Special Report

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Five Ways to Save Your Asphalt!...
And Still Build a Sexy Pavement

By Dave Newcomb

OK, the title is a cheesy supermarket magazine way to get your attention, but increasing asphalt prices and looming shortages are serious business. The geopolitical realities of unstable governments in oil rich countries, the rising global competition for energy resources, natural disasters that disrupt petroleum supplies, and the consolidation of oil companies can leave us with a sense of helplessness. While it is unlikely that any of us is in a position to influence the outcomes of any of these factors, there are practices we can employ to stretch liquid asphalt supplies as far as possible.

Just as a point of reference, take a look at the chart of liquid asphalt prices, and you get a sense that things have been relatively stable for the past five years, with a slight spike in 2003. In March 2006, there is a very notable increase over last year. This combined with fuel price increases will make the coming construction season more of a challenge than those of recent history.

It will require adjustments to cope with the coming hardships, and these adjustments will have to be made soon. Contractors and agencies will need to move forward together to implement strategies that allow for ways to reduce the liquid asphalt requirement in HMA while ensuring performance.

Up the RAP

The HMA industry has been recycling on a large scale since the 1970s Oil Embargo. Research on mix properties and modifications to plant equipment were quickly done in response to the asphalt shortages at that time, and within a few years, recycling became a commonplace practice. Over the years, contractors generally stuck with having one stockpile of recycled material and feeding anywhere from 10 to 25 percent RAP into the mix. This produced significant cost savings, and the industry was content to remain at this level of recycling.

It is time to consider means for increasing RAP content even further. RAP is a resource rich in asphalt and aggregate, and just as we test and process virgin materials, so too should we judge the quality of RAP and process it. The sizing of RAP will help to refine its use in HMA. Having two or even three different size stockpiles of recycled material means greater flexibility in designing mixes for specific applications. For instance, in finer surface mixes, an increased amount of fine RAP can be employed, whereas a greater fraction of coarse sized RAP can be used in large stone mixes.

Like any other material in HMA, RAP should be engineered into the mix, not simply dumped. Understanding the asphalt content and gradation will help the mix designer integrate the recycled material in the right proportion and adjust the virgin materials. If used in large quantities, it may be advisable to extract and test the binder to see if it is highly oxidized and brittle. If it is, then the virgin asphalt may be decreased by one grade to ensure that the resulting mix is not brittle.

If a mix using all virgin materials has a required binder content of 5.5 percent, then a 30 percent RAP mix, where the RAP contains 4 percent asphalt, will reduce the amount of liquid binder by 1.2 percent. This means you could reduce the quantity of liquid asphalt by 22 percent. On 10,000 tons of HMA, this means a reduction of 120 tons of liquid AC. At $250/ton, this works out to a savings of $30,000. Obviously, the savings with RAP go beyond just the savings on liquid asphalt, the aggregate in RAP provides just as much, if not more, money in your pocket.

High RAP content mixes may pose special problems in terms of workability and compactability. While this may be aided somewhat by the use of a reduced PG grade of virgin binder, consideration might also be given to the use of additives or processes that improve workability at high temperatures.

RAP has always been a valuable commodity, and its benefit to the industry and its customers is more evident than ever before.

Rock the Asphalt

It is no secret that mixes having a larger nominal maximum aggregate size require less asphalt for the same binder coating (or film thickness) than those that have a smaller size aggregate. It comes down to the surface area of the aggregate.

This can be illustrated by taking a container that is a box, measuring 10 inches in each direction. If you take 1-inch diameter balls, each one would have a surface area of 3.142 in^2, and it would take 1000 of them to fill the space, if you stacked them directly on top of each other. If you used ½-inch balls, each one would have a surface area of 0.785 in^2, and it would take 8000 to fill the box. Multiplying the surface area of each ball times the number to fill the box leaves you with a total surface are of 3,142 in^2 for the 1-inch balls and 6,280 in^2 for the ½-inch balls. So the larger balls have a smaller total surface area than the smaller ones. Obviously, an asphalt mixture will have smaller aggregate between the larger ones, and the surface area will increase for each.

While the above example is an academic exercise, it is not a stretch to see how it applies to HMA. If the opportunity presents itself to use a 37.5 mm NMAS mix in a base rather than a 19 mm mix, there will be less surface area to coat with asphalt in the larger stone mix than the finer mix. To keep the same asphalt film thickness on the aggregate, less asphalt is required for large stone mixtures.

In a 1988 NAPA publication comparing large-stone (1-3/4 inch NMAS) to conventional mixture (5/8 inch NMAS), it was found that the large stone mix required 1.7 percent less asphalt. For 10,000 tons of HMA, this would work out to saving 170 tons of liquid asphalt, and at $250/ton, this would mean $42,500 in cost savings.

Segregation and permeability are problems that can plague large stone mixes. However, if the right precautions are taken in production and paving, segregation can be minimized or eliminated. For example, proper loading of dump trucks and the use of material transfer vehicles can do much to help segregation. Proper gradation and mix design can help take care of permeability, and it may be advisable to use a lower design air voids to avoid it.

Does this Pavement Make My Asphalt Look Fat? – Thinner Overlays

Many times overlays are placed more to correct functional (smoothness) deficiencies than to strengthen the existing pavement. The appropriate use of thinner overlays can be a way of stretching rehabilitation dollars. The use of a 9.5 mm mix that is 1-1/2 inches thick will use 25 percent less material than a 12.5 mm mix that must be placed at 2 inches thick. Even though a finer surface mix will necessitate the use of a higher asphalt content, money will be saved.

Let’s say the 9.5 mm mix has an optimum asphalt content of 6.5 percent and the 12.5 mm mix has an asphalt content of 6.0 percent. This would mean the 9.5 mm mix would have a coverage of 163 lbs/yd^2 and the 12.5 mm mix would have 217 lbs/yd^2, if they both had a density of 145 lbs/ft^3. The 9.5 mm solution uses about 18 percent less liquid asphalt per square yard than the thicker 12.5 mm mix.

Some feel that finer surface mixes will potentially result in more rutting. In fact, research at NCAT has shown that finer mixes are no more prone to rutting than coarse mixes, and they also improve the ride and lessen the traffic noise. Finer surface mixes placed in thinner overlays could serve the function of thicker overlays if structural improvements in the pavement are not needed.

Don’t be Gauche! – The Right Asphalt for the Right Occasion

Although it is not necessarily a way to use less asphalt, in many instances less of the *expensive* asphalt can be used. For critical situations, it may not be wise to sacrifice performance to lessen the initial cost. However, there are instances where more expensive grades of asphalt and polymer modified asphalt are specified when they are not necessarily warranted. Layers that are deeper in the pavement structure, low-volume pavements, and overlays of existing cracked pavement are all circumstances where specifications requiring premium asphalts should be reviewed and changed if necessary.

As can be seen on the historical graph of asphalt prices, premium grades in Ohio can be anywhere from $50 to $70 per ton higher than the standard grades. It is also likely that the standard grades will be somewhat easier to come by in a shortage than the more expensive grades. Using standard grades could result in a $33,000 savings on 10,000 tons of HMA.

If a particular situation does not involve high truck traffic surface mixtures, then question the need for premium asphalt. Slow traffic, high temperatures, and cold temperatures may all be reasons to specify a better asphalt, but simply specifying a particular grade because it can be specified is not a good use of resources.

Raise the Roof with Shingles

Roofing shingles, especially those from manufacturers' waste, have many of the same ingredients as hot-mix asphalt. This includes high quality asphalt binder, hard fine aggregate, mineral filler, polymers, and fibers. Many state agencies allow up to five percent of recycled shingles in HMA. With an asphalt binder content of 20 percent, the use of five percent shingles in your mix could reduce the HMA binder content by one percent. This would mean, for instance, instead of adding 5.5 percent liquid asphalt, you would add only 4.5 percent. For each 10,000 tons of mix, this would save 100 tons of liquid asphalt and at $250/ton, this would save about $25,000 on mix cost.

Few doubt that the coming construction season will pose significant challenges both in terms of the availability and cost of asphalt binder. Relief is needed to ease the burden that the pavement construction industry faces. Much of this can be accomplished through smart engineering and wise decisions. Contractors and agencies need to work together to get through this period of higher costs. Tough times have occurred in the past and we have weathered those. No doubt that business will have to be done differently, but conditions will eventually stabilize and we will figure out how to keep paving roads.

The ideas for saving asphalt presented here are not the only ones available, nor are they exclusive of one another. Using a combination of solutions can result in even greater cost savings in the coming months. Innovative thinking and a will to change our practices are the keys to surviving the coming months.

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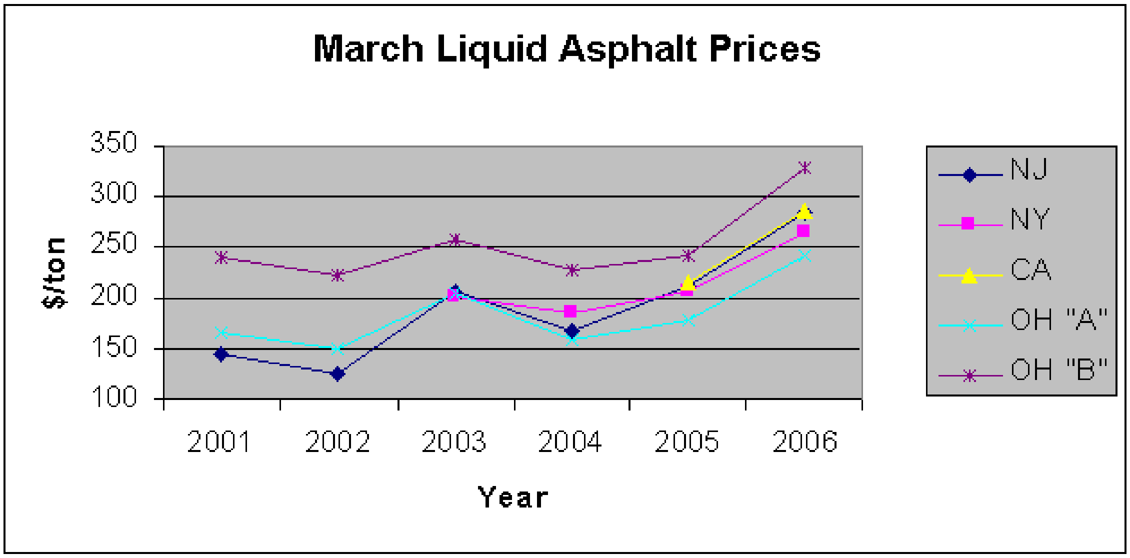
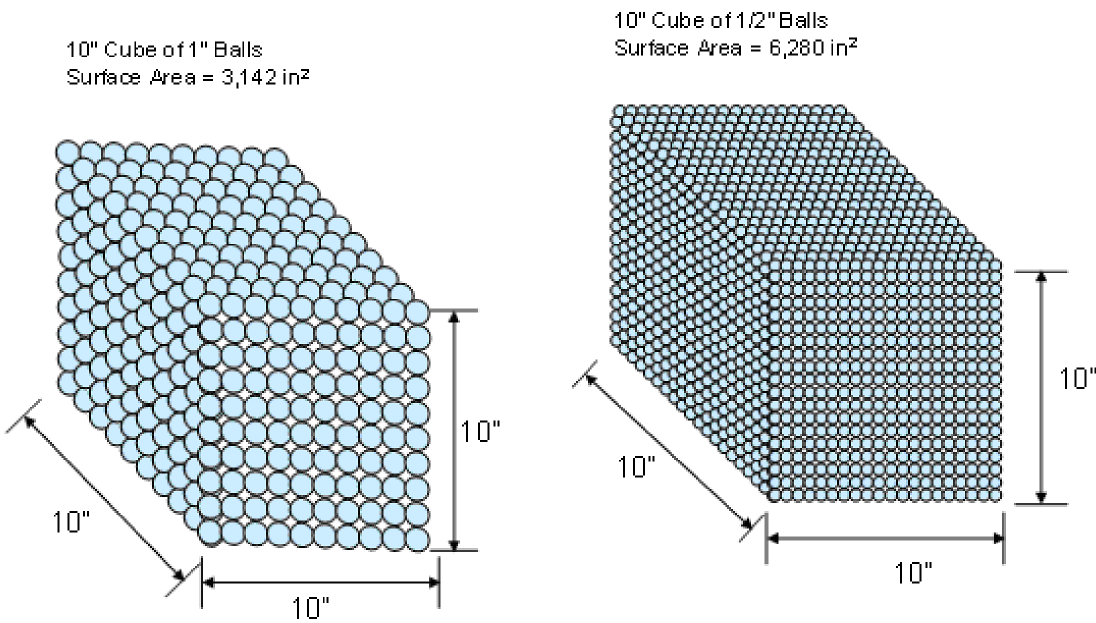


NJ prices are an average between North and South of Route 195
NJ source: http://www.state.nj.us/transportation/eng/CCEPM/PriceIndex.shtm (accessed 3/30/06).
NY source: http://www.dot.state.ny.us/constr/fuel/fuel_home.html (accessed 3/30/06).
CA source: http://www.dot.ca.gov/hq/esc/oe/asphalt_index/astable.html (accessed 3/30/06).
OH “A” are standard grades of unmodified asphalt
OH “B” are nontypical and modified asphalts
OH source: http://www.dot.state.oh.us/construction/OCA/AC/PlaceIdx1997.htm (accessed 3/30/06).

Asphalt prices have been relatively stable in the five years preceding 2006.



For the same volume, large particles have less surface area than small particles.
Small aggregate needs more asphalt to cover the surface area than large aggregate.