Engineering Brief # 21

Date: October 19, 1979

In Reply Refer To: AAS-200

Subject: Engineering Brief No. 21, Use of Sulfur in Bituminous Pavements

From: Acting Chief, Engineering and Specifications Division, AAS-200
To: All Regions

Attn: Chief, Airports Division

Engineering Brief No. 21, Use of Sulfur in Bituminous Pavements, presents a brief background on the use of sulfur to replace a portion of the asphalt in bituminous mixes.

The purpose of engineering briefs is to keep FAA field offices informed of construction methods which are being tried, but which are not necessarily known to the regions and ADO's. The information contained in this brief is not to be construed as general approval by the Office of Airport Standards. Any use of this material will require prior approval by this office.

Any comments you care to make concerning this brief will be appreciated.

ORIGINAL SIGNED BY:
RICHARD J. WORCH
for
EDWARD AIKMAN

ENGINEERING BRIEF NO. 21

USE OF SULFUR IN BITUMINOUS PAVEMENTS

The purpose of this engineering brief is to present a brief background on the use of sulfur in bituminous pavements.

Background

Prompted by the need for conservation of petroleum resources and forecasts of a sulfur surplus, numerous studies on the use of sulfur in bituminous mixes have been sponsored by the Federal Highway Administration, the Bureau of Mines, and other Governmental and private agencies. A review of these studies indicates that the use of sulfur-extended asphalt (SEA) binders is feasible.

Sulfur-Extended Asphalt (SEA) Binders

Sulfur-extended asphalt hinders are formulated by replacing some of the asphalt in conventional binders with sulfur. Binders have

been used with sulfur/asphalt weight ratios as high as 50/50. Most field trials have used binders with 30/70 and 40/60 sulfur/asphalt weight ratios, Since the specific gravity of sulfur is approximately twice that of asphalt, the sulfur in a 50/50 SEA binder has replaced about 33 percent of the asphalt by volume.

Pavement construction with SEA binders is similar to construction with conventional asphalt binders. Mixing plant modifications are minor and the same placement and compaction equipment and procedures are used. Plant modifications can be made either temporarily or permanently and do not hinder the production of conventional asphalt. The modifications consist of a separate storage tank, pump and circulating system, and a means of combining the asphalt and sulfur in the correct proportions. The cost for modifications to an existing batch plant is about $6,000. Mix design procedures are the same as those used for conventional mixes.

Economics

The present cost of sulfur varies, dependent on logistics involving hauling or transportation costs. Where it is readily available sulfur costs approximately $30 a ton. Where transportation is a factor costs may be $85 a ton or higher. By comparison the average cost of asphalt is $100 a ton and continues to escalate. It is anticipated that the future price of sulfur will be much lower because supply will exceed demand. The excess sulfur will be obtained from desouring natural gas, desulfurizing petroleum crude or coal, or recovering elemental sulfur from stack emissions.

Safety and the Environment

In the normal temperature range for handling sulfur/asphalt materials (260 degrees F - 300 degrees F) there is little or no evolution of sulfur-containing gases. If the temperature of the sulfur/asphalt binder is allowed to rise above 310 degrees F, evolution of hydrogen sulfide and sulfur dioxide may start to occur.

Emission monitoring at mixing plant and construction sites during the construction of several SEA pavements indicates that emissions are controllable within acceptable limits.

Conclusion

Use of SEA mixes on airport pavements appears feasible. These mixes have a higher stability and lower air voids content than conventional mixes. This is a function of the sulfur in the material which lowers the viscosity of the binder in the hot-mix form, thereby giving better compaction. On cooling to ambient temperature, the sulfur acts as a filler and gives a higher stability material. In addition SEA mixes are purported to be more resistant to water stripping and resistance to gasoline, diesel fuel and other solvents is improved.

Any conclusion concerning increased structural properties of asphalt/sulfur pavements would be premature, pending further evaluation of the field trials now in progress.

Based on the research already completed and projects currently underway, we feel that SEA mixes are feasible for use on airport pavements and present a viable energy, material, and cost saving alternate

We suggest that demonstration projects be undertaken so that we may evaluate the use of sulfur extended asphalt on airport pavements. Information concerning plant conversions and mix design procedures may be obtained from:

The Sulphur Institute
1725 K Street, N.W.
Washington, DC 20006

Approval of sulfur-extended asphalt mixes will be required by the Office of Airport Standards prior to use since standards for this material have not been developed and it has not been used on ADAP construction projects to date.

Enclosed for your information are the following reports:

1. Direct Substitution of Sulfur for Asphalt In Paving Materials
2. Sulfur Research Development
3. Construction Report - Sulfur - Extended Asphalt Paving Project

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Enclosures