

Bunker Solutions

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History

One of the challenges we faced during the construction of Spring Hill Golf Club was how to maintain sand on steep faced slopes of our bunkers. Although these bunkers fit into the landscape nicely, during any 'normal' rain event, our sand would naturally wash down from the face of the bunker causing a myriad of future problems. Extensive labor repairing the bunkers, siltation of our bunker sand, and subgrade erosion were the main problems we tried to solve during construction. Our first goal was to look at how our drainage would be installed.

We felt that while we couldn't control every rainstorm, we might be able to alleviate the amount of sand washing out by capturing the subsurface water in a tile and quickly getting rid of it through pipes. We installed the typical drain lines in the base of the bunkers as well as added 'face drains' to get the water into pipes prior to it continuing down the subgrade eroding the sand with it (Figure 1).

Our next goal was to find a way to keep the subgrade intact in the event of large rain events. While we felt there was no benefit in using typical liners that were available in the late 1990's, we still were in



Figure 1

search of some solution to the potential contamination of our bunker sand from subgrade erosion. While thumbing through a contractor's supply catalog, I found a product that claimed to be a 'soil solidifier.' My initial thought was to use it to create some temporary construction parking and for aggregate cart path solidification. After successfully testing this product for roads, we got the idea to try

this product on bunker subgrades. What we found was a product that could offer us a solution to the bunker sand contamination issue.

We played around with many different application techniques, rates, and soil preparation processes and came up with a way to put an impermeable membrane under the bunker sand that would conform to the surface of the bunker subgrade, stabilize the soil, and aid in keeping the sand up on the face of the bunkers. What we came up with was a process that is easy, efficient, and most of all, it worked.

Following some success in our bunker application, we decided to specify the Klingstone in our bunkers on the entire golf course. After ordering numerous drums of the Klingstone product, I got a call from the company asking me what we were doing with their product. The company president was an avid golfer so when I told him we were using it on the golf course he became very interested. They flew out to check out our use of the product. After working with us and assuring themselves this product was going to do what we thought it would, Klingstone became a product in the golf course market.

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Figure 2

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The Process

The process can be used in new construction or in existing bunkers easily. Best of all, it can be done at your own pace and it is stored in a 55 gallon drum. The process is as follows:

- 1) Remove existing sand in the area that you want to treat and scarify the surface. (Figure 2)
- 2) Saturate the surface to the point of runoff. (Figure 3)
- 3) Allow the product to penetrate and reapply again to the point of runoff.
- 4) Apply a thin coat of bunker sand to stick to the surface or reinstall the bunker sand to its proper depths. (Figure 4)
- 5) The product will cure in 24-48 hours leaving you with solid subgrade under the bunker sand.

This is a very simple process that produces long-term results. If you have a sandy loam or sandy clay, penetration of the product should not be a problem as long as the soil is not waterlogged. If the soil is predominantly heavy compacted clay, the hardened matrix can be made out of a thin layer of existing bunker sand treated with the product in the same manner. Water helps activate this product so normal irrigation can continue in this bunker and rain will actually help this process as long as it doesn't wash the product away.

About the Product

One of the things that attracted me to this product is the safe track record the Klingstone has in environmental uses. It has been used by the Army Corps of Engineers in Florida to repair seawalls, hillside stabilization in Colorado by the Colorado D.O.T., and is currently being used for aggregate trail stabilization in state parks to make them ADA compliant. Klingstone is liquid polyurethane that reacts with water to expand into the soil pore space and bind together the soil colloids. The cured product is inert and will not harm the environment. Since it is polyurethane, it is resistant to bio or photo degradation. When applied properly, this product will remain in the soil for an indefinite period of time. We have had our Klingstone in place for six seasons and have had to retreat very few areas.

For large applications, we found a dedicated sprayer with a centrifugal or roller type pump works the best. If a small area



Figure 3



Figure 4

is being treated, a watering can works just fine.

Other Uses

Currently we are testing Klingstone to aid in solidifying aggregate cart path rock on slopes that are prone to erosion. By using a higher viscosity material and an aggregate material without 'fines' in them, we have found that a 3-4" solid path can be formed.

Additionally, we are combining two different Klingstone products to solidify the bunker sand in our target green bunkers at our practice facility. Currently,

these bunkers are maintained like our on-course bunkers but are a maintenance nightmare to repair following a big rain. Upon completion, we are hoping this treatment will provide an on-course quality look to the bunkers while being maintenance free in the future.

Success of the Product

We have had the Klingstone in our bunkers now for six seasons and the only place we have had problems with the

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product is where we tried to skimp on the product. Where we applied the product properly, the Klingstone has held up very well to the rains as well as the freeze/thaw cycles of the winter. In fact, our bunker sand is staying so clean that we are currently replacing the sand with more angular sand that will pack better. Our original goal of reducing or eliminating the contamination of our bunker sand has been a success with Klingstone.

During our excavation process we have found that cleaning out our bunkers is made easier with a Klingstone hardened subgrade. We can virtually sweep the bunker subgrade clean of the old sand and rock prior to installing our new sand.

Any areas that we damage during the excavation process are retreated with the Klingstone in those specific areas, as the product will bind to itself.

The only limitations we found with applying Klingstone were when the soil

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temperatures dropped below 40 degrees and overnight temperatures dropped below 40 on exposed, treated soil. As long as bunker sand was installed on top of the product prior to temperatures going lower than 40 degrees, the soil treatment was not compromised.

Shameless Plug

Now that we are all tired of hearing about which candidate is a war hero or who served their country the most

admirably, may I recommend a book for your winter reading. One of the best things about developing this process for bunker solidification is the time I have spent with the company's President James Joyce. Last time I was with him he handed me a book and asked me to read it. James was a Vietnam helicopter pilot and has written

his memories down in the book Pucker Factor 10 (amazon.com). It may make you rethink how bad we have it when we are out handwatering because our pump station went down.



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