

Republic Services - Sunshine Canyon Landfill

Demonstration Project for HydraGuard 21

SUMMARY OVERVIEW OF PROJECT

Objective of Test:

Republic's objective was to test the ability of the HG 21 product to penetrate the cover soil and create a bonded matrix of soil that could help minimize or eliminate the escaping gases. Two subset objectives of the primary objective are:

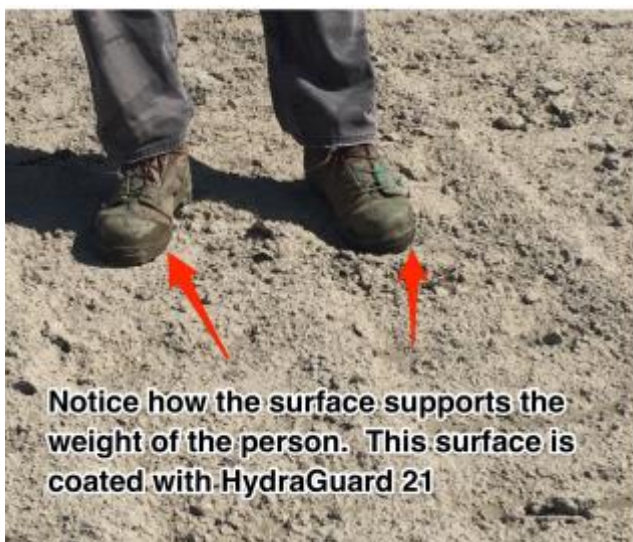
- The surface must be substantial enough to walk on the surface. This will allow employee to track the surface using gas sniffing hand held equipment to pick up gas emissions.
- The surface should be flexible enough to not allow cracking due to shift in the surface

As a secondary objective, NWC was asked to show the ability of its HydraGuard 21 product to be able to control fugitive dust. Two different applications are requested: (1) on untracked surfaces where high wind conditions whip dust into the air in large clouds; and (2) on heavily trafficked roads, the use of the same product in higher concentrations to minimize the application of water and reduce dust.

Benefits of NWC's Hydraguard Product:

After the application of the initial testing done on March 30th, and the second application done on May 3rd, the following are some of the preliminary observations:

- Application process is generally quite simple and can be done quickly. Two applications can be done:
 - Based upon initial applications an acre can be covered within a ____ hours with two coatings
 - This includes mixing all products, filling a 3300 gallon machine with water, and doing the application
- Initial surface drying occurs quickly (within a 24 hour period) but final drying of sub-surface bonding of lower layers took a longer period of time (2 weeks). Actual time was not fully determined because it was four weeks before anyone walked on the fully dried surface.



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- NWC's second application was designed to generate better penetration. Observations relative to the second application in May are detailed under the section on May application
- Surface remains flexible without cracking
- Surface Sheds Water
- Although surface did show locations where landfill gas was escaping or was read, at the time of this report, we did not have any information whether the application actually reduced the volume or intensity of the gas. NWC believes that the HG 21 does do this based upon other real project applications in the remediation market, but in this situation gas emissions were not tested before to determine a base line emission level and then after to determine the emission suppression capability.
- Ease of Repair (small areas): For another site in Florida using the HG 21 technology,

NEW WASTE CONCEPTS - HYDRAGUARD 21 GAS SUPPRESSING COATING



Area to be covered by one quart in 35 seconds is 2 ft by 3.5 ft or about 7 to 8 square feet

This should allow you to coat 16 pipes with a load of HydraGuard 21

Make sure you clean the nozzles and wash out the back pack sprayer with clean water

Filter all HydraGuard 21 going into the back pack as per photos on page 1

4 gallon backpack or 16 quarts. You should be able to use one quart per gas pipe. It takes 35 seconds, under pressure to spray about a quart.

Quart should be mixed for gas work at ratio of 1 gallon of HydraGuard with 3 gallons of water.

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NWC has developed a way that areas which are leaking gas can be repaired. This would also apply to areas where there is penetration due to either walking or tracking on the area. These smaller areas can be repaired using a back pack system where those testing the surface can apply a repair coating (see photos above).

- Ease of Repair (Large Areas): As often happens to landfills, there is always a reason where an area which was untracked becomes tracked or disturbed. HG21, because of its simplicity in application can be reapplied using either a water truck or a small hydroseeder.
- Multiple Uses for Single Product: One single product can be used for multiple uses just by changing the dilution ratio. No need to keep different products

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Type of Use	Dilution ratio Water-prod	Gal of HG 21 Need to cover 1 acre	duration
Untracked dust control	18 - 1	65 gal HG 21 / ac	60 days
Untracked dust control	11 – 1	100 gal HG21 / ac	90 days
Heavily traffic Road	3 or 4 – 1	1200 gal HG21 / ac	
Temporary Roads	6 – 1	290 gal HG 21 / ac	90 days
Vapor and Water Supp	9 – 1	249 gal HG21 / ac.	

- For Dust Control on Roads – can be applied using a Water Truck: NWC will provide a loading rack for totes with a hose connected to an electrically driven progressing cavity pump used to load the HG 21 into the water truck. Piping would be placed so that, like the water, the HG 21 would be loaded from the top first into the water truck, then water would be added allowing the mixture of the HG 21 and water to occur naturally without mechanical agitation.

Issues with NWC's HydraGuard Product and Solutions For Odor & Vapor Suppression:

Although NWC believes that HG 21 is the best available technology to achieve control (i.e. minimize) over dust, odor vapors and rain water permeation, it is not the perfect solution at the Sunshine Canyon Landfill. The weaknesses of the product are as follows:

- Insufficient penetration of bonding matrix into soil due to hydrophobic nature of the soil at landfill. This is not a weakness in clay or sandy soils, especially on flat areas. For the Sunshine Valley Landfill site, this weakness is being addressed in two ways as more fully explained at the rear of this report under the section titled '2nd Improvement Application Testing'.
- The surface coating Issues:
 - The surface coating can be delaminated from the surface of the soil by kicking it. However, this does not eliminated the bonding matrix that has been absorbed into the soil.
 - Surface coatings can be broken apart by vegetation where vegetation has not been killed below the surface. This does not, however, eliminate that 80-90% of the suppressive capability of the bonded soil matrix is still in place and suppressing VOC emissions or rain water permeation.
 - HG 21 surface coatings do not achieve the levels of suppression of which a welded and seamed geomembrane might be capable. Geomembrane's, however, require (1) continued maintenance and weights to hold the membrane down, (2) a gas collection system between the geomembrane and the soil surface to remove gas that collects underneath the geomembrane, and often some surface smoothing before application.
- HydraGuard may need touch up as discussed earlier under the advantages section, given that roads, work, etc. occurs frequently in the landfill.

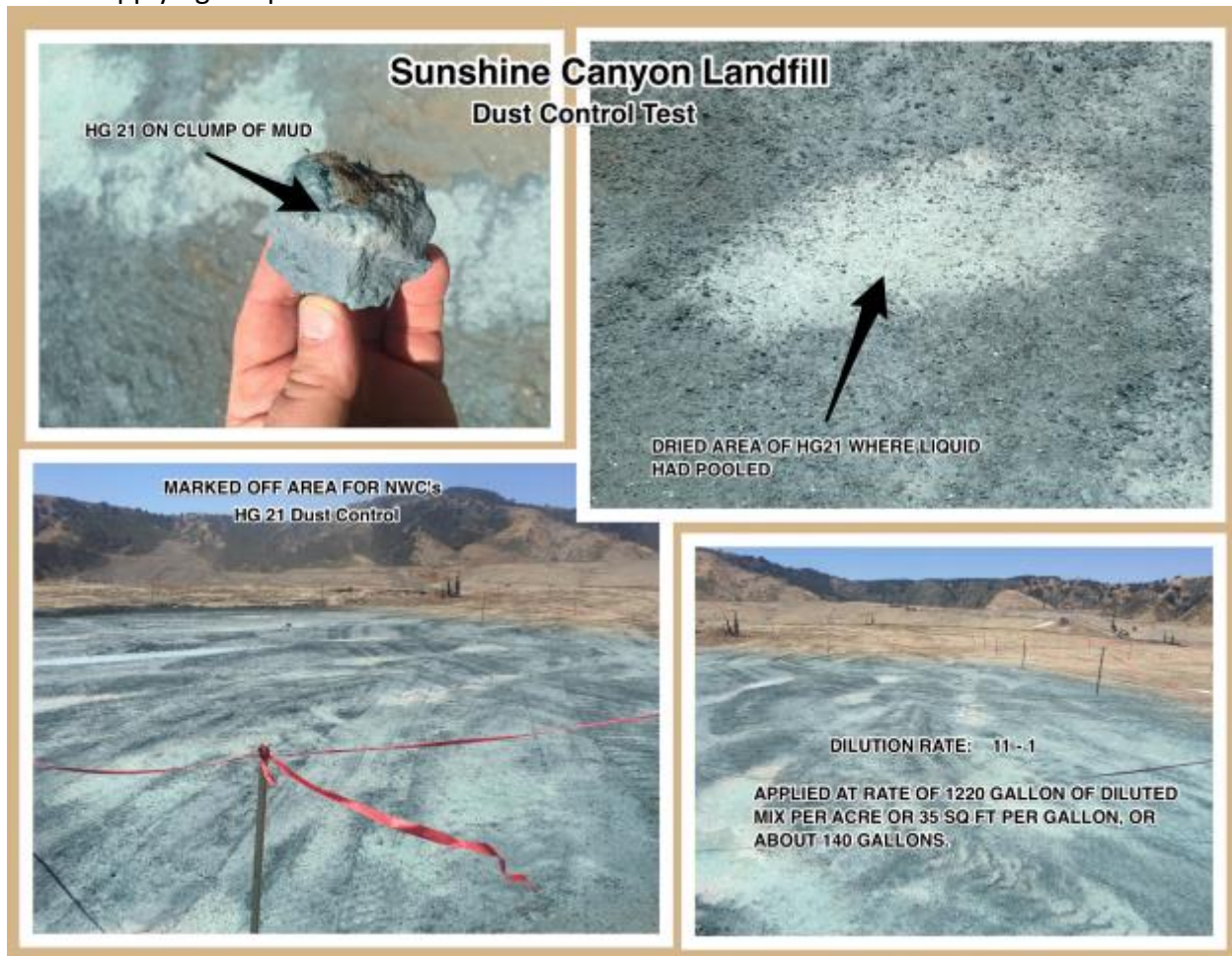
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Dust Control Aspects of the HG 21 Product:

Previously, the flexibility and range of uses provided by HG 21 have been reviewed in the small table on the previous page. Dust control provides a much greater range of use. The dilution rates can range from 11-1 to 18-1. Why is this an advantage:

- First, it allows for an inexpensive application on areas which are subject to trafficking by heavy equipment that tears up the surface.
- Second, it allows for greater and more durable surface application on areas where trafficking does not tear up the surface.
- Since we did not spend time testing the different application rates on the test area where we applied the dust control test (see photo below), it should be noted that the testing would have showed that quick dust control could have been achieved by applying the product at a dilution ratio of 18 – 1.



2nd Improvement Application Testing:

The additional testing was focused on determining if greater penetration could be achieved to create a deeper, better bond with the soil. The testing which NWC did was focused on improving the penetration of moisture by using different materials that help reduce surface tensions. The materials tried included using water, using water and polymer used by the cement industry to reduce surface tensions, and a plant extract that NWC uses in some of its odor control products to reduce surface tensions. Applications were made on test areas 1 through 4.

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Test areas 1 – 4:

I will not detail out the all the elements of the testing with the exception that two elements appeared to help with penetration. Those two elements include the use of pre-wetting the surface, and subsequent applications of HydraGuard once the pre-wetted layer has been applied. The pre-wetting, based upon the core sampling, appears to work well. However, the use of yucca appears also to work well. ***The core sampling showed that the water or the water and yucca offered the best alternatives.***



Application of First Coating of HG 21:

Applications of HG 21 on areas 1 through 3 were done shortly after the pre-wetting applications (see right upper photo in grouping above) reflecting the application of the HG21. Applications were timed to about 36 seconds on average for the longest and about 15 seconds on the shortest. Application was done until we saw puddling at the bottom of the hill, and streaming of the HG product. Application time length indicates how much absorption was occurring before the soil was fully saturated. ***The result reflected the same results as the core sampling did which was that water and/or water and yucca was the best prewetting agent. Final analysis of penetration of the bonding matrix should reflect that areas 1 and 3 were the best but final analysis will have to wait at least 2 weeks while product dries.*** Test Area 4 used a single coating of the prewetting material (water and yucca) and HG 21 at a 4-1 ratio.

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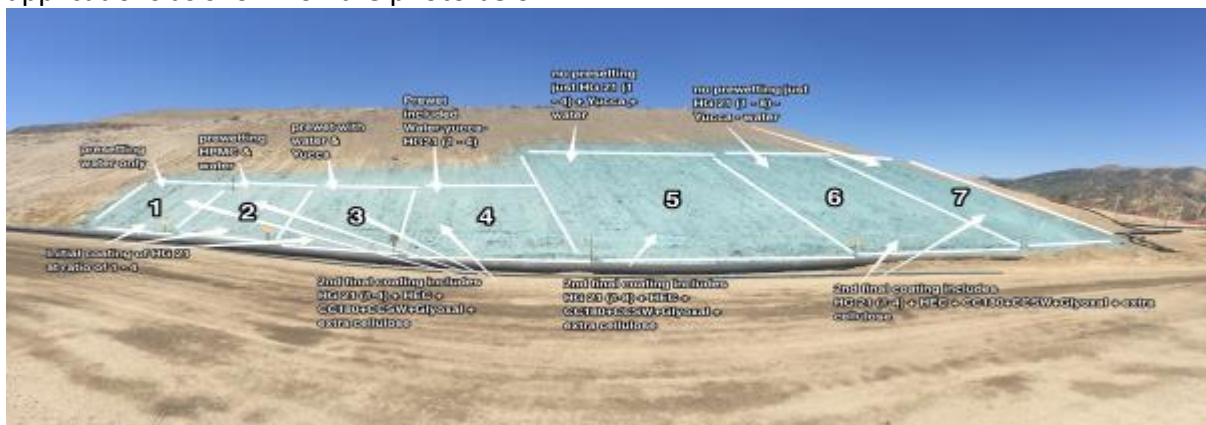
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On Areas 5, 6 and 7 we applied the yucca and water, premixed with the HG 21. Area 5 used an 8-1 ratio of HG21, while areas 6 & 7 used a HG21 ratio of 4 – 1. You can see photos of these applications on this page below.



Final Coating of HydraGuard

The final coating of HydraGuard involved the use of a blend of an additional HEC polymer with a very small percentage of Glyoxal. We also added additional cellulose to the mix to create a thicker final coating than we applied at the beginning of May. You can see the final coating applications as shown on the photo below:



Based upon the first application test results, I would expect the ability to walk on this surface after two weeks. There is some expectation that the application over areas 1 and 3 would

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provide the best surface on which to walk. It is also believed that that area 6 and 7 may be good as well.

Final Evaluation:

The final evaluation of the second application is to determine (1) whether the 'walk on the surface' capabilities of the second HydraGuard 21 application was an improvement over the first application, and (2) whether there was a deeper penetration of HydraGuard into the surface soil.

The two above evaluations, are effectively the best way to determine the ability of the product to allow for employees of the landfill to transit over the surface of the coated areas to measure escaping VOC's. However, this does not test the ability of HG 21 to suppress VOC's as applied. Unfortunately, the ability to test this was the result of not recording readings of VOC's prior to the application of either the first application at the beginning of April or the application at the beginning of May. There are two ways to check on this data

- First, if the Landfill retains records of escaping VOC levels or methane gas, an evaluation of those records could be compared to the readings on the slope at this point. Comparative data should show significant reductions in intensity. To the extent, that intensity has not been dialed back, the number of locations should be reduced. One observation of where the flags were placed on the coated area, most flags were along the borders or in the locations of large mud boulders.
- Second, requires the assumption that if water can be shed, the coating can minimize the escaping VOC's. NWC's has laboratory testing showing the impermeability improvement on its cover materials using the HydraGuard 21 additive.

Conclusion of Testing:

I believe that the initial testing reflected on a surface which could be walked on. The improvements done by the second test application, I believe, will reflect an improvement on the penetration of the HydraGuard bonding material, as well as an improvement to the rigidity or walkability of the surface.

If approved by Republic, the final application blend would be done in the following manner:

- Areas to be coated would be pre-wet with water and yucca and relatively quickly thereafter, a coating would be applied which included a mix of HydraGuard 21 (4-1 ratio) and some yucca to assist in the penetration of the HydraGuard. The initial water and yucca prewet application should only barely wet the surface to reduce surface tension and help permeation of the HydraGuard into the soil
- Areas to be coated would then receive a second coating of HydraGuard 21 (8-1 ratio) blended with HEC polymer and Glyoxal, along with a mix of cellulose and wood fiber. We did not test the use of wood fiber, but we know that the cellulose and wood fiber mixture will create a thicker bonded fibre matrix and stronger surface coating which will enhance the ability to walk on the product.
- Finally, we believe the right way to do the application quickly and successfully is the use of two application machines, one spraying the prewet material and the other coming close behind to spray the firstcoating of HydraGuard.