



TO WHOM IT MAY CONCERN

This is to certify that from 25 to 27 June, 2012, MINUSTAH Military Engineers carried out a pilot project using the **AGGREBIND®** product for surface stabilization. The test was done on a stretch of dirt road (100 meters long by six meters wide) on Tabarre 52, Port-au-Prince, Haiti. Mr. Robert Friedman, President and representative of **AGGREBIND®**, was present to supervise and guide the test by MINUSTAH.

The test was successfully completed by the **Brazilian Engineering Company (BRAENGCOY)**, one of MINUSTAH's six military engineering companies. The Mission Projects Cell (MPC) and Military Engineering Branch (U8) managed the coordination with **AGGREBIND®** to plan and implement the test.

The time-frame of implementation and the initial results were quite satisfactory. We look forward to monitoring the stretch of road completed to observe the long-term results as the road experiences its usual traffic flow.

Port-au-Prince, Haiti

29 June 2012


Malek KABBANI
Chief Mission Projects Cell
MINUSTAH

Malek Kabbani
Chief, Mission Project Cell

UN MINUSTAH HAITI
Tabarre 52 Test Road at the National Police Unit
Before



After



**Tabarre Road Test Report to
MINUSTAH HAITI**



12:00 PM, June 27, 2012



12:30 PM, June 27, 2012



1:00 PM, June 27, 2012



7:00 PM, June 27, 2012

Side One, the inner side, was opened within two hours of completion.
Side Two, the outer side, was opened after six hours of completion.

AggreBind is a cross-linking styrene acrylic polymer that gets progressively stronger and more resilient with the passage of time. The maximize time for full compression strength is 28 days. The process of curing is by the evaporation of the moisture and the chemical action of the cross linking. **Roads are opened within two hours, as a matter of necessity, with no affect to the curing.** When situations permit, it is good to allow more time before opening the road.

Recommendations for future work



Soil, rocks and stones migrated into the road from passing trucks (wider than cars) and kicked these loose stones into the road. The shoulders should have been cleaned of debris. (This was not seen at night when Side One was being finished.)

When prepared materials are going to be used, excavate the full road before processing. Close one side, excavate, then open and do the same on the second side.



This will prevent the spillage of the excavated materials on to the finished side. Grading of Side Two tore up sections of Side One, along the middle.

The spillage into the road from the shoulders caused markings and disturbance to the freshly rolled and coated surface of the road. These “scars” can be avoided in the future with a clean work site from shoulder-to-shoulder.

Further, AggreBind in white (dries clear) can be used on the shoulders to spray the loose material.

- This would eliminate the ambient dust and dirt from rolling onto the roads.
- Would make the road safer and healthier for both motorists and pedestrians.
- It would also reduce vehicle maintenance costs.

If the road sides were sloped (pitched outward) it would reduce or eliminate the surface water on the road after heavy rainstorms.



Piles left on the sides caused unnecessary work. These were finally removed at the end of the project. These piles should have been removed at the beginning so that there would have been clean working areas.

It is not necessary to bring in prepared materials, as AggreBind is designed to work with insitu (on site) materials within parameters. I was not advised in advance that we were to use materials other than what was on site.

The slight orange-peel effect on Side Two was the result of an extremely quick evaporation rate and over compacting. It was agreed with Cpt Bandeira that the smaller compacter used on Side One was better suited for the job.

On Side One the distribution of the AggreBind:Water mixture was completely disbursed in five separate passes, then disc hoe mixed in, vibro compacted and top sealed. On Side Two we disc hoe mixed after each release of the AggreBind:Water mixture and then disc hoe mixed in, vibro compacted and top sealed. The sequence of 5 releases and 5 mixes is better than a full disbursal followed by mixing. The scars or patches caused by the grader were filled in with a slurry mix of the soil and AggreBind.



These patches set very quickly. The patched areas were barely discernible from the rest of the road.



One of the
patched areas

See the attached protocol for patching. AggreBind will bind to asphalt roads and cement roads.

Smoothness of the road surface:

- Side Two is smoother than Side One.
- Side One was opened in 2 hours and the stone piles along the shoulder fell onto the new surface.
- Side Two was closed for 6 hours after completion. The side piles were sand and soil that only created dust.
- AggreBind is a cross-linked styrene acrylic polymer that begins to set immediately. While two hours is absolutely OK with cleaned shoulder (no debris falling in), when possible, overnight is better.

There is an area that bothers me. It is in the middle of the road and across from the driveway entrance to the National Police. Slurry mix was placed in there. It is possible that this patched section was opened up too soon. (The crew needed to leave at 12:30PM. They did not want to leave cones on the road feeling the cones would be stolen. I did not insist that they post someone on the spot for two hours more.) The remedy is to make another AggreBind slurry (soil/sand & AggreBind) and place it in the area. I would continue to observe that small area to confirm that the surface was damaged by the grader and that there is no moving water underneath the road. (This is where the water pipe leaked and was replaced.)

I compliment the crew on their work. While this was a test it was also a learning process for the men. Doing a road is much easier than doing a 100 meter test with a limited amount of material.

**AggreBind is a purveyor of a unique polymer for road stabilization
and block manufacturing.**

Prepared by June 28, 2012
Robert D. Friedman
Partner - AggreBind

'Bike Bakki' rural road pothole repairs plus dust and erosion control services.



Equipment: Pothole repairs.

- Basic equipment:
 - Pick, Shovel, Watering Can, Hand Tamper, Road repair signs and 50 ltrs Aggrebind mixed with 150 ltrs water.
- Procedure:
 - Break the soil to form a square, 15cm deep and slightly larger than the damaged area. Spray the surfaces of the hole with the Aggrebind/water mixture. Obtain some additional soil from the areas at the side of the road and add the Aggrebind/water before mixing thoroughly. Do the 'squeeze in the hand test' to ensure that the moisture level is correct.
- Fill the exposed pothole and compact thoroughly with the hand tamper.
- Spray the compacted surface with the Aggrebind/water mixture ensuring that you spray about one hand width past the edge of the repaired pothole.
- Do not carry out repairs if rain is expected within 2 hours.





Many older roadways are smoothed by applying a thin layer of **asphalt**



Road base with a thin layer of Asphalt



Machine laying asphalt concrete, fed from a dump truck.



Asphalt damaged by frost heave or freezing of groundwater



Pothole

Main reasons for damage to road surface layers:

- Water ingress due to poor drainage.
- Failure of the base/ sub-base layer.
- Frost heave.
- Tree roots.
- Chemical spillage.

AggreBind solutions and procedures:**Surface sealing:**

Remove any loose material and oil from the surface.

Repair any damaged sections.

Spray the surface with a mixture of 1parts AGB mixed with 3 parts water at a rate of +- 1ltr per sq mtr of surface area.

Pothole repairs: (Mixture 1 part AGB mixed with 3 parts water)

Remove any loose material and shape the area to be square or rectangular.

Spray the exposed surfaces of the hole with the AGB/water mixture.

Prepare more material ensuring that there is no stone larger than 8mm.

Add the AGB/water mixture to the material until it reaches the right moisture level for compaction.

Place the material into the hole and compact.

Spray the compacted surface with the AGB/water mixture ensuring that the area sprayed is larger than the repaired hole. This protects the treated area from water ingress during the curing process.

Wash all spraying equipment thoroughly with water at the end of each day.

For more information visit our website at: www.aggrebind.com



Procedures:

1. Thoroughly crush the surface to the required depth.
2. Check that the base below the crushed Asphalt is structurally sound. Repair and re-compact the base if necessary.
3. Carry out a sieve analysis of the crushed Asphalt.
4. Add, and mix in fines (passing through a 0.063 sieve) if necessary, to ensure that the fines content is 35%+ of the total volume to be stabilised.
NOTE: Fines can be any locally available material: Soil, Sand, Mine waste, etc.
5. Spray the area with a mixture of 1 part AggreBind mixed with 3 parts water at a rate of 1.5ltrs per sq mtr per 50mm depth of Asphalt.
6. Grade and profile the surface.
7. Compact with a smooth drum road compactor.
8. Spray the surface again with a mixture of 1 part Aggrebind mixed with 3 parts water at a rate of 1 ltr per sq mtr.
9. Do not install if rain or frost is imminent.
10. Open the road to traffic after 2 hours

AggreBind is environmentally friendly and harmless to plants and animals.

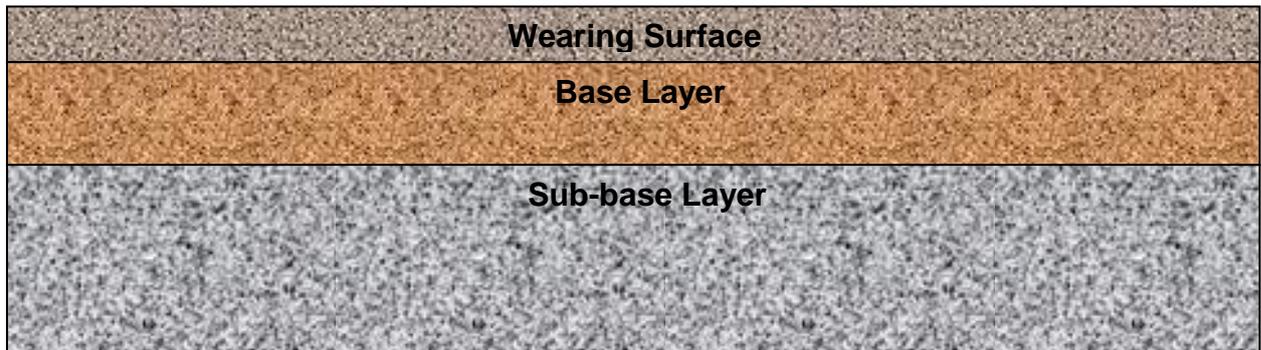
Read the instructions on the Material Safety Data Sheet in case of emergencies.

AggreBind surfaces can be painted with traditional road paints or highlighted in various AggreBind colors.

Visit our website at: www.aggrebind.com

Or

Contact us at: robert@aggrebind.com or don@aggrebind.com



- Significantly improves the bearing capabilities of all on-site sub-soils and sands.
- Significantly reduces the cost of major road construction.
- Reduces the need to import additional materials to site.
- Reduces the contract timeframe.
- Bonds to any applied wearing surface.
- Provides opportunities to reduce the depth of wearing surfaces.
- Significantly reduces road construction's carbon footprint and environmental damage.

OUTLINE OF PROCEDURES

Obtain a full soil analysis on the material to be stabilized.

Use standard engineering criteria to determine the maximum compressive and tensile strength required to carry the maximum load that the road will be subjected to.

AggreBind will improve the load bearing capability of on-site soils by a factor of 4 to 6 times.

Use standard design criteria for drainage, local topography, and climate.

AggreBind is mixed with any type of water (even sea water), prior to application and can be installed using standard road construction equipment.

Evaluation of all cost factors indicate that AggreBind can reduce the cost of highway construction by 30-40%.

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UNITED NATIONS United Nations Stabilization Mission in Haiti	 MINUSTAH	NATIONS UNIES Mission des Nations Unies pour la Stabilisation en Haiti
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BRAZILIAN ENGINEERING COMPANY

ENGINEERING FINAL REPORT – IWO NR 358/U-8 Ops

Data	18 June 2012
Mission	AggreBind Test
Document	IWO NR 358/U-8 Ops
Location	Tabarre 52 Street (next to Charlie Camp)
Coordinates	N18° 33' 21.25" N, W72° 15' 13.58"
Start	25 June 12
End	27 June 12
Deployed troops	17 troops
Used equipment	01 Loader, 01 Skid steer, 01 roller, 01 grader, 01 light tractor, 01 Plough trailer and 01 Air compressor
Used vehicles	01 Water truck, 02 Dump truck, 01 Truck tractor, 01 low bed and 01 ¾ ton Marrua Jeep
Used material	Sand and AggreBind.
Main activities	Leveling and Compacting
Considerations	According to letter “e”, number 2

1. SITUATION

- MINUSTAH was requested to carry out a paving work in order to test the application and resistance of AggreBind, according to IWO 358/U-8 Ops, 18 June 12.

- It is important to highlight that BRAENGCOY was only in charge of paving the street chosen with the product to be tested.

2. EXECUTED WORKS

a. Planning to carry out the works:

In order to allow the flow of vehicles on the road, and in accordance with the representative of the product manufacturing company, BRAENGCOY carried out paving works on the west road lane on 25 June 12. The next day, the team carried out paving works on the opposite lane. The paved stretch is 100 meters long and 06 meters wide. All is as the reconnaissance determined by IWO 342 U8/Ops.



b. PHASE 01: Paving the west road lane:

The lane stretch was set (100 meters long and 03 meters wide) by using sticks every 20 meters, and it was also set a cut level of 15 cm from the natural ground. The cut and the consequently disposal of material are due to the recommendation of the manufacturer to exclude stones whose diameter is over 2.0 cm (these particles are abundant at the site chosen to test the product) from the mixture. Either the cut and disposal of material, or the application of (gravel) sand had been defined by the recce determined by IWO 342 U8/Ops.

After scarifying the soil with the grader, and the consequently disposal of about 75 m³ of material, the water truck poured water on the soil, and by using the roller, the ground was compacted. After compacting the soil, the ground was leveled by using the grader. Next, a mixture of water and AggreBind to the proportion of 1:8 (AggreBind: water) was applied. It is important to highlight that the proportion used differed from that established by the manual and also determined during the recce (1:3). The change was a recommendation given by Mr. Robert D. Friedman, the product manufacturer representative.

After finishing the application of the total quantity of the mixture on the road, the mixture (substance-soil) was homogenized by the plough trailer. Once more, the material was compacted by using a roller.

Finally, a sealing mixture was applied to the proportion of 1:3 (AggreBind: water).

The work ended at approximately 09:30 pm. It is important to highlight that during the scarification, a tooth of the scarifier (grader) broke due to the abundant presence of hard rocks and hand Stones at the site. Also, as an adversity and still during scarification, it is important to mention that a water pipe which supplies the HNP facility was broken. All the necessary repairs were done by BRAENGCOY troops and thus they retard the accomplishment of the schedule set for the day.

c. PHASE 02: Paving towards the east side:

The procedure was analogous to the one carried out the day before. The exceptions are listed below:

- Cleaning of the road sides in order to avoid wind and traffic transportations of particles, as requested by Mr. Robert Friedman;
- Application of the mixture to the proportion of 1:7 (AggreBind: water), as requested by Mr. Robert Friedman;
- Homogenization of the mixture and sand simultaneously to the application (in every application of the mixture by the Dump truck, the plough trailer was used as requested by Mr. Robert Friedman);
- Compacting soil with Tandem roller.

d. PHASE 3: Road cleaning for the Chief of MPC verification

On Wednesday, 27 Jun 12, we used the air compressor to clean the road from side to side, from the beginning to the end, so that the Chief of the MPC could check the results. Mr. Malek went to the worksite in the morning, at around 9:00 a.m.

e. Considerations:

Breaking the water pipe which is under the road caused an excessive humidification of the material deposited. Even under a blazing sun, it is possible to state that the excess of water was responsible for the imperfections on the road. Moreover, the intense traffic of vehicles coming and going out of a residence occupied by the HNP also made it difficult the adequate



execution of works. It is still important to mention that the intense traffic of trucks full of *ramblair*, in some occasions, left material on the road and drivers disrespected BRAENGCOY traffic signs as well.

In order to best support the decision, it is recommended that the performance of the paved area be analyzed as time goes by, mainly in relation to the following aspects: resistance to intense traffic and to weather conditions (esp. downpours).

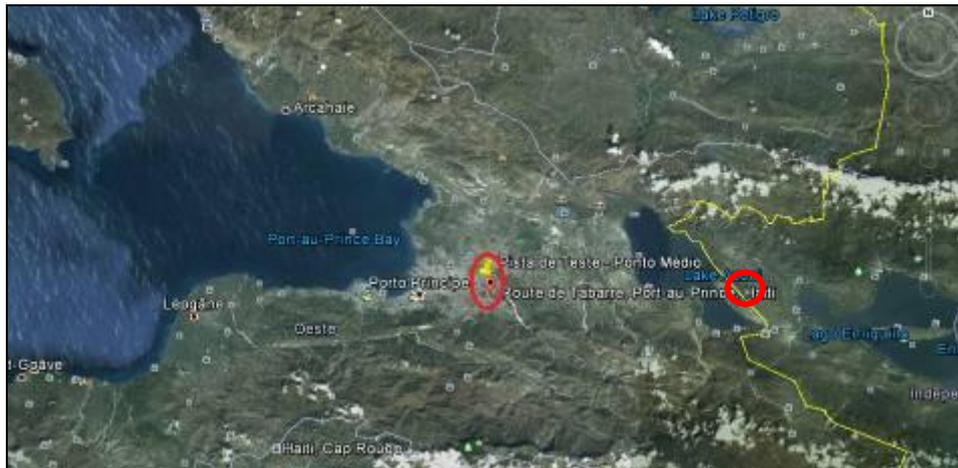
Table 1 summarizes the several procedures adopted and their possible consequences.

PROCEDURE	PHASE1	PHASE 2	POTENTIAL CONSEQUENCE
Cleaning road side areas	Not carried out.	to a great extent of the road	Partially avoids the incidence of particles on the applied mixture, making it easier to visualize results
Mixture proportion AggreBind: Water	1:8	1:7	Lower the proportion of water, better the connections between particles. There was no change on the proportion of the sealing layer (1:3).
Homogenization of the mixture and sand.	After applying all the mixture	Simultaneously with application of the mixture	It was observed that the simultaneous application makes it possible to apparently achieve better results.
Compacting	Roller	Tandem Roller	Compacting by the use of a Tandem roller caused road cracking. This was corrected by applying the sealing layer.
Time to apply the mixture and the sealing layer	At the end of the afternoon and at night	In the middle of the afternoon	The application of the product in the afternoon favors its cure.

3. PHOTOS



a) Location:



Picture 01: General location of the mission



Picture 02: location of the mission

b) Phase 01:



Picture 03: Initial situation and scarification.



Picture 04: Grader broken tooth



Picture 05: Cut and removal of 15 cm of natural soil.



Picture 06: Repair of broken pipe.



Picture 07: Sand application



Picture 08: Ground leveling.



Picture 09: Application of the mixture - Aggrebind: water.



Picture 10: Homogenization.

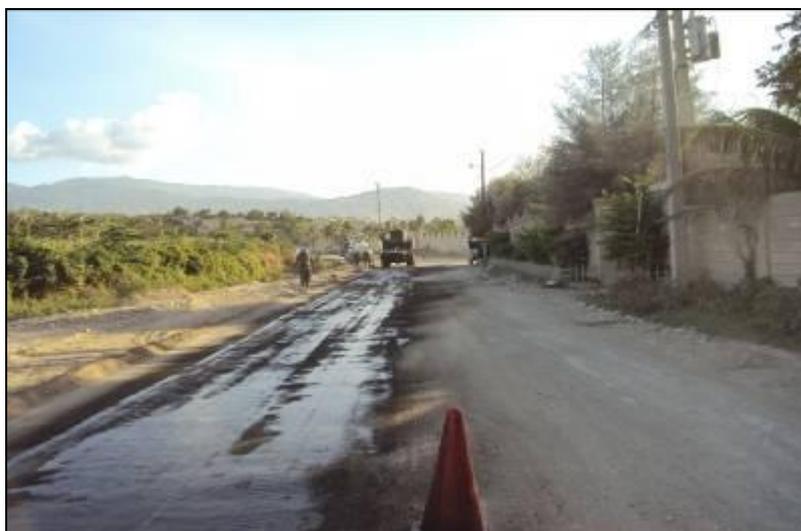
b) Phase 02:



Picture 11: Compacting



Picture 12: Cleaning the road sides.



Picture 13: Application of the sealing layer

c) Phase 03:



Picture 14: Cleaning the paved area for verification



Picture 15: The imperfection on the road was caused by the excess of water in front of the HNP.

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