



# What is **STRATEZYME?**



# STRATEZYME

**STRATEZYME** is a complex non-bacterial concentrated multi-enzymatic formulation that alters the properties of earth materials, providing one of the most cost-effective methods to stabilize roads and seal ponds and landfills.

**STRATEZYME** is one of the world's finest products for road stabilization and pond and/or landfill sealing. Although it has been available for the past 10 years on an experimental basis, due to a recent major expansion in manufacturing capacities, **STRATEZYME** is now available for the first time to the commercial and industrial marketplace.

Compared to all other road treatment materials now in use, **STRATEZYME**, a concentrated enzyme formulation, alters the properties of earth material to produce superior road base stabilization. Developed and proven through many years of field-testing, **STRATEZYME** provides additional advantages to road builders, communities and the environment by being non-toxic, non-corrosive and totally biodegradable.

When mixed with water and applied prior to compaction, **STRATEZYME** acts upon organic fines contained in the soil through a catalytic bonding process, producing a strong cementation action. Unlike inorganic or petroleum based products which temporarily hold soil materials together, **STRATEZYME** causes the soil to bond during compaction into a dense permanent base which resists water penetration, weathering and wear. This process takes place in 72 hours under normal summer conditions.

In addition to creating a new and better way of building and maintaining roads, **STRATEZYME** is being used successfully in the construction of lakebeds, mine leach pads, ponds, landfill liners, and wherever there is a need to increase the load-bearing capacity of the soil and to reduce plasticity and permeability.

## STRATEZYME ADVANTAGES

**STRATEZYME** lowers the surface tension of water, which promotes fast and thorough penetration and dispersal of moisture. This action causes hydrated clay particles to be pressed into and to fill the voids throughout the soil, thus forming a tight, dense permanent stratum. The increased lubricity of soil particles allows the designated soil density to be reached with less compaction effort.

**STRATEZYME** reduces by as much as 25%, the amount of water required to reach the optimum moisture level of soil, since it promotes rapid saturation and inhibits surface evaporation. The **STRATEZYME** cementation action increases the soil bearing characteristics by promoting a closer bonding of soil particles. This reduces the tendency of soil to expand after compaction and results in a strong, stable earth layer. By achieving greater bonding density, soil materials resist migration of water. A properly treated **STRATEZYME** base becomes almost impervious to water penetration and much more resistant to frost heaving.

If sufficient fines are present, road builders can now construct a new road base using existing soil materials without trucking in additional aggregate. Mixing **STRATEZYME** with the top 5 or 6 inches of soil will produce a road base that has more strength and less permeability than can be attained with any other treatment. If imported material is needed, less expensive, dirty aggregate can be used. The dirty fines are needed to bond the material together. "Dirty" here means 15% to 20% cohesive fines passing a 200-mesh screen. Only 15 gallons of **STRATEZYME** is needed to treat one mile of a 25-foot-wide roadway to a depth of 6 inches.

**STRATEZYME** can be applied over wide weather and locale ranges. From temperatures near freezing to hot summer days, from rain forests to deserts, lake bottoms to earthen dams, **STRATEZYME** will provide superior results. New or existing roads treated with **STRATEZYME** to the recommended depth will retain a tough, rupture-resistant surface that requires minimal maintenance, often requiring no additional "dressing" for a number of years.

**STRATEZYME** is sold in liquid concentrate form. This eliminates the bulk storage, pre-mixing and handling of large amounts of materials. It will not corrode equipment.

**STRATEZYME** is non-toxic. It requires no special handling equipment and no special containment procedures as required with toxic and/or corrosive agents. It does not irritate skin tissue and causes no rashes or burns.

**STRATEZYME** contains no combustible materials, is non-explosive and can be used near open flames. It is non-gaseous and can be stored in poorly ventilated areas. It will not harm humans, animals, fish or vegetation under normal use and it is totally biodegradable.

# **STRATEZYME and Containment Structures**



## Common elements in all containment structures include Soil Stabilization and Construction Techniques – Materials.

Whether a natural soil or synthetic liner is used, the underlying surface must be stabilized prior to putting the liner on top. This is an area where **STRATEZYME** can be very effective. It will assist in compaction, producing greater soil strengths and reducing permeability. Once the material has been treated and compacted, it is in a long-term natural state that will resist degradation.

**STRATEZYME** has been specified by engineers for use in construction of a natural soil liner (clay type with low permeability). **STRATEZYME** increases soil density and decreases permeability. Construction includes compacting the material in 6-inch (15-cm) lifts, using proper compaction equipment and the correct amount of moisture to obtain maximum density. **STRATEZYME** is a non-toxic biocatalytic multiple enzyme product distributed by **STRATEZYME, Inc.**. The technology of **STRATEZYME**'s biochemistry is proteinaceous and enzymatic in nature. It has been used for over 30 years.

For Waste Containment or Landfill construction, **STRATEZYME** is used to assist in compacting clay containing soil into a better containment barrier, that will meet regulatory requirements. Common to all systems of construction waste containment structures, testing and special analysis involving soil type and characteristics are required.

When site and pond size have been specified, soil core samples are taken for laboratory analysis. The tests will include particle size determination using ASTM-D-422 Method, as well as a hydrometer test without **STRATEZYME** to demonstrate the condition of the soil clay content. Laboratory permeability tests must then be run on soil samples with and without the appropriate **STRATEZYME** treatment. Tests should be conducted over a wide range of densities so compaction requirements may be specified. If soil tests show a two-micron clay content of less than 20%, it is often necessary to use borrow soil to achieve an adequate clay concentration with the on-site soil.

The pond excavation can be achieved with standard earth moving equipment used in any standard pond construction. The low-permeability soil liner, mixed and treated with **STRATEZYME**, is to be compacted in 6-inch (15 cm) lifts. Total thickness is specified by the desired permeability coefficient. The loss rate for a field liner can be predicted from laboratory data using the following. It is often best to leave the actual mathematics to a qualified engineer.

# Barclay's Law

For Unit Area:  $Q = K \times h/l = K \times d+1/l$

Q	Flow rate, cm per day
K	Permeability coefficient under unit gradient, cm/sec
h	Total head in meters
l	Soil lining thickness in meters
d	Water depth in meters
h/l	Hydraulic gradient equals the total head (depth of water) in meters divided by the soil lining thickness

Each 6-inch (15-cm) layer is mechanically mixed, adding water and **STRATEZYME** as required. One gallon of **STRATEZYME** treats 165 cubic yards of material, which is diluted with sufficient water to bring the soil-clay material close to optimum moisture. This mixing may be done off-site or in place, whichever is most suitable. Uniform mixing can be obtained by disking with an offset disc to a depth of 6 inches (15 cm) or by an approved mixing method such as a blade, pulverizer or other means available. During compaction, **STRATEZYME** performs several beneficial functions. It “wets” the clay particles, thus permitting a higher compaction density [98% to 102% of optimum density (ASTM-D-698)]. The macromolecules in the **STRATEZYME** product provide a “surfactant-like” property that aids dispersion of soil particles and provides certain “cementation” effects.

After mixing, the material is spread over the sub-grade or previously completed layer to the depth required to yield a 6-inch (15-cm) compacted layer. Each layer is compacted to at least 95% as determined by AASHTO Method T-99. The density is verified with a nuclear moisture density meter or other laboratory test method. Compaction is achieved with a sheepsfoot roller and the surface is worked to a smooth finish with a rubber tire or smooth steel-wheeled roller. The final grade should be within 1 inch (3 cm).

Upon completion of a layer of liner material, successive layers are installed by the same procedure. Immediately prior to spreading the treated material, the subgrade or the previous compacted layer should be moistened to permit bonding between layers.

Upon completion of the top layer, the liner is ready for use. Throughout construction of the liner there is no concern about punctures as in the case of synthetic liners. Also, the liner has been stabilized to the surrounding soil and is monolithic – able to withstand a variety of environmental conditions—temperature, settlement and load stresses. Usually there is no overburden protective layer required, as in the case of a synthetic plastic liner.

# CONSTRUCTION OF SANITARY LANDFILLS

## WASTE CONTAINMENT STRUCTURES

### PONDS, SEWAGE AND LIQUID CONTAINMENT

Soil stabilization, construction techniques and materials are the major components of any type of containment structure. Natural clay liners are geologically stable and have longer projected life expectancy than most man-made materials. Clay liners are self-sealing when put under stress. **STRATEZYME** works well with clay soils to assist in compaction and density. It also enhances cohesiveness and binding of soil particles.

The complexity of containment structures and ponds is influenced by:

- Geographic location
- Site topography
- Rainfall
- Ground water conditions
- Soil conditions
- Bearing values
- Expansive nature
- Permeability
- Subsidence danger
- Frost, etc

#### **Type of material to be contained**

- Water / other liquids
- Combination liquid / solid materials
- Mixture of inorganic and organic wastes
- Anticipated level of toxicity

Engineers use well-defined specifications in their designs of containment structures. The design and supervision insures that a proper liner has been installed and that it will meet the intended use over a specified time. Installation costs also play an important role in design. Use of soil-clay liners has been very cost effective and meets long-term design standards.

Several construction methods and materials are used in containment structures and ponds. Liner materials include natural clay and soil, synthetic liners, soil cement and others.



## Important Elements to Consider

- Type of construction (equipment and expertise)
- Construction supervision and testing
- How carefully will material be placed over the liner?
- What stresses will the liner material see over time?
- What unplanned event can occur to breach the liner's integrity, causing cracks, punctures or other liner breach?
- What is the life expectancy of the synthetic liner material?
- What substances might be present to degrade the synthetic material in the future?

## SEALING LAKES, PONDS OR LANDFILLS

For new construction, add **STRATEZYME** to water as described above. The soil ideally should have approximately 25% to 30% cohesive, colloidal fines (200 mesh). Blade or disc the soil to blend in **STRATEZYME** and water, then grade and shape. Next, compact the soil at optimum moisture using a compactor, tractor or truck. Generally, the top 10 to 12 inches is treated for most liners.

When an existing pond or lake is filled with water and less than 8 feet in depth, use one gallon of **STRATEZYME** for every 6,000 square feet of surface area (8 gallons per surface acre). Pour **STRATEZYME** into the water from the windward side and around the perimeter or across the surface if a boat or pump can be used. Stir up the silt from the bottom of the pond any way possible (dragging chains sometimes works). Fines placed into suspension together with the **STRATEZYME** will then migrate to the seepage areas. Do not add water for 3 days. **STRATEZYME** disperses clay and colloidal materials into the voids between each grain of soil and causes a catalytic bonding process, creating a strong, tightly compacted stratum that resists water penetration.

Success with this method will depend on the soil composition of your pond. If loss by seepage does not stop within 10 to 14 days, you can let the pond dry and re-treat using new pond construction methods described above. **STRATEZYME** will not harm fish if used properly. It is most effective in sealing the soils in ponds when at least 25% of the material contains fines that will pass a 200-mesh screen, and the fines are primarily cohesive clays.

# **SAFETY DATA SHEET**



# STRATEZYME

The natural solution

## Material Safety Data Sheet

### Section I.

#### Product Information

Trade Name: **STRATEZYME**  
Synonyms: Nutra-bond Plus, Solidroad 510  
Formula: Proprietary Blend

- D.O.T. Proper Shipping Name: Non-Hazardous Liquid
- D.O.T. Hazardous Class: Non-Hazardous
- D.O.T. Identification No.: N/A

### Section II:

#### Physical Data

- Specific Gravity: (H<sub>2</sub>O) 1.09
- Boiling Point: 212° F
- Freezing Point: 32° F
- Vapor Pressure: 21.84 @ 75° F
- Evaporation Rate: Same as Water
- Solubility in Water: Complete
- Appearance: Brown Liquid
- Odor: Slight Sweet Odor

### Section III:

Hazardous Ingredients: None

#### Section IV: Reactivity Data

- Stability: Stable. Avoid high heat.
- Incompatibility: None
- Hazardous Polymerization: Will not occur

#### Section V: Health Hazard Data

- Eye Contact: Avoid Eye Contact. If contact occurs, flush with water.
- Inhalation: None
- Skin Contact: None
- Ingestion: May cause slight laxative condition.
- Non-carcinogenic: No known conditions to avoid.

#### Section VI: Precautions for Safe Handling and Use

- No Special Gloves
  - No Ventilation
  - No Exhaust
  - No Protective Clothing
  - No Special Equipment
- No Respiratory Protection

**QUESTIONS  
RELATING  
TO  
STRATEZYME**



## QUESTIONS RELATING TO STRATEZYME

**1. *Is the performance of STRATEZYME affected when mixed with any other organic material, e.g., CaO or CaCO<sub>3</sub>?***

**STRATEZYME** works well with all organic soils. **STRATEZYME** will increase the bonding of the fines (-200 mesh) and allow greater moisture penetration to facilitate compaction.

**STRATEZYME** has been successfully used in roads containing limestone (CaO). Calcite (CaO<sub>3</sub>), a fine grain limestone or soft earthy clay, also reacts positively with **STRATEZYME**. However, the use of clays should be minimized in road building, usually less than 30% (-200 mesh).

**2. *Over time will STRATEZYME increase its bonding strength?***

**STRATEZYME** treated soils (for roads and ponds) achieve their greatest strength at the time of compaction and immediate subsequent curing (72 hours curing time). Bonding of the soil particles takes place in the presence of moisture and compactive force. This condition will last as long as the material resists external forces. Heavy wheel loads, water, freeze-thaw cycles ultimately have their effect on all roads. **STRATEZYME** treated roads will resist these forces due to the bonded, high density of the road material. The **STRATEZYME** treated road will resist the detrimental effects of erosion and mechanical forces.

### **3. *Will the road come out with cracks or become fragile?***

Cracking occurs as a result of 2 factors. (1) If the road material contains a high percent of expansive clays having a high shrink-swell factor, after the road is completed and dries out some cracking will appear. This condition reduces the effectiveness of the road stability. However, these roads still perform very well with a slightly reduced service life. (2) A soft sub-base (expansive clays) may not support the treated base under heavy wheel loads. The bearing capacity of the road is insufficient. This can be corrected by increasing the thickness of the road base.

When the clay fines (-200 mesh) exceed 25% or are highly expansive, some surface cracking may occur. Generally, the cracks are superficial, often filling in with road particles during normal traffic use. Generally this condition is referred to as “Alligator Cracking” and does not significantly affect the stability of the road base.

Rain or other moisture will moderately swell the clay fines and the cracks will close. If the clay material is highly expansive, then the percentage of these fines should be kept low to reduce the amount of cracking. Eaglefinger Enterprises’ proprietary additives are added to the specific clays to change the shrink/swell characteristics and greatly reduce cracking.

Reflective cracks should not migrate upward through the asphalt unless the clay fines are in the upper range and site conditions see radical sub-surface ground moisture variations. Proper drainage will reduce ground moisture and keep cracking to a minimum.

### **4. *After compaction, what is the ratio of expansion?***

After compaction, the expansion-contraction ratio will be dependent upon the soil type (percentage of expansive clays) as well as the gradation range (distribution of particle sizes). Well-graded soils (ranging from –200 mesh to 1 inch) are ideal for road building. The -200 mesh fines should be approximately 20%. If the frost level extends below the level of the road base, some heaving may occur. However, in the spring, the road should settle back to its original elevation without severe damage. Proper road construction including shoulder drainage will minimize the effects of frost. Good engineering practices should be observed.



**5. Will extreme weather (hot or cold) affect the road stability?**

Hot weather will not affect a **STRATEZYME** treated road. Other than the effects mentioned in question (4), Cold weather will not affect a **STRATEZYME** treated road.

**6. When the road material contains more than 20%-30% clay, will the road surface become too slippery and lose traction?**

Roads constructed with material containing a high level of clay will exhibit slippery surfaces when wet. It is necessary to use as much aggregate as possible not only to increase the overall strength of the road, but also to increase traction in wet conditions.

In many applications a surface treatment is applied as part of the overall design. This provides a wearing surface with traction, moisture protection and greater overall strength. Cost and availability of material are the primary factors affecting the type of surface treatment, if any.

**STRATEZYME** works well with soils that have clay content passing through a 200-mesh screen between 18%-30%. This range of fines has been indicated as an acceptable range for road building material.

Most counties that use **STRATEZYME** experience a 25%-50% reduction in road maintenance on roads that have been treated with **STRATEZYME**. In the state of Utah, many **STRATEZYME** treated roads have been in use for as long as 14 years with no significant maintenance.

## **7. *How long will the road last when STRATEZYME is applied?***

**STRATEZYME** treated roads have been in use for over 14 years. The longevity of the road is a function of several factors:

- Climatic conditions such as temperature ranges and rainfall.
- Type soils used in construction.
- Road design – crowning, drainage and other engineered parameters.
- Type of vehicular traffic, speed and degree of usage.
- Wearing surface applied (if any).
- General maintenance – frequency and quality.

We have seen **STRATEZYME** treated roads retain their integrity over longer periods than previously experienced by road departments. For example, a road in Idaho, USA, has been in continual use for over 12 years with very little maintenance. Other geographic areas have reported substantial reductions in road maintenance by over 50%. **STRATEZYME** treated road bases last longer.

## **8. *Is compaction required when using STRATEZYME?***

**STRATEZYME** is used when moisture is applied to soil for compaction. Stability or stabilization occurs when soil particles are in close contact. Even when used in pond applications, the downward force of the water assists in compaction.

Applying **STRATEZYME** to soil without compaction will not affect a change in erosion. The soil's ability to resist erosion is a function of the mineral makeup of the soil and compaction (or density).

## **9. *Will STRATEZYME affect plant life if there is any contact?***

**STRATEZYME** is not harmful to plant life in a full range of applications, i.e. road building, pond applications, etc.

# ROAD BUILDING



## ROAD BUILDING WITH STRATEZYME

Road construction under optimum conditions should consider the following:

1. Use materials that are structurally sound. Road base materials using **STRATEZYME** should have a gradation mix (size distribution) that will result in good load bearing values and contain approximately 18%-30% non-granular fines (-200 mesh sized) and be cohesive in nature. Often roads have material outside design standards. If you perform field tests prior to construction to determine suitability, you will obtain excellent results upon completion. Some clays and fines are silty in nature and are not useful for road construction. Excessive fines may cause problems as a result of high plasticity and/or low load value.
2. Proper moisture must be maintained during compaction. **STRATEZYME** works best between 2%-3% below optimum moisture. Do not compact above optimum moisture. After applying **STRATEZYME** to the road material to be treated, additional water may be applied to bring the moisture content to the optimum level prior to compaction
3. Generally, roads should not be compacted in lifts higher than 3"; however, the size and type of compaction equipment plus the type of material being compacted determine lift thickness. Sufficient compactive effort must be maintained during road construction to obtain maximum density. Less compactive effort will be required using **STRATEZYME**.

The **STRATEZYME** treated road should be allowed to cure prior to use (and final testing) if possible. However, the road may be used sooner if necessary. Drying of the base material will create less plasticity, decreased permeability and greater strength.

### Step 1.

Blade or rip the existing road to a minimum depth of six inches and then windrow the loose material. If the road requires greater depth, work the material in lifts. If additional aggregate is needed, use less expensive material with more fines. Check the overall gradation of the material to insure it is within the design limits. The overall depth to be treated depends on the designed axle load requirements.

## **Step 2.**

For each 165 cubic yards of road base material, use one gallon of **STRATEZYME** to the amount of water to obtain optimum moisture. Refer to the **STRATEZYME** work sheet for instructions. Spray both the bladed surface and the windrow to obtain optimum moisture. Blend the **STRATEZYME** treated material using a grader blade, working the soil and aggregate back and forth to blend in the **STRATEZYME** and water. If the material is too wet, then blade dry. If the material is too dry, add water without **STRATEZYME** to bring the material to the optimum moisture level. After thoroughly mixing, spread the material to grade. The treated road material may be left in a windrow overnight to allow complete moisture absorption. This will result in better compaction with less effort.

## **Step 3.**

Extend and crown the road surface with the grader blade. If your material dried out on a hot day, spray again with a diluted **STRATEZYME** and water mixture (1 gallon **STRATEZYME** to 10,000 gallons water). Compact with a compactor such as a sheepsfoot or pneumatic roller. Vibratory rollers may be used for the first and second passes; however, further compaction should be done without vibrator action to avoid cracking. Compact in 3" or 8-cm lifts (layers) to insure maximum compaction.

**After allowing the road surface to dry (cure) for 72 hours, it is ready for use.** If an asphalt or chip and seal road top surface is desired, better bonding will be achieved by moistening the surface with a diluted application of **STRATEZYME** and water at a 1:10,000 dilution rate. This surface application may be applied any time after a 3-day period.

**It is highly recommended that Eaglefinger Enterprises Inc. road technicians are on site for the first few roads to be constructed.**

## ROAD DESIGN

Construction of new and existing roads must consider several design elements, some of which are listed below:

- Traffic loads (wheel weight and frequency of use)
- Availability of road building materials
- Topography and sub-base soil conditions (soft or firm)
- Moisture (rain, snow, ground water)
- Long-term use and maintenance requirements.

Soft sub-base conditions require greater thickness – in some cases as high as 24 inches (60 cm). Where the sub-base is firm a minimum thickness of 6 inches (15 cm) can be used. Roads with truck traffic require greater thickness to support the high wheel loads of 20,000-30,000 lbs. (9,000-13,000 kilos). Analysis of the sub-base conditions and testing for load bearing capacity may be required to achieve proper design specifications.

Traffic loads and speeds also affect the life of a road. In many instances a hard “wearing” surface cover is necessary. High-speed traffic increases the mechanical forces applied to the road surface. To prevent surface wear a protective cover such as asphalt, concrete or a chip and seal coat may be necessary.

Surface and sub-surface moisture conditions also enter into the equation for good road design. It is important that the road has adequate drainage and that the sub-base and road base be kept as dry as possible to prevent structural failure. Side drainage channels are important as is crowning the road surface to allow water to flow away from the road surface. Where ground water is near the surface it may be necessary to place a rock sub-base or other engineered treatment. It is up to the engineer to evaluate these conditions.

Road building materials also affect the design of a road. The type and properties of the material greatly affect the performance of a road. Well-graded gravel and soil give maximum performance. Cohesive fines enhance the performance of a road, producing less rutting and fewer potholes.

There are other factors to be considered. Civil Engineers qualified in road construction should be consulted for specific site conditions.

## **STRENGTH**

The load that the wheel of the vehicle exerts on a gravel surface spreads out as it passes down through the road base. The angle of force, increasing in width as it penetrates deeper into the road material, is referred to as the internal angle of friction  $\phi$ . It varies depending upon the type of material present. The objective in road design is to have sufficient road base thickness to support anticipated wheel loads. **STRATEZYME** treated material has increased compressive strength that resists deformation and excessive flexing due to wheel loading. This stabilization results in an overall stronger road base. It also means less maintenance.

## ROAD BUILDING

**STRATEZYME** is easy to apply and requires neither special equipment nor special application procedures. It can be used with either reclaiming machines or applied with regular road building machines. **STRATEZYME** should be used with soils that contain approximately 20% cohesive fines. Then it is mixed with water and used for compaction during normal road building techniques. A typical application to stabilize a 6-inch existing or new road base is presented as follows:

1. If the existing roadbed is too hard to blade, scarify to the required depth. Normally this should be done dry for better traction.
2. Add one gallon of **STRATEZYME** concentrate to the required amount of water needed to bring 165 cubic yards of material up to optimum moisture. The amount of water needed will depend on how wet or dry your material is. With top loading water tanks, always fill the tank with water first, and then add the **STRATEZYME**. Failure to do this will result in a tank full of foam.
3. Spray the **STRATEZYME** water solution over the road surface and start the blade mixing. 15 gallons of **STRATEZYME** will treat one mile 25 feet wide to a depth of 6 inches. If you misjudged the water and get the material too wet, blade to dry. If the material is too dry, add plain water. After thoroughly mixing, leave the soil material in a windrow overnight to promote total **STRATEZYME** absorption. We recommend this whenever possible for better compaction results with less effort.



4. If the road base is too dry the next morning, or after the material is thoroughly mixed and ready to lay, spray the surface with a **STRATEZYME** water mixture of one gallon to 10,000 gallons water (approximately one pint to 1,200 gallons water) before you pull it out of the windrow. Always start to lay the material on a damp floor. Pull the material out and lay in 3-inch lifts. Start compaction immediately. In sub-base fill or pond areas, a sheepsfoot works fine; but usually a steel or pneumatic roller works best for finished roads. Continue compaction while you shape and dress the surface with a blade. Be sure to crown the surface to promote water drainage. Even while laying and compacting, if your material dries too fast on a hot day, a light mist of **STRATEZYME** treated water (1:10,000 gallons) can be applied, but you must be sure to stay 2% to 3% below Optimum Moisture. Continue to compact until the desired density is reached. Vibratory rollers may be used, but turn the vibrator off when finishing so that no fracturing occurs. The road is now ready for use. If you foresee heavy, high-speed traffic, involving spinning or skidding wheels, you might consider closing the road until the material has had a chance to cure for 2 or 3 days. Normal traffic will not harm it.

5. If an asphalt surface or other permanent-wearing surface is to be added, a better bond can be obtained by moistening the surface with a spray of **STRATEZYME** and water solution (1:10,000 gallons). This permanent surface can be applied at any time after a 3-to-5-day curing period under good weather conditions.

## HAUL ROAD STABILIZATION

Mine haul roads are often constructed with native site soils containing a wide gradation of materials. Often there is a high content of fines (200 minus mesh) that in the past have caused stabilization problems. **STRATEZYME** assists in binding fines together with larger material into a dense well-compacted material having a high degree of stabilization and higher tensile strength than non-treated roads. Also, roads treated with **STRATEZYME** will resist water penetration. Benefits include reduced maintenance and increased utilization of existing site materials.

**STRATEZYME** provides:

- efficient use of water due to easier penetration into the soil—base material
- achievement of greater density after compaction
- increase in tensile strength
- unconfined compressive strength
- less dusting than non-treated roads

## ROAD CONSTRUCTION

One gallon of **STRATEZYME** will treat 165 cubic yards of road base material. It is added to the water truck and sprayed onto the material prior to compaction.

The water to **STRATEZYME** ratio will vary depending upon site conditions and existing moisture in the base material.

Construction of the road should be done in lifts not greater than 6" – depending upon the type of compaction equipment to be used. It is recommended that 3" (8 cm) lifts be used, thereby insuring proper compaction. Attention **MUST** be given to moisture content and blending for maximum distribution of **STRATEZYME** throughout the road material.

**STRATEZYME** is used in some dust control applications. It is applied at a dilution rate of 1 gallon **STRATEZYME** to 10,000 gallons of water. This has been very effective in reducing dust and decreasing the total amount of water required for dust control.

## ASPHALT COVER OVER STRATEZYME

### **“CHIP SEAL”**

*General guideline discussion only*

*Refer to qualified oil-asphalt representative for further information*

Either Emulsion (CRS) or MC asphalt can be used. “Emulsion” asphalt is cut back or diluted with water and is shot at a temperature of around 106° F (70° C). “MC” asphalt is cut back with diesel fuel or other petroleum products and is shot at temperatures of 225° F (107° C). The advantage of one type over the other is debatable, but generally speaking, MC asphalt will penetrate dirty gravel better than Emulsion asphalt. However, MC asphalt has a tendency to bleed off more if the balance of oil to gravel is not correct. When using MC asphalt, the first coat is thinner (usually MC 800), and the second coat is heavier (MC 3000).

When applying Emulsion asphalt, use the same CSR-2 weight for both layers. There are also available variations of CRS-2, some quick-dry; some rubberized, some hard. Check with your supplier to see what is available in your area. Also, when using Emulsion asphalt, you need approximately 29% more material to obtain the same asphalt thickness, to offset drying where water evaporation reduces the overall weight.

The **STRATEZYME** road surface should be prepared at least three (3) or more days prior to applying the asphalt. The surface should be smooth, hard and dry. Dress any imperfections before applying the asphalt, as they will extend up through the finished surface. A smooth base is essential.

After this dries or loses its sheen, apply the oil at a rate of approximately 0.4 to 0.5 gallons of oil per square yard of surface.

Then, immediately apply a layer of ¾” clean gravel at a rate of 120 to 125 pounds per square yard and compact with the compactor.

After the first layer of oil and gravel has been rolled down, pull a non-rotating drag broom over the surface to smooth out any roughness cause by the chip spreader, truck or roller. This will insure a smooth surface for the second layer.

Lay down the second layer of .35 to .40 gallon oil/sq. yd and ½ inch of ½” to 3/8” chips and compact. The gravel chips must be fractured rock to stay in place. Pea gravel cannot be used.

If you have the proper amount of oil, gravel and chips, the oil should penetrate both layers and bond together. Too much oil will cause bleeding; too little oil will not allow proper bonding.

## Equipment Necessary for STRATEZYME Road Application

For each road construction site this is minimum equipment to have available for the **STRATEZYME** application:

- Motor grader
- Vibratory Roller (large size, 15 ton+)
- Pneumatic Tire Roller (recommended – 15 ton+)
- Sheep-foot Roller (recommended – 15 ton+)
- Water Truck with pressurized spray bar (have backup truck if possible)
- Pulving Mixer or Rotary Hoe (RM 250)
- 2 Dump Trucks for hauling aggregates
- Site Surveying and Staking
- Nuclear Densometer or some type of moisture testing equipment to test the moisture on site throughout the construction process.

For the chip & seal, have the following minimum equipment available for each site:

- Water Truck
- Automatic Broom Sweeper (or men with rakes, brooms, etc.)
- Dump Trucks for spreading aggregates chips. (Have gates fitted with a spacer bar to allow aggregates to spill out slowly as truck back up over oiled area.)
- Hot Bitumen Oil Spreader Truck
- Vibratory Roller (medium to large size 12-15 ton+)
- Pneumatic Tire Roller (optional)
- Automatic Chip Spreader (if available)

There should be a skilled equipment operator for each piece of equipment identified above. In addition, if a chip spreader and/or automatic broom is not available, have 4-6 laborers available with shovels and push brooms. Even if the chip spreader and automatic broom sweeper are available, have a minimum of 2 laborers on site. In addition, a skilled soils/road technician should be on site as well as a road superintendent.

# STRATEZYME / Water Application Guidelines

## Water to be added to reach optimum moisture compaction

**IMPORTANT:** Determine the approximate soil moisture before starting. Estimate optimal moisture, and then subtract existing moisture to calculate water needed.

### *Example field calculation for 8cm lift*

- Volume 8 cm x 8 Meters = 640 Cubic Meters
- Material Weight 640 Cu Meters x 1,600 Kg/Cu M = 1,024,000 Kg/liters

Additional water needed to achieve optimum moisture

- (8% moisture x 1,024,000 liters) = 81,920 liters water
- Safety factor (avoids excess water) 70% x 81,920 = 57,344 liters water

**STRATEZYME** (1 liter treats 33 Cu M of soil)

Liters required = 19 liters **STRATEZYME**

640 Cu M road base material divided by 33 Cu M

**STRATEZYME** dilution rate this example only (DRY CONDITIONS)=3,080:1 **STRATEZYME**

### **STRATEZYME Dilution Table – water to be added**

Water to be added to reach Optimal Moisture for Compaction

## PROCEDURE

1. Determine (estimate) water to be added to soil, then determine capacity of water truck and add **STRATEZYME** according to dilution rate calculation (estimate water slightly below amount needed).
2. Apply water and **STRATEZYME** to base material, wetting surfaces evenly.
3. Blend and mix **STRATEZYME** and water into soil with grader blade or recycler. Several passes may be required using a blade.
4. Observe if road base material has enough moisture for compaction. (A hand sample should make a firm ball.)
5. If more moisture is needed, add plain water and re-blend.
6. Compact material to maximum density, usually 5 to 8 passes.
7. Repeat step 6 for the top lift (layer).
8. If first lift surface is too dry, dampen with a small amount of water, before the second lift is extended across the road and compacted.

## TEST METHOD

For preparing and analyzing pavement sub-grade, sub-base and base course materials containing **STRATEZYME** in a materials testing laboratory.

This test method protocol has been developed in response to requests for proper laboratory procedures when testing road base materials treated with **STRATEZYME**. It should be noted that no laboratory sample would simulate the actual strength characteristics exhibited in the field with full-scale **STRATEZYME** treated base materials. Therefore, if one is to obtain a truly valid approximation of the relative strength of treated material, it is recommended to test **STRATEZYME** treated road base by obtaining fully cured samples from actual road-beds. Test methods described below will reference the American Society for Testing and Materials (ASTM). Test methods may be found at the ASTM Internet site: <http://www.astm.org>.

### 1. Preparation of Laboratory Sample

Prior to any laboratory testing, a suitable sample must be prepared. It is recommended to prepare a minimum soil/aggregate mix of five (5) gallons (18.9 liters). All (100%) mineral aggregate must be crushed (e.g., cracked rock faces). That portion of aggregate passing the No. 40 sieve should be slightly plastic ( $0 < PI < 6$ ) when tested in accordance with ASTM Method D43 I 8-9 Sa. Any humus material and/or other organic material (i.e., roots, moss, leaves, etc.) should be removed from the test material. The dry mineral soil/aggregate material should be uniformly graded with the gradations specified in Table 1, following ASTM Method C136-96a.

# **PHOTOGRAPHED PROCESS AND FINISHED ROADS**





## **“STRATEZYME” Road-Stabilization**

An existing road in poor condition was graded for shape and elevation, stabilized and made ready for traffic use the following day. At a later date a chip-seal wear surface will be applied. The following pictures show the application of the STRATEZYME product on about ¼ mile section road in Hidalgo County Texas in the summer of 2003.



The beginning; adding STRATEZYME concentrate to the water truck. About 1 gallon of concentrate per 350 linear feet by 25 feet wide and 6 inches depth.



The area is ripped to a depth of 6 to 8 inches to make ready for the application of STRATEZYME.



The whole of the road is prepared at the proper depth to receive the water product treatment



The water truck applies the product/water mix over the road area after the first ripping pass of the grader.



STRATEZYME starts to breakdown the soil immediately, more ripping and product to follow.



More of the road surface is treated, then ripped again and again.





The area is made ready for the last treatment of STRATEZYME to the surface.



As the product application process continues the soil begins to become friable, soil chunks break down and the soil is easier to mix as the soil section is brought to OMC (optimum moisture content) for compaction.



Dry road sections are treated and the soil is turned to mix the dry soil into the treated sections. More treatment is added from the water truck as this process continues.



A final windrow is made and the product is allowed to set for about 6 hours or even over night in some cases. Here, in this area, the days are hot and evaporation is fast, so set time is limited to 6 hours or so. The area is checked for product distribution throughout the soil section.



The soil is extended over the sub base, after the sub base has been sprayed with the product/water mix and compacted. Compaction starts with the first layer of treated soil extended, then the next layer is added over the compaction section. A Sheep's Foot is used for best results.



The Steel Drum Roller finishes the compaction to the shape made by the grader, crowned for water run-off.



A little grading and addition of more soil makes the compacted section ready for the finishing touches.

The soil moisture content has been kept at the proper level for very good final compaction. The Pneumatic Roller finishes and makes the surface ready for the Double Drum Roller.



Compaction continues and marks will be removed to leave a smooth finish.



The surface begins to cure, and fine grading will be done to address the surface and remove blemishes.



The surface is almost finished. Traffic starts before we can complete the final rolling, but no damage or problems.

**The road is completed and a final surface spray is added before the road is closed to traffic and left overnight and opened the next morning.**

The results for the road project were good. The road section provides a smooth surface, good ride and has good water run-off. The road has been through several storms and is in good condition. A wear surface may be planned for the year 2004.

The type of soil was clay with small aggregate and some silt/sand. Compaction was excellent and the speed of the whole application was quite fast due to good supervision and excellent drivers provided by the owner. We appreciate all the help and assistance from Hidalgo County in this application.

## Directions to “STRATEZYME” roads in Georgia

From Atlanta, take I-20 West toward Birmingham. Go 40 miles or so to Exit 11. At the end of the Exit ramp, turn right onto Highway 27 North (toward Buchanan).

Go 7.3 miles to Business 27 and turn left.

Go ½ mile to Macedonia Church Rd. and TURN LEFT.



The next 2 ½ miles is done with “STRATEZYME” (all the way to the stop sign).



At the stop sign, which is Estvanko Road, turn LEFT. The next 1.4 miles is done with “STRATEZYME” (all the way to the next stop sign).



These roads were completed by Haralson County in 1998 and were chip sealed after completion. The county is happy with the roads, and while the chip seal shows the normal signs of usage, the base beneath the chip seal is still very solid.