

Causes and cures for washboarding

One of the most aggravating gravel maintenance problems that plagues grader operators is corrugation. The popular term for this condition is “washboarding.” It is an appropriate description because driving on a corrugated gravel surface is much like driving over a giant washboard.

Washboarding usually evokes more complaints from the public than any other gravel maintenance problem. It not only causes an uncomfortable ride, but moderate to severe washboarding can cause drivers to have reduced control of their vehicles.

Causes

The causes of washboarding fall into three general categories.

- 1. Lack of moisture.** Prolonged dry weather characteristic of Nevada can cause washboarding, even with relatively low traffic.
- 2. Driving habits.** People’s driving habits can aggravate washboarding. Hard acceleration or hard braking are the greatest problems. As a result, washboarding normally appears first at intersections, around sharp curves, business entrances and driveways.

When vehicle tires lose a firm grip on the road and spin or skid, a slight amount of gravel is displaced. As this is repeated over and over, the gravel will align itself into the washboard pattern.

Light vehicles with small wheels and light suspensions cause more washboarding than heavy trucks.

- 3. Poor quality of gravel.** Washboarding will almost certainly develop if the surface gravel has poor gradation, little or no binding characteristic and a low percentage of fractured stone.

What can we change?

With the exception of a few special situations, it is cost prohibitive to haul water. The amount of moisture available is something we cannot change.

It also is not realistic to expect to change motorists’ driving habits. Generally, people are in a hurry and will continue to accelerate hard, drive fast and apply their brakes firmly.

Of the three major causes of washboarding, we only can



A typical washboard pattern.

change the material we use. In prolonged dry weather, almost any section of road with high traffic volume will develop some corrugation, but good gravel will reduce the problem.

What is good gravel?

Surface gravel should be a blend of stone, sand and fines. Generally, the maximum size stone should be 3/4 inch. Also, crushed gravel that has a high percentage of fractured stone will have much better “aggregate interlock” and will stay in place in the road surface better than rock with a naturally rounded shape. This also gives the road greater strength.

The ideal blend produces a gravel that will compact into a dense, tight mass with an almost impervious surface which will dramatically reduce washboarding. But only by sampling and testing gravel, can you make a good judgment as to its quality.

Perhaps the least understood factor in obtaining good surface gravel is the right percentage and quality of fine material. This is the percentage of material that passes through the #200 sieve.

To resist washboarding the gravel must have a good cohesiveness or “binding” characteristic. In other words, a gravel that has the right kind of fine material in it.

Some fines fall into the silt category and will not give the

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The standard field test for binding characteristics of gravel with moisture is squeezing a handful into a ball.

cohesive characteristic needed. The only way to determine which type of fines you have is through laboratory testing to determine the Plasticity Index.

Fine material that has a low PI or is actually nonplastic will not perform well in the field. Although you may be able to compact it into a dense mass, it will loosen more quickly under traffic and will cause more dust in dry weather. Too few fines will not allow the gravel to form a crust. But excess fines will

make the road slick in wet weather.

Gravel that is short of stone will not have strength in wet weather. Too much stone will make the gravel hard to compact, and it will "float" in dry weather, piling up between the wheel tracks and along the shoulders. Sampling and testing will reduce these problems.

Getting good gravel



Purchasing quality gravel is the first step in dealing with washboard problems.

We have briefly defined good surface gravel. Obtaining it in the field is the challenge. Yet, this is the place to begin in fighting washboard problems.

Start by establishing good specifications. There is close control of

materials used in the base and the asphalt or concrete on our major highway construction projects. However, little attention is normally given to surface material specifications for "plain old gravel roads."

It is crucial to increase your knowledge of materials and then to follow through by specifying what you want.

Some pits and quarries do not have a good natural blend of materials. In some cases, materials such as



No washboarding is evident, even on the curve of this road, which is surfaced with good quality gravel and treated with magnesium chloride.

clay or stone may have to be hauled in and blended at the plant. However, materials often can be improved by simply working the pit differently.

Do not overemphasize an inexpensive initial cost for material. You'll spend more to maintain and replace it over the years and receive more complaints from the public. Quality material lasts longer, requires less maintenance and generates fewer complaints.

Remember, trucking is often 70 percent or more of the total cost of gravel placed on the road. Spending more to increase the quality of the gravel does not change the total cost as much as you might think.

In addition, good quality gravel is hard to obtain in certain areas. Therefore, you should consider hauling the best material you can find to washboard trouble spots. Use regular material for the rest of the road system.

Maintenance tips

It is not always possible to haul new and better quality gravel to reduce wash-boarding problems. So, what can a grader operator do to change the material?

Simply blading over washboard and filling the depressions between the ridges is nearly useless. The best method is to cut all of the material loose to a depth of 1 inch or more below the bottom of the washboard area. This brings up some fines to mix with the surface material. Then transfer the material to the proper crown and shape.

But remember that one cause of washboarding is dry conditions. Never work on washboarding problems without good moisture in the material. When possible work the problem areas after a good rain and then resume normal blading.

A useful tool in working washboards is the replacement bit-type cutting edge. It tends to have a shallow scarifying effect and makes it easier to cut material loose and mix it.

This replacement cutting edge



can be used effectively on a front-mounted dozer blade. The operator can drop the dozer to cut out washboards and use the moldboard to shape the area.

The use of a conventional scarifier also works. But you need to be careful about going too deep and bringing up dirt and large rock from the subgrade. This will contaminate the gravel.

Another method to change gradation is to pull material from the shoulders and mix it with the loose surface gravel. Generally, the material is not the best binder, but it does have some benefit in restoring some fines to the gravel. This

washboarding

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approach works best in the spring when moisture is present and before too much vegetation has grown on the shoulders.

A couple of advanced methods work well but usu-

ally are affordable only in high traffic locations. One of these is treatment of the gravel with either calcium or magnesium chloride.

These products are not binders but are a tremendous aid in keeping gravel in place. They work by simply drawing moisture from the air.

The key to success with these products is to treat gravel that has good gradation, particularly good natural binding. The chlorides then take over by keeping the surface slightly

damp, and the gravel will remain tightly bound.



This example shows a spot treatment with magnesium chloride near a road entrance that is often a washboard troublespot.

The other method is to use reclaimed asphalt as part of your surface gravel. This high-quality product is not available everywhere but sometimes is stored by local agencies.

The best results are with a 50/50 blend of recycled asphalt and virgin gravel. In this mix the asphalt becomes the binder, and the material usually has a good binding characteristic and will resist washboarding. It should be placed at a compacted depth of at least 3 inches. If not affordable for a whole section of road, it works well in trouble spots.

When placing new material on a washboarded area, always cut and rework the area before adding the new material. If this is not done, the washboard pattern in the original surface will invariably reflect right up to the new surface, and your problems begin all over again.

It also is important to have the road properly crowned and shaped. Sometimes the original material will have to be cast to the side and used as shouldering material because adding a depth of new material will make the finished surface too high.

Summary

The three causes of washboarding are lack of moisture, driving habits and poor quality of gravel. You only can change one cause—the gravel.

The gradation of gravel can be modified by scarifying, pulling more fines from shoulders, etc. But the key is to get a high quality surface gravel in place in washboarding areas.

With heavy traffic in prolonged dry periods, even good surface gravel will not guarantee elimination of washboarding. However, it definitely will reduce it. You also will realize a bonus in reduced blading requirements, less material loss from whip off and less dusting.



This high traffic road uses recycled asphalt place on a gravel bed.



These two contrasting examples appear quite different, but the real difference is only in the surface gravel. The material on the right has a nice bleed of stone, sand and fines which remain tightly bound and resist washboarding.

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For additional information, contact the Nevada T² Center at the address shown below.

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