SAND
MINERAL AGGREGATE
Sand Specification 129.9

PURPOSE

Sand is a very beneficial and important ingredient for emulsion pavement sealer. It has a major effect on the finished coating. The type, quantity, and quality of sand should be carefully chosen since it affects:

Texture	Traction	Durability	Streaking
Appearance	Abrasion Resistance	Filling	

CHOOSING THE RIGHT SAND PARTICLE SIZE AND SHAPE

One coat of pavement sealer with 4.5 lbs. of sand per gallon when applied at 0.1 gallon per sq. yd. (based on undiluted material) will deposit a dry coating with an average thickness of approximately 0.011 inch. A sand particle at 20 mesh is approx. 0.033 inches in diameter.

At most, 1/3 of such a particle could be imbedded in the average depth of the coating, while at least 2/3 would have to protrude above the average surface level.

With less than half the diameter firmly anchored down in the coating, such a particle is more readily knocked out of the coating by traffic, etc. This leaves a pit in the coating and gives a shorter path to the substrate for agents such as gasoline, oil, water, salts, etc. that can damage the asphalt.

The oversize particle winds up loose on the surface where it can act as an abrasive. Eventually it is washed away by rain to the drain area. A two coat system greatly reduces these detrimental effects, but does not eliminate the disadvantages of oversize particles.

A sand with too high a "fines" content is also undesirable since as the particle size drops below 200 mesh, the total surface area in a pound of the particles increases extremely rapidly. 22 lbs. of sand displaces one gallon (231 cubic inches) of volume when the spaces between the grains are eliminated. One pound of sand will always increase the dry volume of the coating by the same amount (10.44 cubic inches), regardless of particle size and apparent volume of the dry sand before addition to the coating.

The surface area of one pound of sand, that must be coated by the non-volatile binders in the coating, does however, vary with the particle size. A solid sphere of silica weighing one pound would have a diameter of 2.71 inches and a surface area of 0.16 sq. ft. As that one pound sphere is broken into smaller and smaller pieces, the weight and solid volume remain the same, but the total surface area increases. Assuming all spherical particles, and every particle at the exact mesh size, the number of particles and the total surface area of one pound of silica would be as shown on the following chart:

Mesh Size	Particle Diameter in Inches	Number of Particles in 1 lb.	Total Surface Area of 1 lb. of Sand in Square Feet
Solid Sphere	2.712	1	0.16
3 Mesh	0.265	1,072	1.64
5 Mesh	0.157	5,154	2.77
10 Mesh	0.0787	40,917	5.53
20 Mesh	0.0331	544,976	13.14
40 Mesh	0.0165	4,439,933	26.37
50 Mesh	0.0117	13,050,000	38.98
100 Mesh	0.0059	104,430,380	79.32
200 Mesh	0.0029	817,537,880	149.88
400 Mesh	0.0015	5,907,831,500	291.29

As can be seen, one pound of sand at 400 mesh will have 11 times the surface area (and use up eleven times as much of the binding power of the resins and tars in the sealer) as one pound at 40 mesh. Too large a quantity of fines could result in a situation of so much sand surface area that there would be insufficient binder to totally coat and surround the sand particles as well as provide adhesion to the asphalt. This could lead to a more porous brittle coating with reduced adhesion, early "gray out" and early erosion.

Essentially all sand deposits are composed of a wide range of particles. Unless very unusual screening steps were taken, a sand for example sold as a "70 mesh" sand would be composed of a wide variety of particles, (possibly varying from 30 mesh to 200 mesh) but in this example with the greatest quantity centered around 70 mesh and about equal in weight percentage above and below 70 mesh. This is good, since a sand with a range of particle sizes will pack better in the dry coating giving a denser, stronger structure (similar to filling the spaces between marbles with BBS).

All sand used should be clean, dry, pure silica sand, free of clay, trash particles and other contaminants. Medium fine sand with an A.F.S. rating of 50 to 75 gives best results. There should be no more than 2% retained on 30 mesh or coarser, no more than 12% passing 140 mesh and no more than 3% passing 200 mesh.

MIXING OF SAND IN PAVEMENT SEALER EMULSION

To achieve the desired optimum sealcoating results, each particle of sand must be separated from all other particles and individually coated with the sealer. This requires energy. The most commonly used equipment is a horizontal, cylindrical, mixing tank with powered, sweep type blade, agitation. This type of agitator is good for turning over thixotropic materials, but at low speed it does not produce much dispersion energy. The comments that follow refer to this type of equipment, but the basic considerations would apply to other methods.

1. The dilution water called for in the mix formula should be added to the emulsion and mixed in prior to adding sand.
2. The mixer should be running at, at least, a moderate rate as the sand is added.

3. The sand should be poured in, in a moderate rate stream so that the agitator can quickly break it up and suspend it in the sealer. The mix should never be "bombed" with a whole bag of sand at a time.
4. After all the sealer, sand, water, etc. is in the tank, the lid should be closed to prevent splashing. The agitator speed should then be increased to give intensive, high energy, mixing for at least ten minutes in order to break any sand clumps and separate every individual sand particle.
5. After the intensive mixing period, the agitator can be slowed to moderate speed and preferably should be kept running. If the agitator is shut off during travel to the job site etc., it must be re-started at least five minutes before application begins and kept running during the entire period of application.

Uncoated sand particles are weak spots in the coating. The binder in an emulsion sealer is not in solution. It is present in the form of microscopic size discrete particles. The outside of a sand clump that is not broken apart by the application of enough energy, can act as a filter for the binder particles. The spaces between the sand particles can be so microscopically small that water can pass through, but the binder particles can be left behind. Pavement sealer particles trapped in the outer layers of the clump can begin to thicken (and help hold the clump together), due to loss of water to the interior of the clump. Even a small 1/8" clump of 100 mesh sand could contain several hundred sand particles. Any small agglomerate of uncoated sand left in the coating is a potential weak spot with less strength to resist traffic stresses, etc.

In addition, the uncoated interior of a tiny sand clump can act as a little water holding pocket in the coating which can freeze in the winter and put expansion stresses on the coating when, due to the cold temperature, the coating is least able to relieve the stress without damage.

If a filter plugging problem occurs when spraying high sand content sealer, it can often be traced to sand particles that were not 100% dispersed, possibly complicated by localized thickening of sealer around the agglomerate due to loss of water to the interior.

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