with the optimum lime content 7% can **improve the physical and mechanical properties** of Bengawan Solo river embankment due to drying process.



References

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THANK YOU

