

29090.PDF SW-912

Experimenting with Other Additions

An aggregate company
experimented
with incorporating
recycled glass,
asphalt shingles,
and foundry sand
into its asphalt mixes.

Here are the results

By Jeffrey Frantz

Mr. Frantz is director of technical services, Eastern Industries. This article is adapted from his 1994 presentation at the Second Annual Construction Materials Recycling Seminar in East Rutherford, N.J.

Eastern Industries is one of the largest suppliers of construction materials in Pennsylvania. From more than 40 locations, the company supplies bituminous concrete, portland cement, concrete, road oils, block, crushed stone, sand and gravel, and agricultural lime. During the past several years, it has participated in a number of projects and experiments involving recycled products, including glass, foundry sand, and roofing shingles. The company has utilized all of these products in its asphalt-processing facilities, and this article discusses Eastern Industries' experiences and findings.

Glass

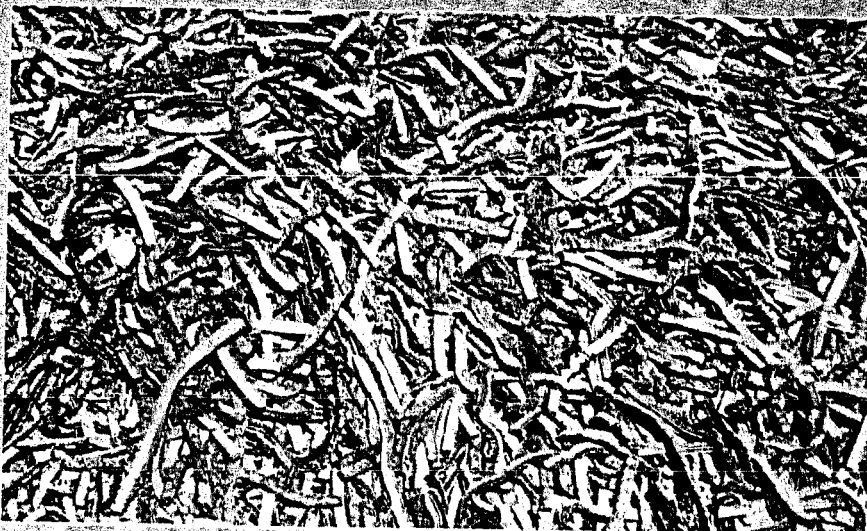
In Pennsylvania, the waste stream includes an estimated 100,000 tpy of mixed colored glass, which glass recyclers cannot recycle and is currently being landfilled. The state lieutenant governor put out a challenge to the industry to find ways of utilizing this material.

The company initially looked at using glass as an aggregate substitute in its 2A modified stone product. Pennsylvania aggregate specification currently allows a maximum of 10% glassy particles in coarse aggregate. Therefore, the specification was already in place allowing for the introduction of glass into the coarse aggregate. This left us with the problem of obtaining the glass product.

After numerous phone calls with various glass recyclers, it became clear that there was a major problem in obtaining sufficient clean processed glass. The majority of the glass that was available was unprocessed and contaminated with other waste materials. The availability of clean uncontaminated processed glass in sufficient quantities and at a price that promotes

Left: These 8-in.-long, 1/4-in.-wide factory tabs are generated during the production of asphalt shingles on a regular basis.

Background: A view of a project site in Allentown, Pa., where 10% glass was used in the blacktop mix. Although difficult to tell from this photo, the roadway glitters in the sunlight.





TO Hot Mix

using glass as a competitive alternative turned out to be a major deterrent in using glass as an aggregate substitute.

The second option was using the glass in producing a plant-mixed "glasphalt" bituminous concrete product at a 10% maximum substitution rate. The Pennsylvania Department of Transportation (PDOT) developed a glasphalt specification with a top size of 100% passing $\frac{3}{8}$ in., which can only be substituted into base coarse mixes at a maximum rate of 10% by weight of the total mix.

Some municipalities in the state also have specified glass in the wearing course. For instance, for the second year in a row as part of an experimental research project, Allentown city officials have specified glass in both base and wearing course mixes. There also has been a steady increase in the number of local townships involved in their own recycling programs and are specifying glass in bituminous concrete.

The procedure involved in producing glasphalt is very easy. An existing asphalt pavement (RAP) system is used to introduce the glass into the plant, where it is then weighed and mixed with the remaining virgin materials. No problems arose with this procedure for producing either the base or wearing mix.

One of the major advantages of glass in bituminous concrete is the cost savings as compared to virgin aggregate. Therefore, a middle ground has to be established between the glass

recycler and user to make it beneficial for both parties and help eliminate the otherwise unnecessary landfilling of this product.

Asphalt shingles

Four years ago, Eastern Industries had its first joint project/experiment with Georgia-Pacific, which supplied factory tabs left over from its asphalt shingle production. The tabs were about 6 in. long and $\frac{1}{2}$ to $\frac{3}{4}$ in. thick, and Georgia-Pacific generates 10,000 to 15,000 tpy of this material, which they landfill.

For this project, we looked at both fiberglass and organic shingle tabs. These two types appear very similar but are quite different in their material composition. The organic tabs have as much as 36% asphalt as compared to 22% in the fiberglass tabs. The organic tabs also contain as much as 28% filler material whereas the fiberglass tabs contain 48% filler. The filler material is a pulverized limestone with 60% passing #325 sieve and 90% passing the #200 sieve. The gradation summary of the final product can be seen in Table 1.

About 30 tons of shingle tabs was required to do the planned project. The materials were run through a small hammermill in an attempt to get them down to a minus $\frac{3}{8}$ in. particle size. It took 2 $\frac{1}{2}$ weeks to produce 30 tons of usable product, so obviously using a hammermill may not be the way to go.

The next task was to prepare a

Table 1 Recycled Factory Shingles

Gradation Summary
(% Passing)

sieves	fiberglass shingles	organic shingles
#200	37	28
#100	46	32
#50	48	35
#30	52	40
#16	77	65
#8	94	80
#4	97	88
$\frac{3}{8}$ "	100	100
asphalt content	20	32

Table 2 Recycled Roofing Shingles Composition

(ReClaim's Material)

property	tested results
Asphalt Content	30%
Fiber Content	7%
Filler Content	63%
Specific Gravity	1.608 - 1.668

Table 3 Recycled Roofing Shingles (ReClaim's Material)

Gradation Summary

sieves	% passing
#200	15
#100	21
#50	32
#30	60
#16	100
#8	100
#4	100
$\frac{3}{8}$ "	100
asphalt content	21.0



Top: These blending bins were used to mix 25% foundry sand and 75% limestone sand for a Pennsylvania Department of Transportation test project.

Bottom: The material made from tabs is mixed with virgin asphalt, dumped into a paver, and rolled. No difference in this mix's rolling patterns and conventional mixes could be detected.

mix formula for the organic and fiberglass product. During the designing process, it was discovered that the organic shingle material by itself would not work. The problem was the felt mat in the organic shingles. The asphalt was absorbed and locked into the felt and was of no benefit at the 1/8-in. particle size. On the other hand, the fiberglass tabs easily broke down into their various original components.

In the mix design using the fiberglass tabs, it was possible to reduce the virgin asphalt content by 0.7%, in comparison to the virgin mix, while also increasing the stability of the mix significantly.

After processing the tabs and preparing a job mix formula (JMF), we thought the headaches were over...until we tried to introduce the material into the plant. Initially, we planned on feeding the material through the recycled asphalt pavement (RAP) system, but this material tended to conglomerate and pack to the point where it would not flow out of the bin.

The next plan included building a ramp next to the conveyor that feeds the material into the plant weigh hopper. The bucket of a front-end loader was then filled with the processed tabs, taken up the ramp to the conveyor, and the tabs were pulled out of the bucket onto the conveyor by two men with garden rakes. It was quite a task raking 30 tons of material, but it worked.

Table 4
Foundry Sand Properties

Chemical Analysis

Silica, quartz	less than 90%
Carbon	0 to 3%
Iron	0 to 1%
Alumina	0 to 4%

Physical Properties

Specific Gravity	2.65
Absorption	1.43%
Sodium Sulfate	7.0%
PH	8

Table 5
Fine Aggregate Grading and Quality Requirements

Minimums Concrete (ASTM C 33, Class II) Maximums Organic Content

Sieve Size	#	Concrete	Organic Content
3	60	100	0
75	300	100	0
150	1000	95-100	0
300	500	85-100	0
600	250	70-100	0
1250	125	55-100	0
2500	60	40-100	0
5000	30	30-100	0
10000	15	20-100	0
20000	7.5	10-100	0

Organics Test max. 0.3%

The project site included eight sections, with each section being a minimum of 500 ft in length. We used one section as our control section of conventional ID-2 binder and wearing mixes. The additional section contained various combinations of both conventional and fiberglass modified mixes. The modified mixes contained 5% shingle tabs, while replacing 5% of the virgin components.

There was no noticeable difference in placement or rolling patterns in comparison to conventional mixes. If you examined the modified wearing sections closely, you could see the fiberglass fibers from the tabs protruding in the mat. It appeared as though we had added polyethylene fibers to the mix.

Our second shingle project involved a material called ReActs,

which is produced by Reclaim Inc. This company has developed a process whereby discarded roofing shingles are processed into a useable product, whose composition and gradation summary are shown in Table 2 and Table 3, respectively.

In the initial design phase, we ran across the same problem that came up with the organic shingle tabs: we were unable to use the asphalt in the ReActs products because, at the time, the

ReActs product was $\frac{3}{8}$ in. in size. In order to use the asphalt from the ReActs material, it had to be reprocessed to produce a product gradation whereby 100% passed through the #16 sieves.

Once again, a JMF was formulated at a 5% replacement factor. But this time it provided results that complied with PDOT specifications. At a 5% replacement factor, the virgin asphalt content was reduced by 1.2% while

Table 6
Job Mix Formula
Summary
Virgin vs. Foundry Sand
ID-2 Binder

	JMF Virgin mix	JMF with 7% foundry sand
asphalt	4.4	4.2
specific gravity	2.475	2.472
solids	4.4	4.5
voids	14.3	13.4
voids	71.6	67.6
stability	2067.0	2200.0
flow	12.8	9.2
% sand in JMF	33.8	31.3

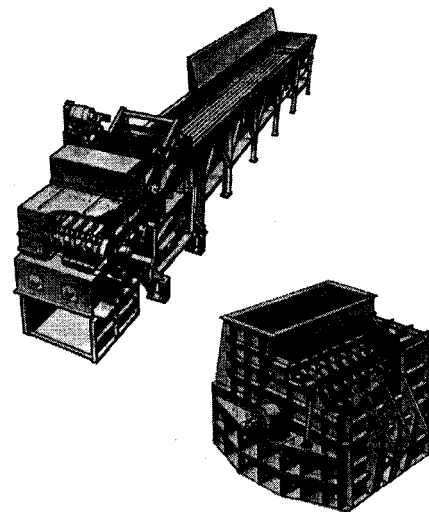
Table 7
Job Mix Formula
Summary
Virgin vs. Foundry Sand
ID-2 wearing

	JMF Virgin mix	JMF with 7% foundry sand
asphalt	6.2	6.1
specific gravity	2.409	2.415
solids	4.1	4.0
voids	8.2	16.9
voids	7.6	7.5
stability	225.0	2283.0
flow	10.3	9.1
% sand in JMF	9.3	10.3

**"FEED THEM
ALL YOU
WANT."**

And feed them often. Because Jeffrey refuse shredders are rugged and durable with minimum downtime for service. No matter what your operation—landfill production, incineration, pyrolysis, resource recovery, or industrial waste—these shredders have built-in features that produce consistent products and high capacities. Heavy fabricated steel with reinforced ribs assures maximum rigidity. Rotors feature heavy-duty design with self-aligning spherical roller bearings. Wear surfaces are protected by removable steel liners, drilled and tapped for heavy-duty service.

So, feed them all you want. And often. They'll return the favor with production and profit.



JEFFREY

P.O. Box 387 • Woodruff, SC 29388
Telephone: (803) 476-7523

© 1995 Jeffrey INDRESCO

CIRCLE 41 ON READER CARD



Foundry sand is a byproduct of a foundry casting operation and comes in various colors.

decreasing the overall asphalt content by 0.2%. We placed one small test section, and there was no noticeable difference in placement or rolling vs. conventional material mixes.

Foundry Sand

Foundry sand is a byproduct of foundry casting operations and comes in various colors (black, red, green, gray), depending on the production process.

The sand used in this project came from a foundry sand landfill owned and operated by a coalition of foundries. The unprocessed foundry sand is hauled into a landfill where it is further processed through a portable screening plant. The plant rescreens and removes all foreign material from the incoming foundry sand product. The reprocessed foundry sand properties are listed in Table 4.

The foundry sand used in this project was processed to comply with PDOT #2 fine aggregate specifications (Table 5). The first task was to develop an ID-2 Wearing job mix formula (Table 6 and 7) using a minimum of 10% foundry sand as a direct substitute for the fine aggregate portion of the mix. The foundry sand allowed us to reduce the asphalt content by 0.2% and decrease the fine aggregate percentage in the mix by 5%.

In 1993, Eastern Industries produced about 25,000 tons of ID-2 Wearing material for PDOT with a minimum substitution of 10% foundry sand in the mix. PDOT's general services division provides a 5% bid preference to those suppliers who use a minimum of 10% foundry sand in the mix and also meet current PDOT specifications. A blending plant was required to blend 25% foundry sand to 75% limestone sand. This material then was fed through the cold feed system at the asphalt plant at 50%, which enabled us to comply as a user of a post-consumer product and therefore the 5% bid preference.

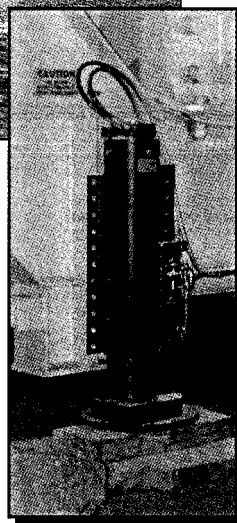
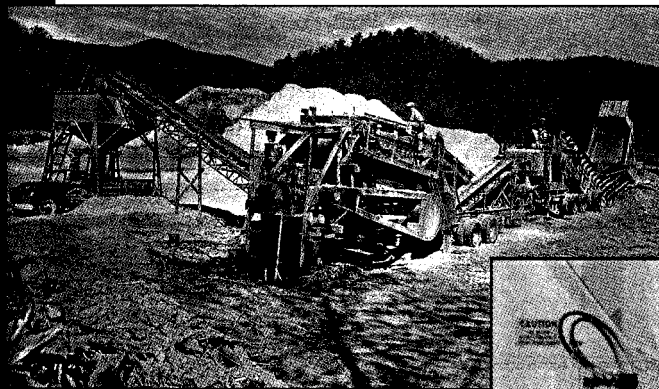
One of the major advantages of the foundry sand is the large quantities available, at least in Pennsylvania. Most foundries have stockpiles of foundry sand that have accumulated during the last 50 years. Some of these stockpiles contain more than 500,000 tons of material, which in many cases is available for further processing.

Of the recycled products discussed in this article, the foundry sand product offers the greatest advantage for a material supplier from an availability and cost standpoint. ■

Stabilize Your Future

1950 vs. 1995

It's not the 50's anymore! Power Gear Stabilizer Systems produced by Milwaukee Cylinder provide portable equipment owners with the ability to lift and level within minutes. Save valuable time and labor! In the competitive 90's you need an edge on the competition. Insist on Power Gear Stabilizers on your new - or existing - portable equipment. Complete custom systems available. Call today for more information on how to make your portable equipment more efficient and profitable!



milwaukee
Cylinder
a versatek company

Beaver Dam, WI 53916

800-334-4712

