EVALUATING THE USE OF WASTE MATERIALS IN HOT MIX ASPHALT

by

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Solid Wastes Generated in U.S. (Million metric tons)

- Agricultural (1910)
- Domestic (180)
- Industrial (273)
- Mining & Mineral (1640)
INTRODUCTION:

The issue of waste management is becoming an ever-increasing problem in the United States and throughout the world. Recent estimates are that 4.1 billion metric tons of solid wastes are generated every year in our country — that’s about 14 tons for every man, woman, and child!(1) Few of us really appreciate the magnitude of the overall problem since we see so little of the non-domestic wastes. We, as a society, must develop a plan for dealing with this ever-growing quantity of solid wastes.

Waste materials are by-products of every aspect of society. Figure 1 shows the principal categories of solid wastes and the relative proportion of the total represented. Agricultural and mining wastes obviously are the two major contributors to the solid waste stream with industrial and domestic wastes almost an order of magnitude less.

Each step in the process of supplying raw materials, manufacturing finished goods, distributing finished goods, and consuming goods generates various types of waste materials. Some waste products may be inert; some may be hazardous. What to do with these waste products has become a major issue in our environmentally conscious society.

Conventional methods of disposal include: landfill disposal, incineration, and/or recycling into different products. From an environmental standpoint, waste materials may be, or contain components that may be, classified as hazardous materials. The waste’s classification may limit the potential disposal options, increase the disposal cost for some waste products, and increase public awareness of all waste products in general.

The Hot Mix Asphalt (HMA) Industry has been a long-time supporter of recycling and encourages continued research in this area. Recycling, on a large scale, began in this Industry in the 1970’s and has been growing ever since. Federal Highway Administration and Environmental Protection Agency’s recent report to Congress indicated that 91 million metric tons of RAP (reclaimed asphalt pavement) are produced annually with 73 million of those tons recycled into highway applications. That’s 73 million tons per year of landfill space not used plus substantial savings in asphalt cement and aggregate. Hot Mix Asphalt is a 100% recyclable product and is designed to be that way. Portland Cement Concrete and aggregate also are now routinely recycled into HMA.
Recently, pressures have been placed on the HMA Industry to incorporate a wide variety of waste materials into highway projects - everything from toilets to tires. Concern has been voiced by the Industry regarding increased costs, potential worker risks, and potential environmental impacts, as well as effects on the long-term performance of pavements that contain waste materials. The Industry concerns can be separated into three distinct areas: engineering, environmental, and economics.

The purpose of this paper is to offer some thoughts on the use of waste materials in highway construction from the perspective of the HMA Industry. As the direct employer of an estimated 300,000 people in the United States, the HMA Industry wants to ensure performance of our product and the safety of our people, but at the same time, we want to be a partner in helping to solve society’s difficult waste problem.

HMA BACKGROUND

Asphalt, more than any other single product, sustains the nation’s highways and facilitates the flow of commerce and personal mobility. As the nation increasingly focuses on the rehabilitation of roads, dollars spent on asphalt and the importance of this product to the nation’s economy and lifestyles increase proportionally. (2)

These words were used in 1984 to begin the effort that became the Strategic Highway Research Program. The HMA Industry supports this philosophy and strives to build high-performance pavements. We feel that this philosophy should be the guiding principle for any materials and processes which affect our product.

Although HMA contains only two principal ingredients, asphalt and aggregate, the production and placement of an HMA pavement requires a great deal of technical knowledge on a wide variety of topics. The processes involved in the production and placement of HMA include:

- Crushing and grading of aggregates
- Proportioning asphalt cement and aggregate for mix design
- Verification of the job mix formula at the HMA facility
- Storage and handling of aggregate stockpiles at the HMA facility
- Storage and handling of asphalt cement in the HMA facility
- Safety and Environmental Stewardship at the HMA facility
- Heating and drying aggregate
- Mixing aggregate with asphalt cement
- Storage of HMA prior to shipping
- Transporting HMA to jobsite
- Placing HMA on existing surface
- Rolling HMA to achieve density
- Ensuring proper pavement properties.
Many of these processes occur simultaneously, but as with any manufacturing process, the final product is only as good as the raw materials - garbage in - garbage out! Thus, the HMA Industry is diligent to ensure that the aggregates and asphalt cement used in the "recipe" are high quality products. Quality tests are performed before and during production to ensure the right materials are used to produce the appropriate final product.

ASTM and AASHTO write extensive specifications for materials which go into HMA. While it is true that these specifications do not specifically relate to performance, these requirements provide at least some empirical baseline of performance expectations.

Experience in the HMA Industry clearly has shown that materials and processes that work in the laboratory under controlled conditions do not always work in production. Logistical problems in the HMA facility may prevent what seemed like a good idea, based on laboratory data, from being implemented. This issue must be kept in mind when evaluating a process based on laboratory experience alone.

The inclusion of waste materials into the raw material stream obviously affects the entire process just described. Therefore, it is critical that proper evaluation of any and all materials be made prior to inclusion in the HMA mix.

**USE OF WASTE MATERIALS IN HMA**

As previously noted, the HMA Industry has raised several concerns regarding the potential use of waste materials in highway projects. The three specific areas of concern are engineering, environmental, and economics.

**Engineering**

As a first step in the Engineering evaluation of waste materials, clear definitions need to be developed to describe what a waste material is, when a material becomes a waste, and when a material once labeled as a waste no longer is a waste.

Any waste material introduced into HMA replaces a conventional material and could change the properties of the end product. Therefore, a thorough analysis of both the HMA and the pavement structure must be performed where the use of waste materials is proposed.

Evaluation of waste materials must be done in a manner similar to that which occurred with reclaimed asphalt pavement - sound technical studies with appropriate field demonstrations. Appropriate evaluations must be done prior to routine use to determine if any changes will occur and to evaluate its impact on performance and maintenance.
As shown in Table 1, there are five major areas involving use of wastes which are of engineering concern: handling and storage; processing; mixture requirements; supply; and performance.

TABLE 1

ENGINEERING CONCERNS RELATING TO THE USE OF WASTES IN HMA

Storage and Handling of Wastes
- special requirements for transportation
- requirements for containment/runoff control
- storage/handling stability of material
- potential leachate
- personnel health/safety

Processing of Wastes
- equipment requirements
- residual wastes from processing
- on-site requirements

Mixture Requirements
- test methods
- mix design procedures
- mix Quality Control/Quality Assurance

Supply of Wastes
- consistency of waste stream
- variations in properties of waste
- appropriate quantities for project

Performance of HMA Containing Waste
- equal to or better than conventional
- recyclability
- limitation on quantity of waste used
- other engineering applications more appropriate?

Environmental:

HMA is produced at temperatures ranging from 250°F to 325°F prior to placement on the roadway. Strict emission and environmental controls are placed on facilities that produce HMA. Given the current regulations of EPA, even stricter controls are anticipated. Waste materials added to HMA during production may require higher temperatures and may change the emissions, fumes, and/or odor characteristics of the resulting HMA.
Under the Clean Air Act, HMA facilities will be regulated on the amount of emissions produced. Any waste material that increases emissions would require HMA facilities to revise their operating permits (a very expensive and lengthy process) or decrease production capability. In either case, the cost of the final product would be increased.

Proper handling and processing practices must be developed to assure that no contamination of the site or surrounding neighborhood waterways or lands will occur from the use of waste material. Waste material added to highway projects must not leach out and contaminate storm water runoff from the roadway. Waste materials added to the project must not pose any health risks to the construction workers or general public using the facility.

There are four major environmental concerns relating to the use of wastes in HMA: safety, potential by-products, liability, and public relations. Table 2 presents some of the specific concerns relative to each issue.

**TABLE 2**

ENVIRONMENTAL CONCERNS REGARDING THE USE OF WASTES IN HMA

**Safety**
- worker health
- Material Safety Data Sheet for each waste
- fumes analysis for each waste
- air emissions from HMA facility processing waste
- personnel monitoring

**Potential By-Products**
- type and kind of materials generated
- stability of materials generated
- hazardous nature of by-products
- potential for leachates

**Liability**
- definition of wastes
- ownership of wastes
- responsibility for "paper trail"
- future environmental impact/responsibility
- limitations on quantity of waste to be used
- recyclability

**Public Relations**
- perceptions of HMA Industry
- impact of waste handling on surrounding community
- local residents opinion of waste handling
Economic Concerns:

From an economic viewpoint, mandated use of waste products may raise the price of construction and decrease the number of miles resurfaced and repaired each year. Short-term and long-term economic impact studies must be made to determine the impacts on service life and performance. If a pavement including waste materials cannot be recycled in future years, the cost and burden of disposing of the contaminated pavement would be staggering. The HMA Industry wants to ensure that "linear landfills" are not being built.

The four major economic concerns relating to the use of waste in HMA are: equipment issues; performance issues; political issues; and alternative disposal options. Table 3 summarizes the concerns for each of these areas.

TABLE 3

ECONOMIC CONCERNS FOR THE USE OF WASTES IN HMA

Equipment Issues
- modifications for environmental requirements
- modifications for production requirements
- operating costs
- maintenance costs
- effect on production rates

Performance Issues
- effect on pavement salvage value in life cycle cost
- recyclability of HMA with wastes
- quantity of wastes to be used
- relationship between cost increase and performance

Political Issues
- incentives for using materials?
- should generators offer incentives to highway industry?
- who pays additional costs?

Alternative Disposal Options
- require original manufacturer of product to recycle
- incineration
- civil engineering applications
- conventional or specialty landfill costs
- innovative uses
The National Asphalt Pavement Association (NAPA), representing the HMA Industry, promotes the use of quality products and recognizes that our products are under intense environmental scrutiny. NAPA and its Membership support the research activities of the Strategic Highway Research Program whose goal was to improve the performance of HMA. The strength of our economy is based on a healthy transportation network, and highways are a major portion of that network. We must continue to strive for the highest performance pavements possible to provide for the "flow of commerce and personal mobility."

However, our industry is being asked to fulfill an additional societal responsibility of waste disposal because of the large volumes of material placed annually, a large percentage of HMA is purchased with public funds, and the versatility of HMA itself. In some ways, this is in direct conflict to the mandate of SHRP. Few waste products will improve performance of HMA, and many will diminish life expectancy or affect its recyclability.

Any use of a waste product must be thoroughly researched with respect to worker risk, cost-effectiveness, performance, recyclability, and potential for emissions and fume generation during handling, storage, manufacture, placement, and future recycling operations. Use of waste materials in HMA should be the result of research, field performance and verification, and only in the best interests of this country's future.

There are five basic points that are the foundation blocks in the waste issue:

1. Use of waste materials in highway construction should not be mandated; they should be used because they provide appropriate engineering performance and are driven by market demand.

2. The waste material used in highway construction should not be subsidized by the highway user; it must be cost-effective in its own right or be subsidized by other sources.

3. The waste material should perform as good or better than conventional materials.

4. The waste material must be environmentally secure both for present-day construction and future recyclability.

5. The use of waste materials in pavement construction should not place any particular element of the Construction Industry at a competitive disadvantage.
Recommendations:

In order to fairly and uniformly assess waste materials, a protocol of standards and test methods is needed for the evaluation and testing of waste materials proposed for use in highway construction. This protocol should be developed to address the issues described herein and to evaluate the engineering, environmental, and economic concerns. Such a protocol would provide an opportunity for any waste material to be fairly evaluated for inclusion into HMA pavements.
References

