STATE OF ILLINOIS
STATE HIGHWAY DEPARTMENT

BULLETIN NO. 11

Surface Oiling of Earth Roads

Prepared by
B. H. PIEPMEIER,
Maintenance Engineer, Illinois State Highway Department

SPRINGFIELD, ILLINOIS,
December 1, 1915

[Printed by authority of the State of Illinois.]

STATE OF ILLINOIS

STATE HIGHWAY DEPARTMENT

BULLETIN NO. 11

Surface Oiling of Earth Roads

BY

B. H. PIEPMEIER,
Maintenance Engineer, Illinois State Highway Department

SPRINGFIELD, ILLINOIS
December 1, 1915

[Printed by authority of the State of Illinois.]

SCHNEPP & BARNES, STATE PRINTERS
SPRINGFIELD, ILL.
1915.

CONTENTS.

PREFACE.

The State Highway Department has received numerous inquiries relative to the advantages and methods of oiling earth roads. It seems expedient at this time, therefore, to publish this treatise on surface oiling of earth roads to aid in furnishing information that will assist in securing the best results with this method.

As this method of surface treatment is relatively new, there is no very definite information available as to its economy. However, an attempt has been made in this publication to give as much information as is available. In the majority of cases this information will answer the questions generally asked concerning such work.

The purpose of this bulletin is not to cover in detail all that might be said in regard to the oiling of earth roads, but rather to give a general outline of the subject together with suggestions as to the best methods for oiling and maintaining earth roads.

WM. W. MARR, *Chief State Highway Engineer.*

OILING OF EARTH ROADS.

The oiling of earth roads has been practiced on a small scale in a number of places for the past fifteen years. California has done more of this work than any other state, primarily on account of its natural resources and climatic conditions. It has used a large amount of oil and has successfully maintained many of its roads by this method, largely on account of the high grade oil that is available at a very low cost and also on account of the sandy condition of the soil, and the light winters that prevail.

Illinois can never expect to accomplish the same results in oiling earth roads as has California. The black, loamy soil, the low and poorly drained conditions of many of the roads, together with the severe winters and springs make it a fallacy to expect anything like a permanent road to result from the use of road oil.

It should be kept in mind that continued oiling will not make an earth road entirely satisfactory for all localities or for all conditions of traffic. The oiling of earth roads, like dragging, is a maintenance proposition. The intelligent use of oil, like the continued use of the road drag, will maintain the earth road so that it will materially improve the present conditions existing on many of the earth roads in Illinois.

The oiling of earth roads should not be practiced promiscuously, but used only where the roads are suited to such work. The intelligent use of oils on many earth roads is unquestionably a justifiable expense.

It is the purpose of this publication to present as many facts concerning the use of oil as it is possible to secure at this time, also to describe what is shown by experience to be the best method of preparing the road and applying the oil together with a few suggestions that may be of some assistance to the contractor or individual who has such work under consideration.

The Selection of Roads for Oiling.

Roads should not be oiled until they have a permanently established grade; that is, all hills should be cut down, hollows filled, embankments widened, and all drainage structures established. Low, flat, undrained roads should not be oiled until proper drainage has been attended to. The oiling of a mudhole will not remedy the trouble but often aggravates it.

Roads that have a preponderance of heavy hauling should not be selected for oiling. The oiling tends to waterproof the road, but it is readily understood that continued heavy hauling even on perfectly dry earth roads will eventually rut and dig them out in pot holes. The mixture of oil and earth lacks stability to meet all the requirements of traffic. If something could be mixed with the oil

Fig. 1. Oiled Earth Road 15 Feet Wide After First Treatment of Three-eighths Gallon Per Square Yard. Note the Road Was Well Graded and Shaped Before Oil Was Applied. Such Work Insures The Best Results.

and earth to give it stability and aid it to resist the wear of traffic, it would more nearly meet all traffic conditions.

On moderately traveled roads where there is a greater amount of pleasure travel, the oiled earth roads will give better service.

The Purpose of Oiling.

It should be kept in mind that the main purpose of oiling earth roads is to suppress the dust and aid in maintaining a smooth and waterproof surface. If it is possible to prevent dust from forming, the surface of the road will remain much smoother and there will be less mud form during rainy weather. By reducing the mud nuisance it is possible to use the road a larger portion of the year. By keeping the surface of an earth road smooth, the traffic is distributed more uniformly over the road, thereby making it wear much longer. The suppression of the dust not only makes the road wear longer, but prevents a portion of the road from blowing into the adjoining fields, washing away, etc. The oil also prevents the encroachment of weeds and sod upon the traveled portion of the highway, thus improving the appearance and producing a more thoroughly compacted road.

The suppression of dust makes an earth road more sanitary and desirable for pleasure traffic. The expense of oiling many roads is in many cases justifiable from the standpoint of the increased comfort to pleasure drivers.

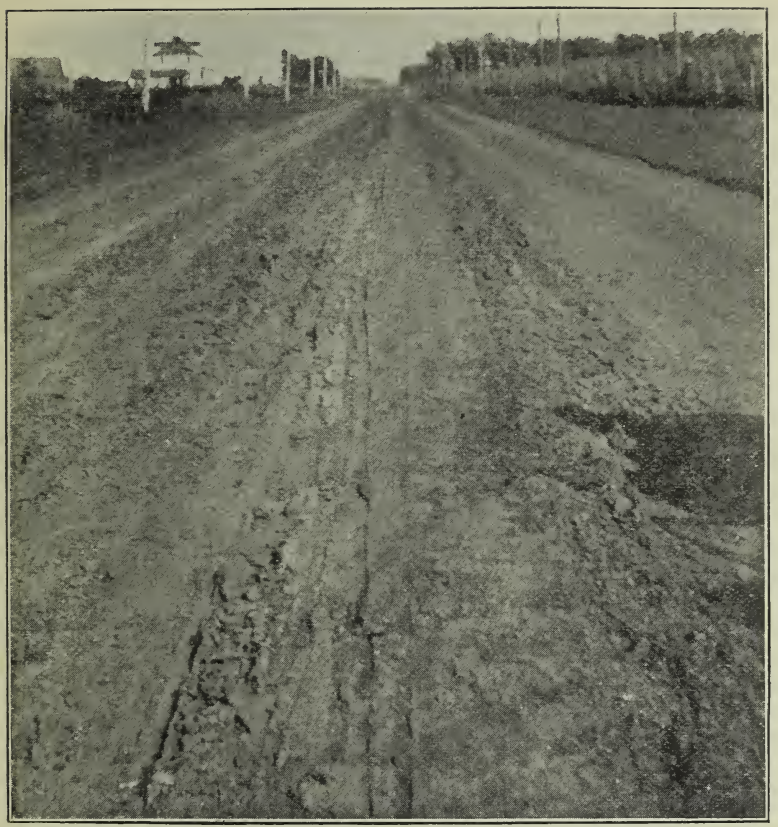

Fig. 2. Oiled Earth Road Unsatisfactory on Account of Applying Heavy Oil on Top of the Dust so That it Could Not Penetrate the Surface. The Oil and Dust Pick Up in Bunches and Make a Very Rough Surface.

A road that is oiled systematically for a series of years gradually acquires an oil-soaked crust which is more or less impervious to water. The heavy oil-soaked crust, however, will rut if the traffic is not distributed uniformly over the road and it will break through during the continued freezing and thawing of a severe winter and spring. This is particularly true if the road is used by heavy traffic. However, when such roads rut and cut through, they may be reshaped by use of the road drag at a very slight expense.

The purpose of the oiled earth road, therefore, is not to replace what is generally recognized as a hard surfaced road, but to keep the moderately traveled earth road in a suitable condition for ordinary traffic a larger portion of the year.

Preparation of the Earth Road.

The mistake is often made of attempting to improve a road without first grading and draining it. When a road is graded for

oiling, graveling, or any other form of surfacing, a permanent grade line should be established. Money spent in properly grading an earth road is not wasted, but has practically its full value when such a road is designated for later improvements. The great advantage of establishing a permanent grade and cross-section before the road is oiled is to utilize the oil-soaked crust of earth as a foundation for later improvements, such as gravel, stone, brick or other hard road surfaces. If oil, gravel, or other surfacing material is applied to an improperly graded road, a very large portion of the material will be disturbed and practically wasted when later improvements are demanded. In other words, any money that is spent upon the public highways should be spent with a view of further improvements that will naturally be required as traffic increases.

The Road Surface Preparatory to Oiling.

As the prime objects of oiling an earth road are the suppression of the dust and the maintaining of a smooth waterproof surface, it is very important that the road surface be oiled when it is smooth, free from dust, and in a condition to absorb the oil.

Oil applied on dust will not penetrate the road surface, but will merely mix with the loose material to make an oiled-dust surface that is apt to fly readily and become a nuisance. The surface should be perfectly smooth and free from low places that will retain water. If water is allowed to stand upon an oiled earth surface, a bad mud hole will soon result. A moist subsoil preparatory to oiling is not serious though best results may be expected when the road is reasonably dry for about two inches on the surface.

Applying Oil.

After the road has been prepared as heretofore described, the oil should be applied at the rate of one-fourth to one-half gallon per square yard of surface. If the road has never been oiled, or if more than a season has elapsed since a previous oiling, it will be found that about one-half gallon per square yard will be required. If the road or street has been oiled regularly, one-fourth to one-third gallon per square yard will usually be satisfactory. It is much better to apply a small amount of oil twice each season rather than to put on the full quantity in one application. When too much oil is applied, it is not only wasted, but is often very disagreeable to traffic.

After a road has been oiled for several years, one light application each year may be sufficient, or at least equal in results to two applications per year on a new oiled road.

The time for oiling will necessarily vary considerable depending upon the season. Favorable times for applying the oil will be about April and September.

The uniform distribution of the material is one of the essential requirements for success. An ordinary street sprinkler or a home-made device attached to a thresher tank wagon or similar tank may be utilized for distributing the oil. An expert using such equipment can ordinarily get the required amount of oil on the road rather uniformly. Much better results, however, can be secured by the use

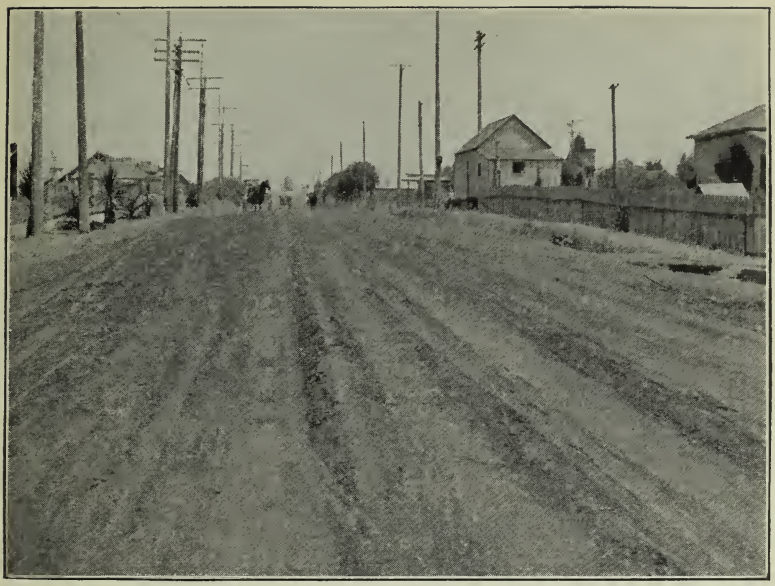

Fig. 3. Oiled Earth Road in California Under Heavy Traffic. Note That the Surface is Rather Badly Rutted.

Fig. 4. Oiled Earth Road in Spring of the Second Year. Surface is Kept Smooth by Means of Light Drag. The Continued Use of a Light Drag is of Great Benefit.

of some specially designed apparatus made for the purpose, such as pressure distributor tank wagons.

There are a number of specially designed pressure distributing wagons on the market that vary in price from $400 to $6,000. The horse-drawn distributors have a capacity of from 450 to 600 gallons and can be purchased at from $400 to $600. Such distributors are usually equipped with some form of heating device so that hot oil may be applied when required.

Some of the auto distributors hold 1,000 gallons and are equipped with oil heaters for heating the oil quickly; also, special oil pumps for filling the distributor and for spraying the oil upon the road in the desired quantities. Such trucks cost from $5,000 to $6,000 complete.

Shipping and Handling Oil.

Road oil is usually shipped in 8,000 or 10,000 gallon tank cars. Some companies are able to furnish 4,000 and 6,000 gallon tank cars, but such cars are very few and usually hard to get. The railroad tank cars are equipped with steam heating coils so the material may be heated in the tank by attaching a steam pipe or hose. Small quantities of oil may be purchased in molasses barrels, but when delivered in barrels there will be an additional cost of two to three cents per gallon. The tight barrels will ordinarily hold about 50 gallons. If the barrels are handled with care they can be sold at 50 to 65 cents each when empty. Heavy oil shipped in this manner is usually very difficult to remove from the barrels. In such cases the barrels are dumped into an open heating kettle and broken. After the oil is warm the staves and hoops may be removed by a large hoe or rake and used as kindling. The hot oil can be pumped from the heating kettles to the distributor and, while still hot, applied on the road.

Where there is no heating kettle on the job and there are but a few barrels of heavy oil to apply, they may be emptied direct into the distributing wagon by first placing the barrels in a very warm room or close to a fire for several hours.

When there is but a small quantity of oil desired, say 3,000 or 4,000 gallons, it is usually cheaper and much more economically handled if shipped in a large tank car. Freight will have to be paid on a full tank car of 8,000 or 10,000 gallons, but this will ordinarily be compensated for by the saving in barrels and in the economy effected in handling the oil on the job.

Pumping Oil.

There are a number of special oil pumps on the market that can be purchased at from $15 to $30 that will readily pump hot or cold oil. The rotary pump is the one most commonly used. It may be driven by a gasoline engine or a steam engine, in case the latter is needed at the tank car for supplying steam heat. A 1½-inch or 2-inch rotary pump will fill a 600-gallon distributor in from ten to fifteen minutes.

The ordinary water tank pump may be used for pumping cold oil. A 2-inch suction tank pump will fill a 600-gallon tank in 30 to 40 minutes. Such pumps cannot be used for hot oil, as it will soon burn out the valves.

Fig. 5. Proper Drainage is Important on All Earth Roads Before Oiling. There Are Many Flat, Seepy Places That Should be Drained by Tiling. A Line of Tile on Some Sections of Road Will Relieve the Underground Water Pressure and Tend to Prevent the Oil Soaked Earth Crust From Rutting.

Fig. 6. Grading and Compacting on Earth Road Prior to Oiling. It is Important That an Earth Road Have a Proper Grade and be Thoroughly Compacted Before the Oil is applied.

All of the above named pumps work best attached to the bottom of the railroad tank car by means of a hose or pipe. However, it is well to eliminate hose connections as much as possible as some oils and tars eat them out very rapidly.

A 3-inch or 4-inch lift pump may be used to an advantage in pumping oils. Such pumps are set in the tank car at the top and one man will readily pump a 600-gallon tank in 20 minutes. This kind of pump can be purchased for $20 to $25. It has many advantages as there is no mechanical power needed nor any pipe or hose connections.

After the pump is connected at the bottom of the tank car and everything is ready to receive the oil, the cap on the dome of the car should be unscrewed and the discharge valve opened from the inside. This valve has a stem projecting up to the dome. It is well to have a cut-off valve in the hose or pipe connection at the bottom so the tank car valve may be left open during the day that oil is being used.

If there is an elevated siding or switch eight or ten feet high at the station, the tank can be spotted thereon and the oil allowed to flow by gravity into the distributing wagon from the tap in the bottom of the tank car.

Heating Oil.

Where oil must be heated before being applied, it is often convenient to spot the car on a spur near some steam plant, such as a mill, creamery, or electric light plant. Where such arrangements can be made, a ¾-inch or 1-inch steam pipe line may be connected from the plant to the tank car. If no steam plant is accessible, an ordinary steam tractor or roller can be connected with the tank car. Where a steam connection is made for supplying the heat, from 12 to 24 hours are required to bring the oil up to 150 to 175 degrees F. which is about the maximum temperature that can be reached with the steam heat. This temperature will permit the oil to be pumped readily. Its temperature may then be increased the desired amount in the distributor.

The steam connection with the tank car is made at one of the 2-inch pipes that project beneath the tank, the other 2-inch pipe that projects should be supplied with a valve so the amount of steam passing through the coils may be regulated.

It is advisable to have a thermometer on the job so that the temperature of the hot oil may be tested from time to time.

Some road oils have a very low flash point and extreme care should be taken to prevent any oil from coming into contact with a flame. An analysis of an oil always shows the flash point so it is well to keep the temperature somewhat lower to prevent burning and to be on the safe side.

The presence of a slight amount of water in heating oil will cause the oil to foam and give a great deal of trouble. Where the oil tends to foam, it should be heated very slowly. In such cases every precaution should be taken to prevent accidents.

Fig. 7. A Well Graded Earth Road But Badly Cut Up at Time Picture Was Taken. It Should be Carefully Dragged and Compacted Under Heavy Roller Before Oiling. A Uniformly Compacted Surface Will Show the Best Results After Oiling.

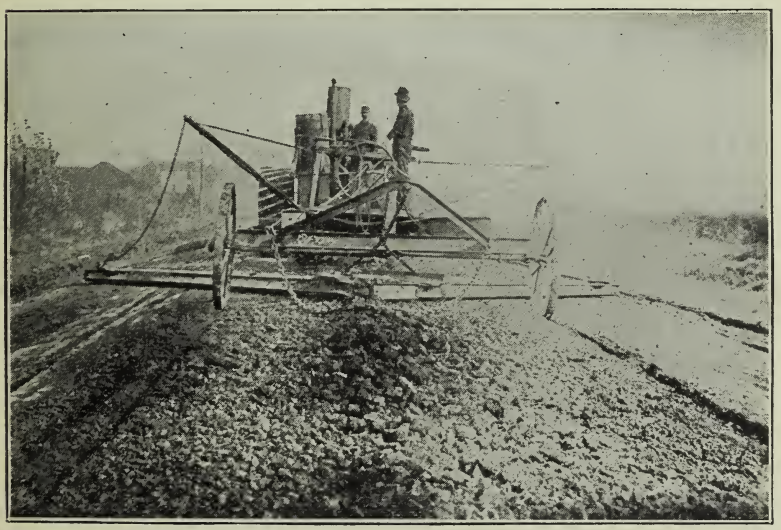

Fig. 8. Roads Graded in This Way Are Unsatisfactory For Oiling. It is Almost Impossible to Thoroughly Compact the Center of the Road on Account of the Sod and Humus that Has Been Carelessly Dragged to the Center.

Sanding Oil Surfaces.

Better results can be secured from sanding the road slightly after either hot or cold oil has been applied. Clean hard sand is much better on a road surface than dust or the sweepings from the road. A hot oil application should be followed with a light dressing of sand, or the traffic will likely pick up the oil and make the surface of the road very uneven. Sand may be applied at the rate of one cubic yard to each 100 to 150 square yards of road surface. It may be applied by shovels from a wagon or from a special apparatus for distributing the sand.

The application of sand gives an oiled earth surface more stability. The sand retains the oil, assists in preventing wear, and aids in keeping down the dust. The light application of sand is a justifiable expense on a majority of oiled earth roads.

Oiling Sandy Roads.

There are many sections of roads in Illinois that are very sandy and will have to be handled differently than the ordinary earth road. Where it is possible to mix clay or loam with the top four or five inches of sand before oiling, much better results may be expected. A suitable clay or loam can usually be secured at a reasonable distance from the sandy section. Where possible, the sand and clay should be thoroughly mixed and allowed to compact under traffic before the oil is applied. The sand-clay road will permit a slightly heavier oil than the ordinary earth road.

If there is no clay or loam within reasonable distance of the sand road, it may be materially improved by mixing a heavy oil (70 to 90 per cent asphaltic product) with four or five inches of the top layer of sand. This can best be done by applying about three-fourths gallon of oil and then covering it with about one inch of the sandy soil from the road side, then applying about one-half gallon of oil and another layer of sand. By building up successive layers of oil and sand, it is possible to get from one and one-half to two gallons of oil per square yard of surface. This amount of oil mixed with four or five inches of the sandy soil will form a solid oil and sand crust that will hold up light traffic. The cost of such applications will vary from $800 to $1,500 per mile of road fifteen feet wide.

The cost of applying a four or five inch layer of clay or loam that may be secured within one mile of the road, and mixing it with the sand, will be about the same. It is generally recognized that the mixture of sand and clay is more serviceable that the mixture of oil and sand.

The Cost of Surface Oiling.

The cost of preparing a public road for an oil treatment may vary from $100 to $2,000 per mile. However the grading and preparation of an earth road should not be charged against the cost of oiling. The oiling or dragging of an earth road is a maintenance proposition and should be estimated separately from the building or preparing of the road. The road should be kept well shaped regardless of whether it is

Fig. 9. Removing Dust From the Surface of a Road by Means of a Street Sweeper Before Applying Oil. The Best Results Are Secured From Oiling Earth Roads That Are Free From Dust.

Fig. 10. Oiled Earth Road After Two Weeks of Summer Rains. Surface in Excellent Condition. Note Uniform Grade and Crown of Road.

to be oiled or not. However, some cleaning is almost always necessary prior to the first application of oil, and this cost will vary from $25 to $50 per mile of road.

Road oil can be purchased for from three to seven cents per gallon, depending upon the quality. It may be applied on the surface of the road at the rate of one-fourth to one-half gallon per square yard. So the cost of oil alone may vary from $75 to $275 per mile of road 15 feet wide, depending upon the quality and quantity of oil applied.

The cost of applying the oil will vary depending upon the length of haul and the kind of equipment used. This cost may be estimated at from $50 to $150 per mile of road 15 feet wide.

The above figures show the cost of oiling to vary from $150 to $475 per mile of road. With average conditions and with a medium priced oil, the average cost of oiling alone per application may be from $200 to $250 per mile of road 15 feet wide. It must be understood that these costs are based on the conditions prevailing during the season of 1915.

It is understood that the above figures are only an approximate estimate. A complete record of the cost of oiling, together with the quality and quantity of oil used each year over a period of years is not available. The above figures, however, are based on the best information available in this and other similar states.

It is predicted by same enthusiastic users that a road will not require oiling after it has been oiled for two or three years and the surface has become thoroughly saturated with the oil. The writer has visited some twenty different towns that have oiled their streets for a period of more than five years and the present condition of such streets indicates that the oiling will have to be repeated each year indefinitely to secure the desired results. The quality or quantity of oil used in the twenty towns referred to is not known. It may be that if a high grade of asphaltic oil is used that some annual applications may be omitted after a few years of treatment. With the best oil, however, it is hardly expected that more than one year could elapse without some attention.

Some experiments have been made along the line of thoroughly saturating the top six inches of earth and then compacting it with a petrolithic roller. The saturating of the earth with the first application of two and one-half to three gallons of oil was intended to resemble somewhat the continual oiling of the surface over a period of four or five years. The experiments referred to were made in 1908 and 1909 on three different sections of road of one-half to three-fourths of a mile in length. Two of the sections were considered failures and were within three years covered with a more desirable wearing surface. The third section still remains; however, it shows very few signs of having such a treatment. This section seems to rut in the winter and spring almost as badly as the other portion of the road; in midsummer the surface of the road pulverizes and forms a dust that flies almost the same as dust from other portions of the road.

In view of all the information that is available on oiled earth roads, indications are that the treatments must be made each year or at least every other year to get the desired results. On this basis,

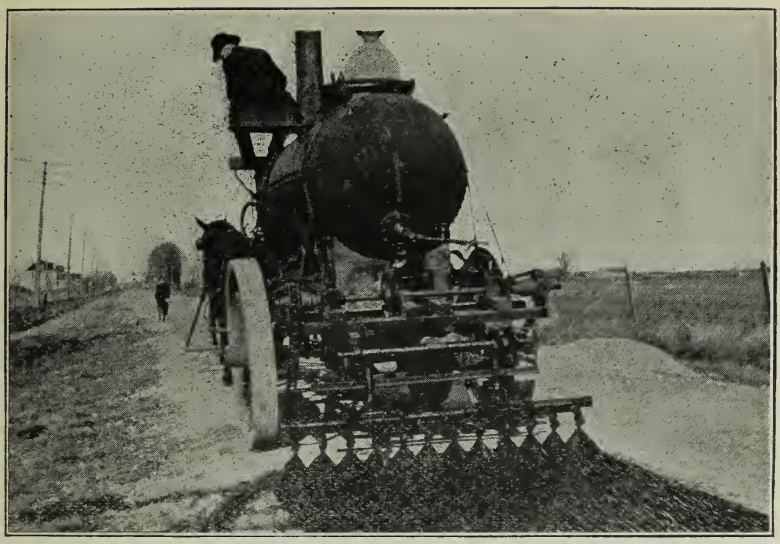

Fig. 11. Pressure Distributor For Applying Hot or Cold Oil. Heat Supplied by Coal Furnace Under Tank. Equipment Owned by The State Highway Department.

Fig. 12. Pressure Distributor For Applying Cold Oil.

$150 to $200 per year for five to ten years may be a basis for estimating the cost of surface oiling.

Quality of Oil.

On practically all work that has been done in the past, a light oil with a paraffin or semi-asphaltic base has been used. There is very little information available on the use of the higher grades of asphaltic oil on earth roads. It is predicted by our best authorities that the use of the higher grade asphaltic oils will prove to be more satisfactory and more economical in the end than the use of inferior products.

It seems to be the unanimous opinion of all extensive users of road oils that the semi-asphaltic products are far superior to the paraffin oils.

From the information that we have, therefore, it seems essential that careful analysis be made of all road oils before using and that preference be given to the natural and semi-asphaltic products over the paraffin oils.

The best products are secured only by purchasing the material under carefully drawn specifications and using the same under the approval of a competent chemist.

The amount of asphalt or residue that a product may contain does not classify it as a suitable material for the road under consideration. For instance, a thick heavy material with 40 per cent asphalt or residue will not give the same results as a light thin product of the same asphaltic content.

The purpose of oiling an earth road is the suppression of dust and the waterproofing of the surface. It is evident, therefore, that the best results may be secured during the first application, by applying either a cold oil or at least a very thin product that will penetrate the surface of the road several inches and at the same time contain as many binding elements as possible so as to seal all pores in the earth, making it waterproof and at the same time adding some binding qualities that may assist the bond of the soil itself. A suitable product, as is commonly expressed, may very from 30 to 60 per cent in asphalt. After the surface of the road has been thoroughly saturated, a hot oil or a slightly heavier product may be used.

If the heavier oils are used for the first application they will not readily penetrate the surface of the road and will consequently form a mat on top. The forming of the mat before the surface of the road is more or less waterproof may be a serious fault as moisture will accumulate beneath the mat and the road will be much slower in drying out than it would had the oil not been applied. The mat surface with a soft subsoil will rut more readily, besides breaking and scaling off in large pieces, making the road surface rough and undesirable.

The paraffin oils are ordinarily thin and light, yet they do not contain sufficient binding elements to seal and hold the surface of a road. Such oils after being in use a short while apparently have very little value as they permit the surface of the road to grind up into a light oil-mixed powder which makes a slick, slimy mud

Fig. 13. Pressure Distributor For Applying Hot Oil. Heat Supplied by Oil Burners.

Fig. 14. Pressure Distributor For Applying Cold Oil. The Spraying Attachment Can be Attached to an Ordinary Tank Wagon as Shown in the Cut.

when wet, and which when dry, flies almost as readily as the ordinary dust. The oiled dust becomes very disagreeable when it flies. It dulls the glossy finish on vehicles, makes the eyes burn and almost ruins clothing and household furnishings. A number have remarked that a poorly oiled earth road is much worse than no oiled road.

Oiling Gravel and Macadam Roads.

Gravel and macadam roads that are in good shape may be economically maintained by applying a surface treatment of oil or tar. Where gravel or macadam roads are subjected to a large amount of motor traffic, they soon become very rough and begin to ravel. This is largely due to the fast motor traffic that whips out the bonding material that holds the stones or pebbles in place on the surface of the road. To maintain such roads, it seems necessary that some bituminous products be applied occasionally to the surface of the road to retain the bonding material and to prevent rapid deterioration of the road.

Experience shows that more care should be taken in the preparation of the road surface and in the selection of the quality of bituminous products than in the oiling of earth roads. It is not the purpose of this bulletin to deal with the maintenance of gravel or macadam roads; more complete information may be had upon this subject together with complete specifications for oiling earth, gravel or macadam roads, by requesting Bulletin No. 6, Dust Prevention, from the State Highway Department.

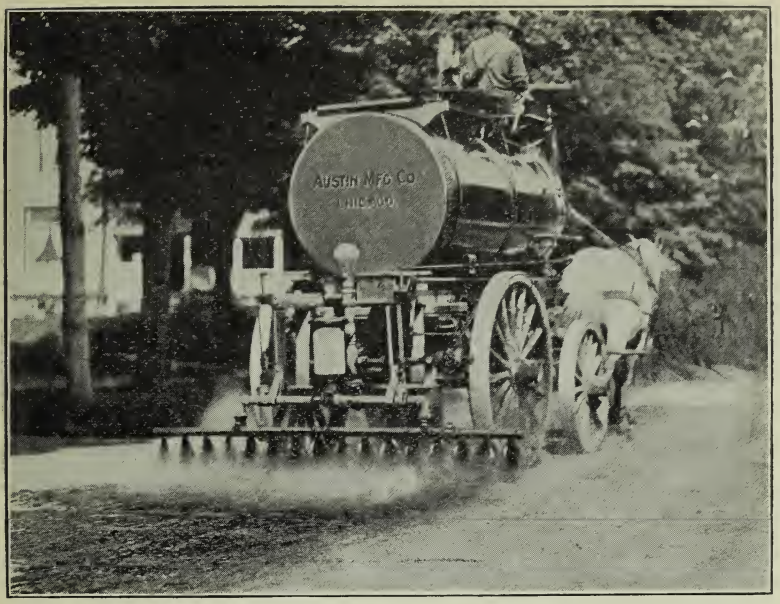

Fig. 15. Six Hundred Gallon Pressure Distributor For Cold Oil. Pressure Secured From Rotary Pump Driven From Rear Wheel.

Fig. 16. Pressure Distributor Applying Cold Oil. Poor Results May be Expected From Such Uneven Distribution of the Oil. Note That Only About One-half of the Nozzles Are Working Properly.

Fig. 17. Applying Heavy Asphaltic Material at the Rate of One-fourth Gallon Per Square Yard of Surface. Material is Heated by Kerosene Burners Beneath the Tank. Note Uniform Distribution of the Asphalt.

Fig. 18. Applying Oil From a Gravity Distributor. With Such Equipment it is Almost Impossible to Distribute the Oil Uniformly. A Uniform Distribution of the Oil Insures the Best Results.

Fig. 19. One Thousand Gallon Auto Pressure Oil Distributor For Applying Hot or Cold Oil. Such Equipment Has Been Used in Distributing Oil 25 Miles From the Supply.

Fig. 20. Eight Hundred Gallon Auto Pressure Oil Distributor For Applying Cold Oil.

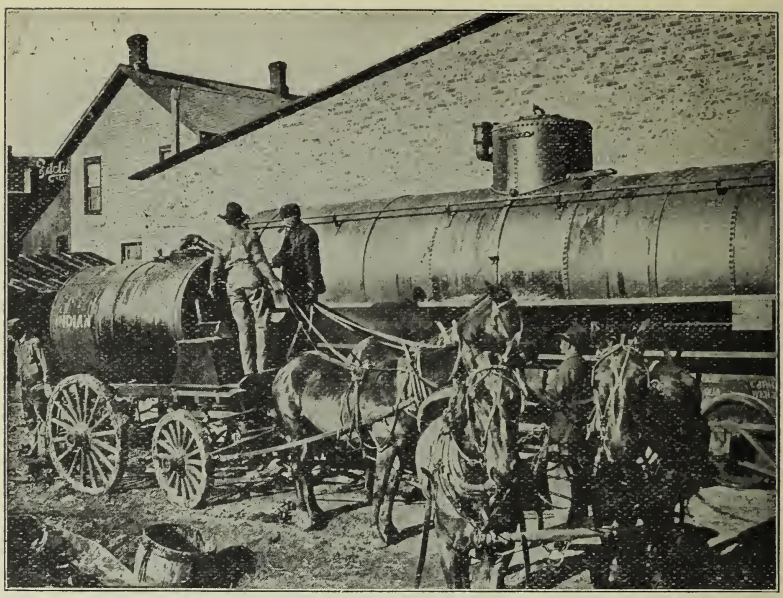

Fig. 21. Unloading Hot Oil From Railroad Tank Car Into Distributor by Means of a Rotary Pump Attached to the Tap in the Bottom of the Car. Tank Car Heated With Steam From Adjacent Ice Plant.

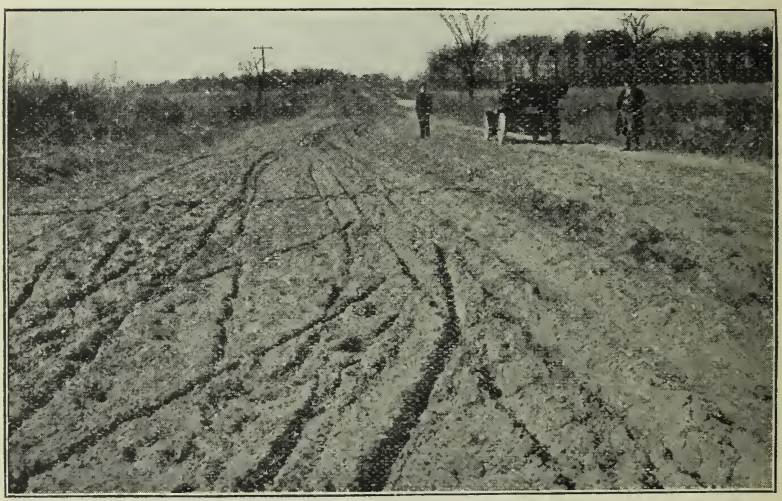

Fig. 22. Sandy Road That May be Found in a Few Places in Illinois. Such Roads May be Improved by Applying Four or Five Inches of Clay and Thoroughly Mixing it With the Sand, or in Mixing Heavy Oil With the Top Four or Five Inches of the Sandy Surface.

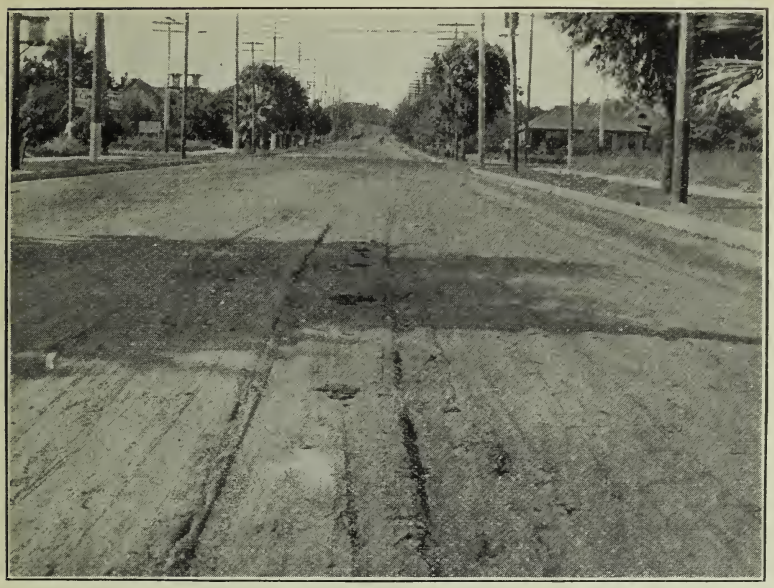

Fig. 23. Oiled Sand Road in California. Surface Not Entirely Satisfactory on Account of the Greasy Oil Used.

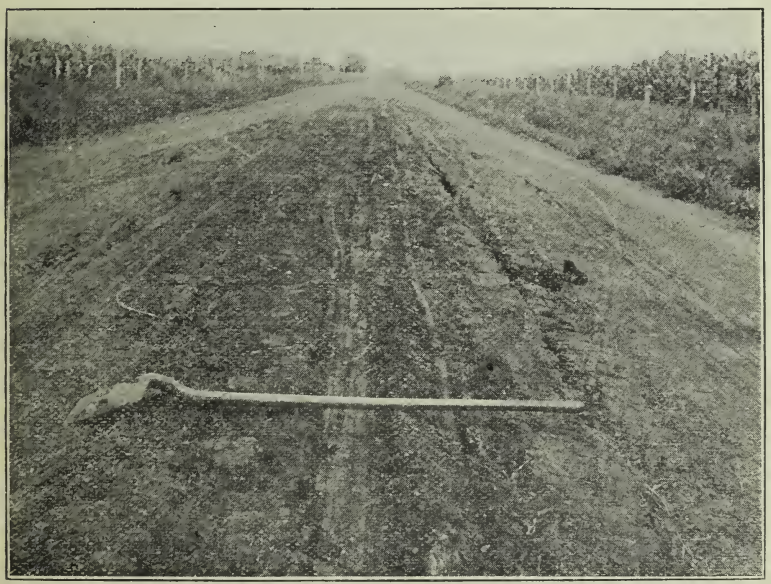

Fig. 24. Oiled Earth Road After Thoroughly Mixing Oil With Top Five Inches of Earth. Three Gallons of Oil Used Per Square Yard of Surface. Condition Not Entirely Satisfactory as it Breaks Up in Winter and Spring. More Economic Results May Be Secured From Continued Surface Oiling.

Fig. 25. Sand Spreader Sprinkling Coarse Sand Over Freshly Oiled Surface. The Spreader Holds About One Ton of Coarse Sand or Stone Chips and Drills it Uniformly Over the Oiled Surface. The Spreader May be Loaded From Piles Alongside of the Road or Direct From Wagons. On Light Oils the Spreader May be Hitched to the Sand Wagons and Materials Shoveled Into the Spreader Direct.

Fig. 26. Macadam Road Maintained Under Heavy Traffic by Means of Annual Treatments of a Bituminous Material and Coarse Sand.