

PROVEN SOLUTIONS
AND TECHNOLOGIES FOR
MINING APPLICATIONS





Proven Solutions and Technologies for Mining Applications

Tensar International Corporation (Tensar) is the leading developer and manufacturer of high-performance products and engineered solutions for earthwork challenges in the mining industry. We satisfy customer needs and exceed expectations by providing a wide range of geosynthetic solutions for problems common to mining operations.

By providing innovative application technologies and specialized technical services, we use our products to deliver value-enhancing alternatives to traditional materials and practices in earthwork construction. We are committed to serving our clients' global interests by providing innovative, engineered solutions using sophisticated earth stabilization and reinforcement techniques.

Our expertise focuses primarily on providing full service, economical solutions for the following areas:

- ▶ Haul Road Construction
- ▶ Working Platforms
- ▶ Retaining Walls and Grade Separation
- ▶ Rail Applications
- ▶ Erosion Control
- ▶ Leach Pads
- ▶ Dewatering
- ▶ Underground Mine Safety





Tensor Can Meet a Variety of Mining Site Challenges

1. STABILIZATION SOLUTIONS FOR HAUL ROADS AND WORKING PLATFORMS

Weak subgrades pose the greatest challenge to the performance of access/haul roads and working platforms. Left untreated, a weak subgrade subjected to continuous heavy traffic will quickly deform, causing the road or platform surface to rut, pothole, “washboard” and ultimately deteriorate beyond use. Good construction and subsequent maintenance practices are vital to maintaining maximum cost efficiency and production. The savings to be gained from a well designed haul road using the appropriate materials are considerable.

There are now unprecedented demands to design economical roads and working platforms which reduce maintenance costs and improve haul truck efficiency. Tensor® TriAx® Geogrid delivers a high performance solution to meet these growing demands by reducing up-front costs and future maintenance. The structural contribution made by TriAx Geogrid is to stabilize the unbound layers of roads and platforms by creating a Mechanically Stabilized Layer (MSL). An MSL is created when aggregate particles interlock with the geogrid and are confined within the apertures. Once granular particles are compacted over these geogrids, they partially penetrate and project through the apertures and are mechanically confined by the geogrid to create a stiff composite layer with improved load

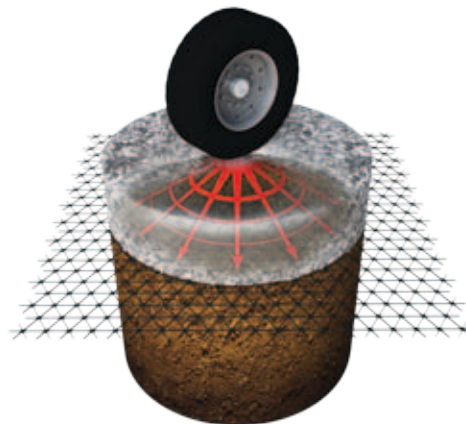
distribution and resistance to rutting. An MSL incorporating TriAx Geogrid combines major cost savings with considerable performance benefits in granular capping, sub-base and other aggregate layers.

When compared with an unstabilized aggregate layer, an MSL incorporating TriAx Geogrid can:

- ▶ Maintain surface quality to increase operating speeds
- ▶ Reduce the frequency of costly and disruptive surface maintenance
- ▶ Reduce aggregate requirements up to 60%
- ▶ Reduce labor and equipment needs
- ▶ Increase design life
- ▶ Increase bearing capacity
- ▶ Eliminate the need for costly overexcavation and disposal of poor quality soil during construction
- ▶ Avoid issues associated with chemical stabilization including weather and climatic restrictions, curing, uniformity, chemical solubility and environmental and personnel safety



Using Tensor TriAx Geogrids reduces up-front costs and future maintenance.



TriAx Geogrid interlocks with and stabilizes the unbound aggregate layers in roads and construction platforms by creating a composite Mechanically Stabilized Layer (MSL).



2. TENSAR RETAINING WALL SYSTEMS – HEAVY LOAD RESISTANT AND DURABLE

Retaining walls are vital to the operational efficiency of mines worldwide. They must be designed to be durable with the ability to carry heavy loads and repeated traffic for many years. Tensar’s full line of Grade Separation Solutions featuring Tensar® Uniaxial (UX) Geogrid address grade separation and earth retention needs on and adjacent to coal, mineral, aggregate and other mining sites to keep operations running safely. Our retaining wall systems incorporate a proven, positive, mechanical connection between the geogrid and the wall face for increased structural integrity and performance. When specifying a Tensar wall, you are assured that the system’s structural components are reliable and designed for the long-term. And with soil reinforcement that is 100% polymeric, Tensar® Grade Separation Solutions also enable structures to be built using a wide range of backfills, including recycled materials, translating into greater economy.

Tensar UX Geogrids are manufactured using select grades of high-density polyethylene (HDPE) resins that are highly oriented and resist elongation when subjected to heavy loads for long periods of time. These geogrids carry large tensile loads applied in one direction, and their open aperture structure interlocks with natural fill materials, making them ideal for

Mechanically Stabilized Earth (MSE) walls required by mining operations.

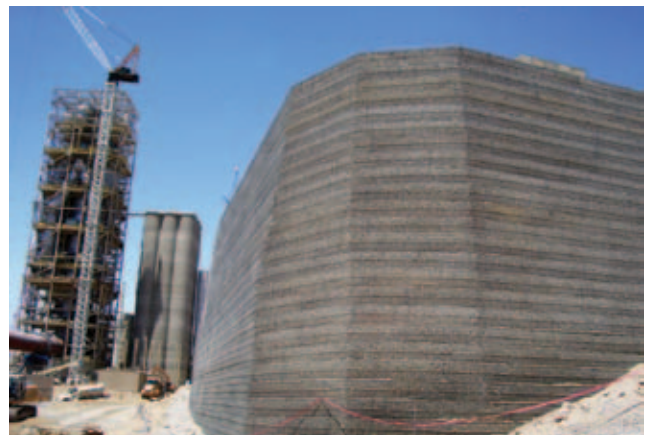
Benefits of Tensar’s Grade Separation Solutions include:

- ▶ Durable geogrids that are unaffected by aggressive soil conditions and resist chemical, biological, and environmental degradation
- ▶ The ability to use a variety of backfill soils, including those with chlorides, sulfates, and high and low pH levels
- ▶ Rapid and economical construction, without the need for specialized equipment or labor
- ▶ Reliable structures with little or no maintenance
- ▶ Resistance to impact loading and seismic activity
- ▶ Reduced need for expensive foundation treatments due to low bearing pressure

In addition, Tensar’s team of professionals can provide a full spectrum of services including initial planning, engineered drawings, and on-site assistance. We offer a complete range of systems that combine technology, engineering, design and products to meet the unique requirements of mining operations and applications.



Tensar Grade Separation Solutions can be built using a wide range of backfill materials and a variety of facing types.

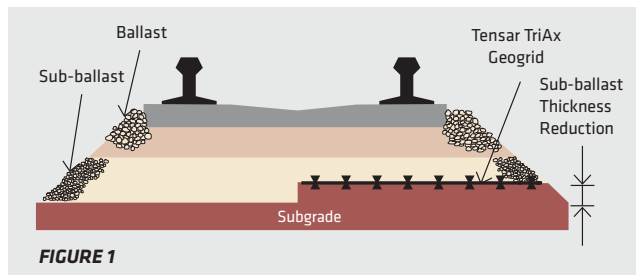


Tensar Retaining Wall Systems are durable and require little to no maintenance.



3. RAILWAY TRACKBED STABILIZATION

Poor track geometry and a loss of vertical and horizontal alignment of the rails is a major reason for line speed restrictions and track maintenance work. These can significantly affect schedules as well as being expensive and disruptive to correct. With Tensar® TriAx® Geogrid, it's possible to reduce the costly maintenance of trackbeds or even save on trackbed construction cost. By reducing the required trackbed thickness (Figure 1), Tensar TriAx Geogrids can save up to \$30,000 per linear mile of track. Over the long term, Tensar TriAx Geogrids preserve the integrity of the trackbed structure by confining the ballast and sub-ballast layers. This typically extends the period between maintenance operations by a factor of three to five times.



Tensar TriAx Geogrids are used to stabilize the trackbed structure in two ways:

- ▶ **Sub-ballast Stabilization** – installed at the bottom of the sub-ballast, TriAx Geogrids help distribute imposed loads more efficiently over the underlying subgrade, leading to a reduction in the required sub-ballast layer thickness (Figure 2).
- ▶ **Ballast Stabilization** – installed between the ballast and sub-ballast layers, TriAx Geogrids limit lateral movement of the ballast, and thereby minimize track settlement. This helps increase the period between maintenance cycles (Figure 3).

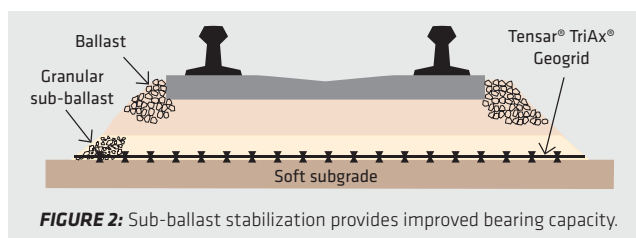


FIGURE 2: Sub-ballast stabilization provides improved bearing capacity.

4. EROSION CONTROL

The unique erosion control challenges generated by wind and water forces can create many issues on mining sites. Whether an active mining site or reclamation project, Tensar® Erosion Control Systems address these challenges. Tensar's permanent VMax® Turf Reinforcement Mats (TRMs) are ideal for high-flow channels, streambanks, shorelines and other areas needing permanent vegetation reinforcement and protection. More economical than rock riprap, TRMs protect vulnerable areas with minimum maintenance and maximum durability and are perfect for emergency overflows, retention pond banks, and vegetated drainage areas. For areas where high scour is expected, combine the VMax TRMs with the ShoreMax® transition mat. This unique armoring solution dramatically elevates the permissible shear stress and velocity protection while retaining a flexible vegetated liner.

For large sloping areas, our HydraMax™ Hydraulic Erosion Control Products (HECPs) can offer temporary coverage and protection of soils, fugitive dust, and mine tailings. All-natural fibers and non-toxic tackifiers in the HydraMax HECPs blend to create a porous matrix with strong soil adhesion, forming an excellent vegetation establishment and erosion control medium. The HydraMax HECPs are a great erosion control solution for hard to access areas and areas where soil-prep is unachievable. For longer lasting temporary protection, our RollMax™ Erosion Control Blankets (ECBs) can protect steep slopes and moderate flow areas for up to 36 months.

Controlling sediment is the main goal of erosion control measures during active mine use or during construction phases. SediMax™ Sediment Retention Systems can help protect areas until a more permanent means of stabilization can occur. The SediMax filtration rolls and straw wattles can prevent damage and save money typically spent on restoring slopes, rebuilding drainage channels and dredging ponds and streams.

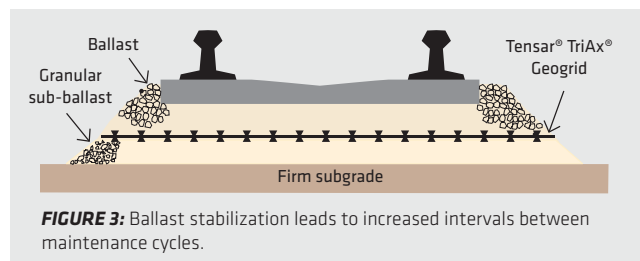


FIGURE 3: Ballast stabilization leads to increased intervals between maintenance cycles.



5. DEWATERING

Dewatering and containment of mining waste requires a special solution of its own. Tensar® Triton® Geotextile Tubes provide an economical, environmentally friendly alternative to traditional technologies. Manufactured using a Weft Insertion Knitting (WIK) process, Tensar Geotextile Tubes have the ability to contain even fine grained, highly organic materials. It is not uncommon for the effluent from Triton Geotextile Tubes to contain less than 50 ppm Total Suspended Solids (TSS). That means the runoff from Triton Geotextile Tubes can comply with most states' National Pollutant Discharge Elimination System (NPDES) regulations.

6. HEAP LEACHING

Heap leaching is used at many mining sites to extract precious metals and copper compounds from ore. The process begins when mountains of mineral ore are loaded on to a leach pad that is lined with an impermeable clay or geomembrane liner. The ore is then sprayed with a leach solution so the valuable metals are dissolved. This solution then percolates all the way through the heap and into collector pipes. Since significant amounts of ore are required to produce the precious metals, collector pipes experience very heavy loads. Tensar® Geogrids can be used to effectively confine the particles above and between the pipes. Geogrid supports the heavy equipment used in the process as well as providing a greater bearing capacity for the leach pad.



Tensar® Geotextile Tubes can contain even fine grained, highly organic materials.

7. SAFE CAPPING OF TAILINGS LAGOONS

Remediation treatments of mine tailings lagoons can be costly and environmentally challenging for a mine owner and operator. Tensar has developed solutions that address many of the site work challenges that tailings lagoons present. Tensar solutions, including TriAx® Geogrids, enable safe placement and compaction of fill material when tailings or other industrial waste deposit are capped. Our solutions have become a proven and reliable method of capping tailings lagoons as they:

- ▶ Enable safe access to the tailings lagoon as well as safe installation of the tailings cap system
- ▶ Replace more expensive tailings treatments
- ▶ Reduce environmental impact
- ▶ Help to minimize differential settlement

Since the design and construction of successful capping projects are directly related, Tensar does not currently offer standalone design services related to capping tailings lagoons. The success of a lagoon cap is very much a function of experience-based installation techniques. Tensar referrals are available to professionals who are qualified and experienced in the design and construction of tailings lagoon caps.



Tensar Geogrids provide additional bearing capacity over leachate collection systems to support heavy equipment loads.



8. UNDERGROUND MINING APPLICATIONS

Tensar® Mining Systems offer a wide range of cost-saving solutions to meet the needs and objectives of mining operations. Among the proven applications are roof and rib control, and long-wall shield recovery screens.

Tensar® Mining Grid, teamed with Minex™ Rock Mesh, provides effective roof and rib control for soft minerals as well as the most demanding hard rock and tunneling applications. Tensar Mining Grid meshes are impervious to acidic environments and have very similar strength characteristics to steel, but at a fraction of steel's weight. Lightweight, easy-to-handle Tensar Mining Systems easily reduce installation and material handling time by up to 75%. Flame-retardant Minex Rock Mesh maintains similar weight characteristics to Tensar Mining Grid, yet is over eight times stronger with increased flexibility.

The Tensar® System Approach

Tensar delivers engineered systems that combine technology, engineering, design and products. By utilizing Tensar's approach to construction, you can experience the convenience of having a supplier, design services and site support all through one team of qualified sales consultants and engineers. By working with Tensar you not only get our high quality products but also:

- ▶ Site Assessment
- ▶ Design Assistance/Services
- ▶ Specification
- ▶ Site Support

For more information about Tensar products and systems, call **800-TENSAR-1**, visit www.tensarcorp.com or e-mail info@tensarcorp.com. We are happy to supply you with additional system information, complete installation and design guidelines, system specifications, design details, conceptual designs, preliminary cost estimates, sealed construction drawings, summaries of completed projects, software and much more.

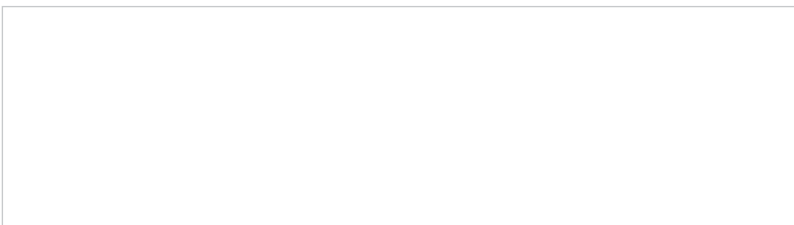


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