On The Surface,
Lightweight Aggregate Paves the Way to Safer, More Economical and Longer Lasting Roads

. . . But its performance is superior throughout:

Higher Skid Resistance

Eliminate Windshield Damage

Cheaper to Transport

Natural Affinity for Asphalt

Ideal 3-D Particle Shape

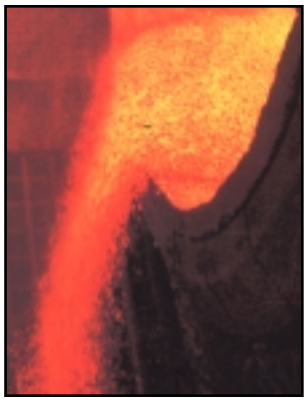
Competitive Total Installed Cost

Now You Can Predict Your Pavement's Reliability

The Right Stuff . . .

Not your traditional natural stone or gravel

Expanded Shale, Clay and Slate Lightweight Aggregate (LWA) has been used on all types of roads, from rural highways and city streets to interstates and freeways, with proven superior performance. First introduced to the asphalt market over 45 years ago, the use of LWA currently exceeds 3,000 miles annually in the United States alone. LWA has been used in over twenty states. Its **total installed costs** are competitive with normal weight aggregates, but LWA provides many more advantages.



What Is LWA?

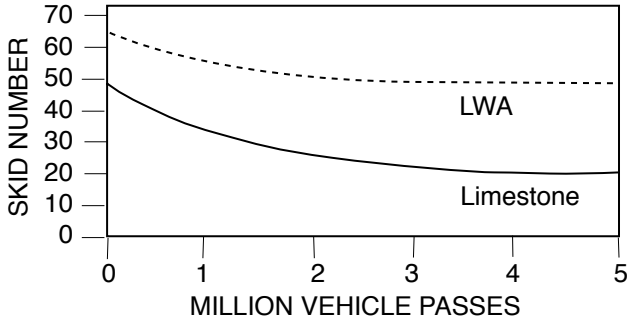
Expanded Shale, Clay and Slate Lightweight Aggregate has a long track record of quality and performance. Since its development in the early 1900's, LWA produced by the rotary kiln process has been used extensively in asphalt road surfaces, concrete bridge decks, high-rise buildings, concrete masonry, geotechnical, landscaping and horticultural applications – everywhere that demands construction material which does not deteriorate with weather and time. Contact your regional supplier for the test results of their product. The supplier for your area may be found at escsi.org.

The quality of LWA results from a carefully controlled manufacturing process. In a rotary kiln, selectively mined shale, clay or slate is fired in excess of 2,000° F. The LWA material expands, cools and is then processed to specified grading. The result is a high quality lightweight aggregate that is inert, durable, tough, stable, highly insulative and free draining, ready to meet stringent structural specifications. When bonded to asphalt, it creates an advanced road surface that is safer, more economical and longer lasting than those created with traditional natural sands, stone and gravels.

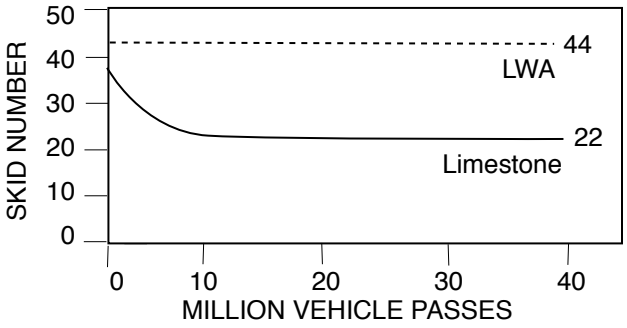
Why Use LWA?

Safety is increased because LWA road surfaces provide superior skid resistance, wet or dry. The high skid resistance (Fig.1 & 2) is maintained throughout the road's service life because of LWA's rough micro surface texture. Pavement made with natural aggregates (especially those using limestone, dolomites and gravel) can polish or become slick under the wearing action of traffic, and lose a large percentage of their skid resistance. **Lightweight aggregates do not polish as they wear**. LWA pavement maintains its high skid resistance because as it wears, fresh interior cells with rough ceramic edges are continually exposed.

Chip Seal Skid Resistance (Figure 1)



Hot Mix Skid Resistance (Figure 2)



NOTES: Information provided by the Texas Department of Transportation, District II, and the Texas Transportation Institute, Austin, TX. **Figure 1:** The all-LWA plot represents over 100 skid tests with each test representing up to 6 data points. The all-limestone plot represents over 75 skid tests with each test representing 6 data points. **Figure 2:** The Hot Mix Asphalt concrete plot, using all-LWA coarse aggregate, represents approximately 200 skid tests with each test representing up to 6 data points. The Hot Mix Asphalt concrete plot, using all-limestone coarse aggregate, represents approximately 100 skid tests with each test representing up to 6 data points.

Lightweight Aggregate Makes Tax Dollars Go Farther

Roadway service life is extended because of LWA's unique and superior capabilities to bond with asphalt. When bonded to the asphalt, lightweight aggregate presents a tough, durable pavement that holds up well under traffic and outlasts most pavements made with natural aggregates. Unlike natural aggregate that is often coated with dust that prevents uniform bonding, LWA has minimal dust that adheres to the particle and has an ionic affinity for bonding to asphalt. This

Choose the Superior Economy of Lightweight Aggregate

translates into no additional cost when using LWA because of the longer life-cycle.

LWA is durable. Lightweight aggregates consistently pass Los Angeles abrasion requirements as well as other quality tests. LWA also shows superior "freeze-thaw" resistance and durability to de-icing salt corrosion. If snow-plow damage occurs, LWA is far more resistant to being displaced than natural aggregate because of its superior bond.

Lightweight aggregate is the proven solution for cost-sensitive highway and road departments. LWA offers lower direct and indirect costs over the service life of the road and is the reason more state and local transportation departments are specifying LWA. Lower liability costs result from using a "safe" aggregate – one that does not damage windshields and keeps its skid-resistance.

Multiple Cost Advantages In Transport and Construction

• Material transport costs are reduced because LWA weighs about half that of natural aggregate; therefore, **LWA allows larger volumes of material per truck load resulting in fewer drivers and trucks being assigned to the project.** This directly impacts the bottom line. A higher yardage capacity front-end loader may be used at the stockpile since each bucket load weighs less than half as much as the natural aggregate. This improves truck loading efficiency.

Example of Dump Truck Reduction

27 pounds per square yard of natural aggregate chip seal is being applied to a 22-foot wide road:

Natural Stone Coarse Aggregate:

27 lbs/sq. yd. = 174 tons/mile = 134 cu. yds/mile = 96 sq. yds./cu. yd. spread rate = **11.5 dump trucks/mile**

Substituting ASTM # 8 size LWA for this natural stone:

118 cu. yds/mile = 109 sq. yds./cu. yd. spread rate = **4.75 dump trucks / mile.**

• The crew's payroll will be less when LWA is used instead of natural aggregate. One contractor claims this cost savings is 4 cents per square yard of paving.

• LWA is much easier to hand-broadcast than heavy materials.

• LWA is a ceramic and should be applied in a single particle layer, which results in a lower application rate. Oil should be seen around each particle.

• Brooming excess chips from chip seal projects is much easier with LWA. The application rate is lower than with natural aggregate, so brooming is minimized.

A thin application of LWA shows oil around the particles next to the exposed edge of the old deteriorated road surface.

• Chip seal projects receive fewer driver complaints because flying particles caused by passing vehicles are fewer and far less dangerous. Windshield damage claims are practically eliminated, stretching the agency dollar and minimizing paperwork.

• LWA is easily pre-wet and affords virtually dust-free placement, a plus when emulsions are used with chip seals. Unlike natural materials, LWA dust does not bond to the aggregate surface. Resident's dust complaints are minimized. When purchasing some natural crushed stones, 2% of that cost is dust that blows through the neighborhood.

• LWA can be pre-coated for hot AC chip seals. Precoating is not necessary for LWA aggregate bonding to oil as it often is with natural aggregate.

• LWA is readily available throughout the U.S. and Canada, and much of the world. Materials specifications usually are bid by the ton. In considering LWA, equivalent volume measurements, not just weights, must be made. Bid specifications must be modified to volume measurement for natural aggregates.

• The contractor can use the same machinery and equipment with LWA aggregates as with natural aggregates. Only pneumatic rubber tire rollers should be used with all chip seal projects. No steel-wheel rollers!

Choose the Superior Versatility of Lightweight Aggregate

Chip Seal Application

Highway surface treatments are called by different names depending on the local area. Chip seal is perhaps the most commonly used. Chip seals are constructed by spraying a layer of asphalt emulsion or hot liquid asphalt onto the road surface, then covering it with aggregate, and using pneumatic rubber-tire rollers to embed the aggregate into the asphalt. Routinely, a 20% longer life of your Chip Seal paving project may be expected due to the LWA-asphalt bonding improvement. This translates into the LWA being "free to you" because of a longer life cycle.

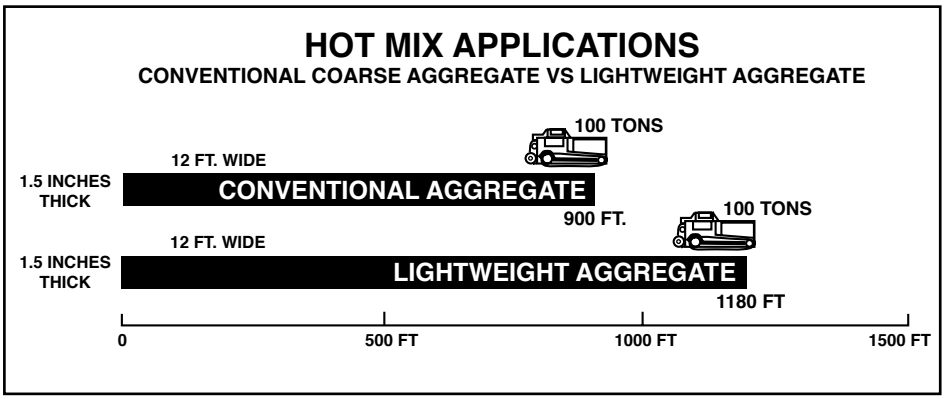
(Above) ASTM # 8 LWA applied at 115 SY/CY over CRS-2S at 0.40 GAL/SY in a county residential street • (*Left*) Pneumatic rubber-tire roller

For Chip Seal: Suggested Sizes, Application Rates and Uses

Specifications	AASHTO M-43, Size # 7 ASTM C-33, Size # 7 Passing 3/4" Majority retained on 3/8"	# 8 Size # 8 Size Passing 1/2" Majority retained on # 4	# 89 Size # 89 Size Passing 3/8" Majority retained on # 4	# 9 Size # 9 Size Passing 1/4" Majority retained on # 8
Common Emulsions LWA Spread Rate	0.42 to 0.52 GAL/SY 1 CY/95-105 SY	0.37 to 0.45 1 CY/110-125 SY	0.30 to 0.36 1 CY/125-135 SY	0.20 to 0.25 1 CY/130-140 SY
Common Aspahlt LWA Spread Rate	0.30 to 0.40 GAL/SY 1CY/95-105 SY	0.26 to 0.32 1 CY/110-125 SY	0.20 to 0.25 1CY/125-135 SY	0.15 to 0.18 1CY/130-140 SY
Common Asphalts LWA PRECOATED (Provides black paving)	0.30 to 0.40 GAL/SY 1 CY/95-105 SY	0.26 to 0.32 1 CY/110-125 SY	0.20 to 0.25 1 CY/125-135 SY	0.15 to 0.18 1 CY/130-140 SY
Suggested Applications	High Traffic, Rural (Noisy - due to size)	High Traffic Rural or Urban	Medium Traffic Rural or Urban	Low Traffic Rural or Urban

Hot Mix Surface Course

LWA has been used in Hot Mix Asphalt (HMA) with the primary purpose being to increase the skid resistance of the riding surface. The Lightweight HMA is usually a blend of LWA and normal weight aggregates and is produced at an off-site plant. The mix is shipped hot and laid down using conventional methods. LWA hot mixes have performed successfully on freeways with high truck traffic.



Choose the Superior Advantages of Lightweight Aggregate

Micro-Surfacing (Slurry Seal)

Micro-Surfacing applications are useful in stopping the deterioration of an oxidized asphalt surface, sealing the surface (in place of hot mix resurfacing), correcting rutting-in wheel paths, and other types of maintenance problems. Fine-graded LWA works well in slurry seals and micro-surfacing and improves skid resistance.

Cold Mix - Pothole Patch

LWA can be mixed with an emulsified asphalt to produce a cold mix asphalt product for use in highway maintenance applications. The material can be produced at off-site plant and hauled to the job or mixed and applied at the job site with a Pot Hole Patching Machine. LWA's affinity for asphalt emulsions produces a superior product that has many applications. The product reduces loaded truck weights on roadways in need of maintenance and performs well in deep patches.

Squeegee and Scrub Seals

Squeegee and scrub seals are a maintenance application used to repair streets that are cracked and porous. Because of its affinity to asphalt emulsions and skid resistant properties, LWA is an excellent aggregate for these applications.

Icy Streets and Bridge Treatment

Due to its greater skid-resistance, LWA works extremely well as a de-slicking grit and can be used to reduce dangerous skids on icy road patches. Because the LWA is half the density of comparable aggregates, once the ice melts and the moisture evaporates, the LWA remaining will blow off the road under normal traffic conditions without damage to automobiles. This saves on costly sweep and clean-up costs.

Additional information can be found on www.**escsi.org**

1. *Ceramic Aggregate Cuts Kansas Road Costs*, BETTER ROADS, Jan. 2003
2. *41-Mile Chip Seal Project*, Cowley, Co., KS, BETTER ROADS, Oct. 2002

A thin application of LWA shows oil around the particles.

Lightweight Aggregate offers more than **twice the aggregate volume** for the same weight of conventional aggregate.

ASTM #9 LWA applied at 130 SY/CY over RS-1P Emulsion at 0.20 to 0.25 GAL/SY in a rural, residential cul-de-sac in Buchanan County, MO

In every application, LWA is the preferred pavement choice. For suppliers located in your area and for published paving articles, see **www.escsi.org**.

See the back page to create a **life cycle cost comparison**.

Life Cycle Comparison of Lightweight Aggregate (LWA) Versus Natural Aggregate in Chip Seal Applications

Natural Aggregate Chip Seal	2007 Example	Your Calculations
1. Total installed cost per mile for 22'-wide (12,907 SY) road at $1.47 SY	$19,000	$_____
2. Number of years in normal maintenance cycle (service life)	5 years	_____yrs.
3. Chip seal cost per year per mile (Line 1÷ Line 2)	**$3,800**	**$**_____
4. Natural aggregate cost per ton, delivered to job site	$12.50/ton	$_____
5. Natural aggregate cost per lb. (line 4 / 2000 lbs/ton)	$0.0063	$_____
6. Natural aggregate design spread rate, lbs / SY	27 lbs/SY	$_____lbs/SY
7. Natural aggregate tons / mile (Line 6 x 12,907 SY/mile ÷ 2000 lbs / ton)	174.2 Tons/Mile	_____tons/mi.
8. Natural aggregate cost / mile (Line 5 x Line 6 x 12,907 SY/mile)	$2,195	$_____
Lightweight Aggregate (LWA) Chip Seal		
9. LWA $ / CY, delivered to the job site	$41/CY	$_____
10. LWA design density, lbs / CY	1200 lbs/CY	_____lbs/CY
11. LWA cost per lb. (Line 9 ÷ Line 10)	$0.034	$_____
12. LWA design spread rate, lbs / SY, provided by supplier	11 lbs/SY	_____lbs/SY
13. LWA CY / mile (Line 12 x 12,907 SY / mile ÷ Line 10)	118.3 CY/Mile	_____CY/mi.
14. LWA cost per mile for 22'-wide road (Line 11 x Line 12 x 12,907 SY / Mile)	$4,827	$_____
15. Additional cost of LWA chip seal vs. natural aggregate (Line14 - Line 8)	$2,632	$_____
16. Total installed cost of LWA chip seal (Line 1 + Line 15)	$21,632	$_____
17. LWA seal service life, years. LWA chip seal paving typically provides a 20% longer service life than natural aggregate (Line 2 x 1.20)	6 years	_____yrs.
18. LWA chip seal cost per year per mile (Line 16 ÷ Line 17)	$3,605	$_____
Cost Comparison		
19. Life-cycle cost savings per mile using LWA (Line 3 - Line 18) x Line 17	**$1,170**	**$**_____
20. Life-cycle cost savings per SY using LWA (Line 19 ÷ 12,907 SY / mile)	**$0.09**	**$**_____

Add in these additional cost advantages when using LWA . . .

- Less traffic interruption because of a 20% longer service cycle
- 50% fewer dump trucks, fewer drivers and less fuel required from dump site to chip spreader
- Windshield and paint damage eliminated; liability to public minimized
- Dustless LWA protects the public safety and the environment
- Greatly improves skid resistance; will not polish with wear
- Eliminates aggregate pull-out from asphalt during snow plowing

For Additional Information About High Performance Lightweight Aggregate, Contact

ESCSI
Rotary Kiln Produced
Structural Lightweight Aggregate

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