compared to that with an area of 2L, their values started equalizing from 120 days above after the stabilization process.

occur at the early stabilization stage but this was caused by the peat's increased water content. In addition, it is a plausible behavior because

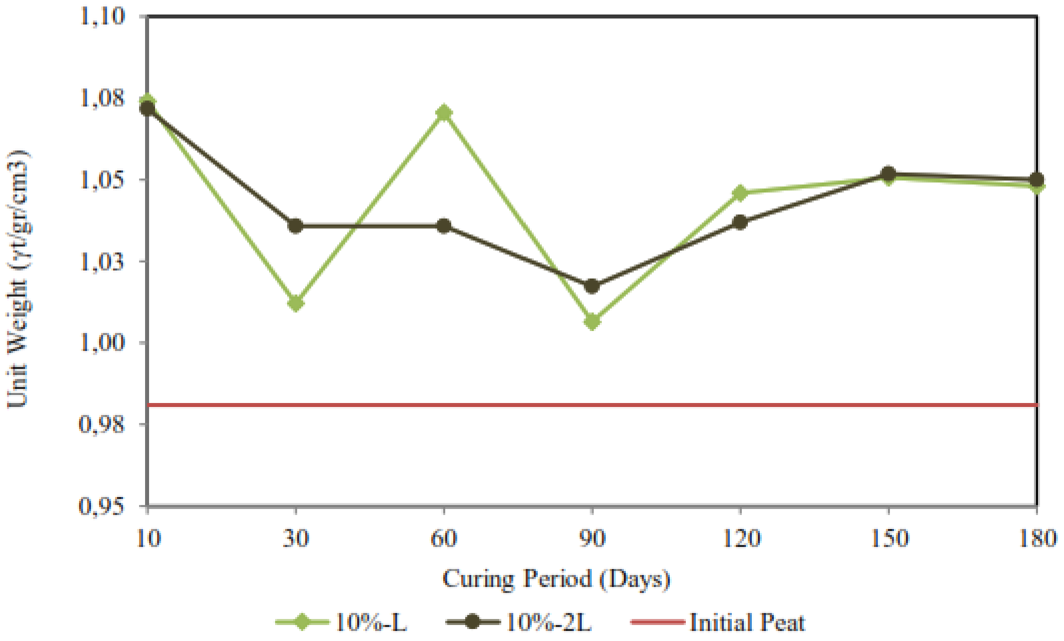

Fig 7. Unit Weight of Stabilized Fibrous Peat (γt)

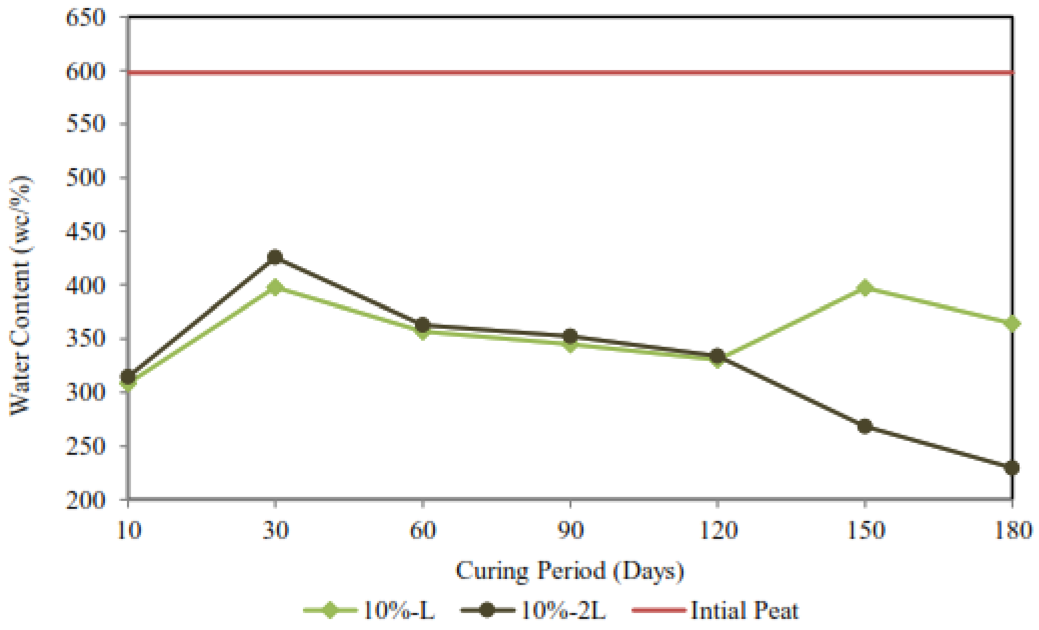

Fig 8. Water Content (Wc) of Stabilized Fibrous Peat Soil

Following this, the addition of a mixture of $CaCO_3$ lime and Fly Ash significantly affected the water content (Wc) of the stabilized peat soil (Figure 8). The stabilized peat's water content value dropped sharply by more than 45% from its initial state, or from 598% to roughly 310% for the entire area's width. This phenomenon does not usually

the formation of $CaSiO_3$ led to a significant decrease in the peat pore's water content. As a result, the volume of the pore space increases. Another effect of the gel formation is the decrease in the unit weight (Figure 8), which was caused by the increase in pore space and the incomplete filling of the pores by the $CaSiO_3$ gel that had formed.

In addition, the peat's water content continued to decline once the post-stabilization period exceeded 30 days. This process continued for 180 days after stabilization (for the 2L stabilization area). This behavior was predicted to occur because the water was still being used to form the $CaSiO_3$ gel in the peat pores. Meanwhile, a different behavior occurred in stabilized peat with an L-width and this was because the width of the stabilization area was smaller, thereby causing the water filtration to easily reach the pores.

Also, the application of stabilizing agents increased the value of the stabilized peat's specific gravity (Gs) from an initial value of 1.5 (Figure 9). Previous research [1, 5, 6] claimed that the peat soil's mixed mineral content was the cause of the increased Gs value. Even though the values unit weight and peat moisture content values were utilized, the Gs value remained unstable until after 120 days. This behavior is similar to the CaSio3 gel formation which began to stabilize after 120 days. However, there is only a slight difference between the Gs values of the L and 2L stabilization areas. Also, the Gs value of the two different stabilization areas was both stabilized after 150 days. This was possible because the formed $CasiO_3$ gel had also started to stabilize. The stabilized peat's Gs value with a 2L stabilization area did, however, slightly decrease at the 150th day and remained that way.

Lastly, the changes in the stabilized peat's void ratio (e) are shown in Figure 10. In the early days of the stabilization period, the soil with an additional stabilizing agent displayed an inappropriate behavior in the pores of the stabilized peat. The peat pores were getting bigger, particularly in stabilized peat with a 2L stabilization area, and had lasted for up to 90 days.

This behavior occurred due to the continued use of water in the peat pore to form $CaSiO_3$ gel. This makes the pore space bigger even though the gel growth at the beginning of stabilization was very slow [14]. In contrast, the peat pore in the L stabilization area shrunk because water filtration was easier due to the difference in the width of the stabilized area.

When the stabilization period exceeded 90 days, different treatments were observed between the L and 2L stabilization areas. There was a decrease in pore values of the stabilized peat having a 2L area. However, when the peat's area was L, the void ratio was unstable. This was because the $CaSiO_3$ gel formation process of the smaller stabilization area was easily disturbed since it was more easily accessed by water from the surroundings (initial peat). The phenomenon of unstable physical properties of the stabilized peat with an L stabilization area also occurred at the values of γt (Figure 7), Wc (Figure 8), and Gs (Figure 9).

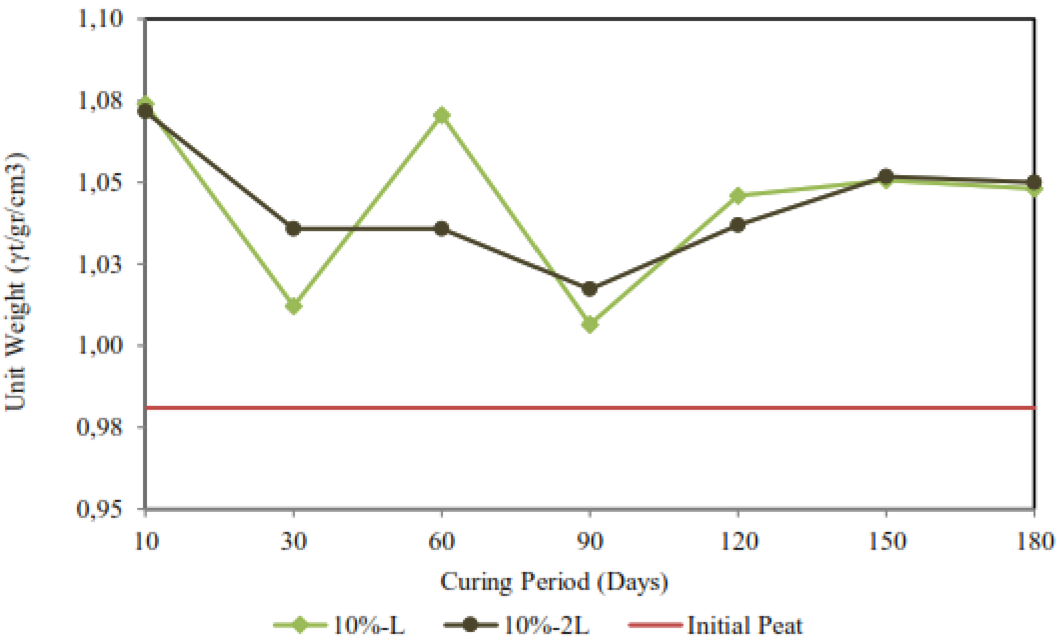

Fig 9. Specific Gravity (Gs) of Stabilized

This was possible because the $CaSiO_3$ gel's formation was slightly hampered by the water level in the peat pore, which continued to decrease (Figure 8), thereby affecting the Gs value.

This leads to the initial conclusion that the stabilization area significantly impacts the peat's physical characteristics.

The engineering properties of the stabilized peat were examined by the following: direct shear

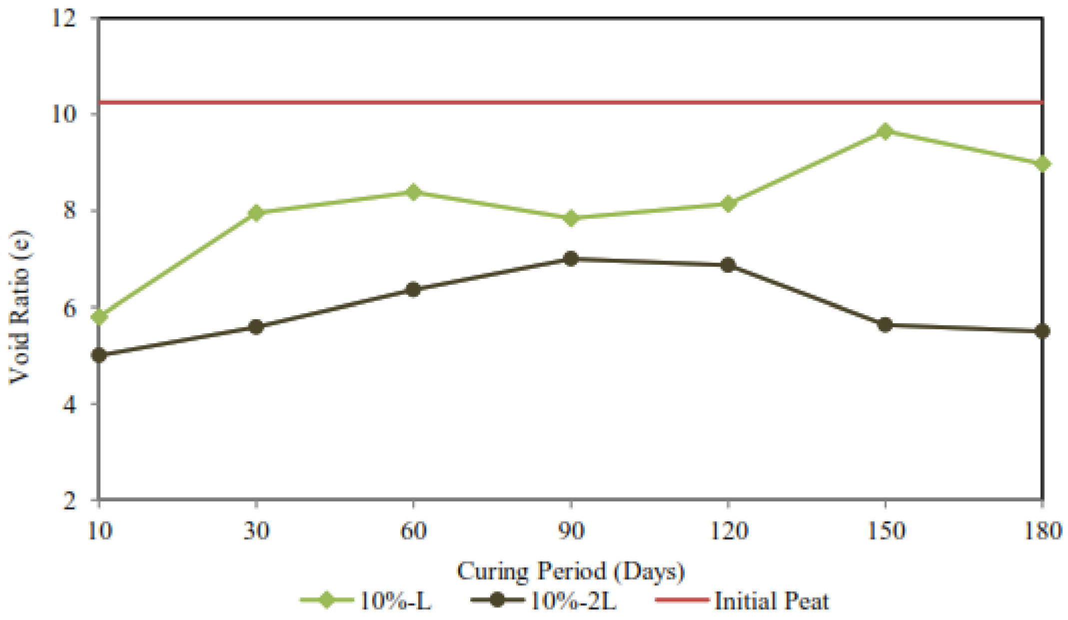

Fig 10. Void ratio (e) of Stabilized fibrous peat soil

testing to calculate the value of the internal shear angle (ϕ), the stabilized peat's shear strength using Coulomb's theory, and the use of two-dimensional consolidation to determine the amount of compression that occurred. According to previous research [7, 9, 16, 17, 18, 19, 20], the degree of peat decomposition, the distribution of the fibers within the peat, and the peat's water content all have a significant impact on the shear strength of the core peat soil. Figure 11 shows the value of the shear strength of stabilized peat with a traffic load of 50 kPa.

At the beginning of the stabilization, there was an increase in the shear strength value of the peat soil. However, these values were not constant, specifically for a period of fewer than 90 days. The shear After 90 days of stabilization, the shear strength behavior earlier claims that the $CaSiO_3$ gel formation process, which filled the peat pores and enclosed the peat fiber, was in the early stages of development and easily influenced by water filtration from the environment [5, 14].

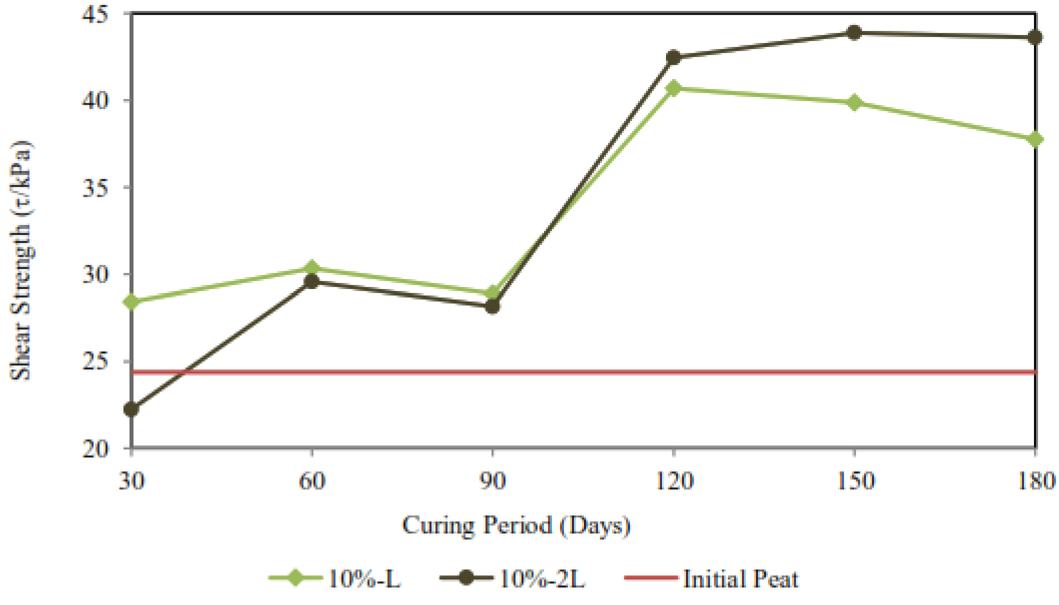

Fig 11. Shear Strength (τ) of Stabilized

When the peat soil has been stabilized for longer than 90 days, an increase in shear strength was more noticeable (120-180 days). However, there was a slight decrease in the stabilized L-width peat's shear strength value after 120 days (although still above the initial shear strength). This behavior indicated that the formation of CaSiO3 gel is significantly influenced by the stabilization area's width and the amount of water present in the peat pores. This assertion is supported by the shear strength value, which decreased slightly due to unstable water conditions in the peat pores during the stabilization period of 180 days.

The compression behavior of stabilized peat is shown in Figure 12. Furthermore, the degree of compression of stabilized peat soil at the early days of the stabilization (90 days) varied much similar to the behavior of other stabilized peat soil parameters. There was also a decrease in the compaction of the stabilized peat soil when the stabilization period was above 90 to 120 days, where the $CaSiO_3$ gel formed could withstand the working load. At 180 days, the value of the stabilized peat compression increased very slightly. This was caused by either the availability of excess water in the peat pore of the L-width stabilization area or the lack of water in the peat pore of the 2L-width area.

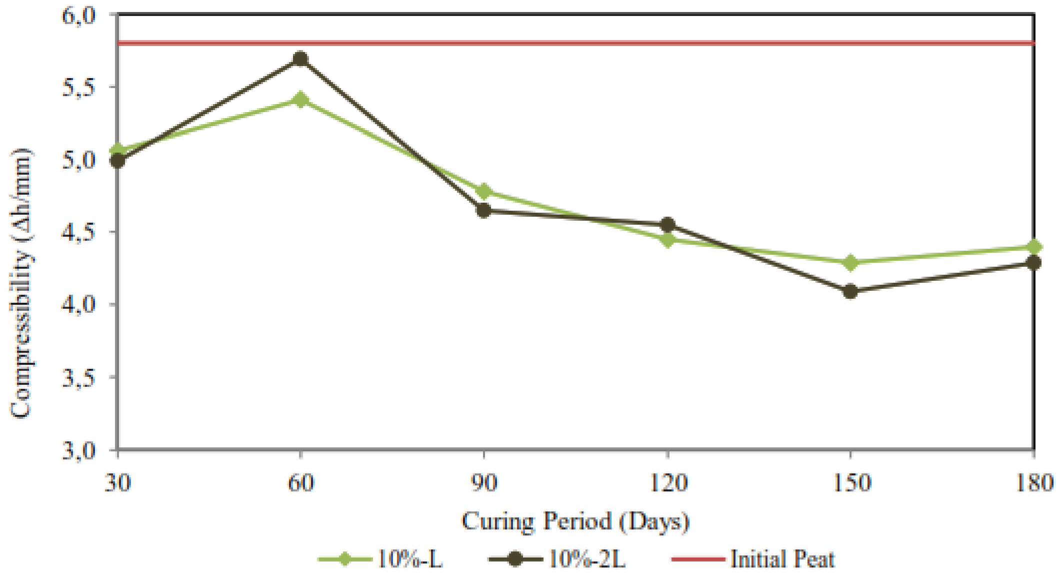

Fig 12. Compression (Δh) of Stabilized Fibrous Peat

5. CONCLUSION

The following conclusions can be drawn from the physical and engineering behavior of peat soil stabilized with a mixture of lime ($CaCO_3$) and fly ash:

1. The addition of stabilizer can form a calcium silicate gel (CaSiO3) which can fill the pores and wrap the peat fiber even though it is not perfect because of the influence of water filtration from the surrounding peat in the process of forming calcium silicate crystals.
2. The peat soil's engineering and physical properties can be greatly enhanced by stabilization.
3. The width of the stabilization area is quite influential on the values of the physical and engineering properties of the stabilized peat soil, specifically on the availability of water in the peat pores.
4. The physical and engineering properties of the stabilized peat soil began to stabilize after 90 days and this was because the $CaSiO_3$ gel formation also began to stabilize. However, it remains reliant on the water in the peat pores.

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