GUIDANCE FOR CONSTRUCTION & DEMOLITION DEBRIS RECYCLERS ON THE ENVIRONMENTAL IMPACTS OF ASPHALT PRODUCTS

CDRA Mission:

Provide positive support and representation to the industry and CDRA members in legislative and rule-making venues that impact the recycling business.

Act as an advocate to promote C&D recycling and the recycle business in every manner possible that benefits CDRA members.

Facilitate and sponsor CDRA member interaction between the membership companies and further facilitate interaction between the membership and the many specialized services that can potentially benefit the membership such as equipment, financing, insurance and other specialized third party resources.

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Construction and demolition debris (C&D) represents one of the largest components of the solid waste stream in the United States (US). A previous CDRA study published in 2017 estimated that the US generated 583 million tons of C&D, where the majority of the material consisted of bulk aggregate in the form of portland cement concrete (PCC) (342 million tons) and asphalt concrete (76.5 million tons) (Townsend). A large majority of the generated PCC and asphalt concrete were recycled (85% and 99% recycling rate, respectively). Whereas, mixed C&D debris comprised of the remaining 164 million tons generated and was recycled at 38%. Mixed C&D debris include: wood, asphalt shingles, drywall, metals, concrete, bricks, reclaimed asphalt pavement (RAP), C&D fines, cardboard, glass, organics, plastic, and carpet.

The beneficial reuse of asphalt products is a suitable pathway allowing C&D recyclers to generate revenue and jobs while practicing environmental stewardship. Some asphalt products, most notably asphalt pavement, are recycled in large quantities. However, because asphalt is derived from petroleum, it is sometimes thought to contain toxic organic chemicals, namely polycyclic aromatic hydrocarbons (PAHs), this may limit reuse and recycling options. The environmental issues of concern are related to asbestos, leaching to water, and direct exposure.

The CDRA created a guidance document for C&D recyclers on the environmental impacts of asphalt products. The objective of this document is to provide CDRA members with a strong understanding of the types of asphalt products encountered in C&D, how they are typically managed (including recycling) and identify the environmental issues that affect recyclability and markets. The CDRA contracted with the University of Florida to conduct research on the impact of asphalt particles on PAHs concentration in C&D Fines. The objective of this research was to provide CDRA members with information on the PAHs they can expect in their asphalt containing C&D fines and the bioaccessibility fraction of C&D fines. Typically, risk thresholds are calculated using a 100% bioaccessible fraction, meaning if 50% was used instead then the risk threshold would be higher for PAHs. The materials could be used in a wider range of beneficial use applications without exceeding risk thresholds calculated based on chemical bioavailability. The results of this study can aide recyclers seeking regulatory approval for C&D fines recycling as well as aide the industry in developing solutions to better produce, market, and distribute this commodity in a safe and economic fashion.

### C&D Fines

C&D recycling facilities vary greatly in terms of processing assemblies and their definition of fines, impacting the quantity and properties of fines and whether fines are generated or not. The materials found within C&D fines have varying size fractions and characteristics, such as a fine and coarse aggregate fraction with both containing floatable material. These size fractions can be sorted and processed to effectively reuse fines, limiting the amount of material that needs to be disposed at a landfill.

<table>
<thead>
<tr>
<th>Asphalt Product</th>
<th>Description</th>
<th>Lifecycle Use</th>
<th>End-of-Life Management</th>
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<td>C&amp;D Fines</td>
<td>Typically, soil and fine aggregates comprise the majority of the material mass found in C&amp;D fines.</td>
<td>Small amounts of other C&amp;D components such as wood, gypsum and asphalt shingles may also be encountered depending on the source of the material and the processing method.</td>
<td>A very common reuse market for C&amp;D fines is alternative daily cover (ADC) at landfill sites. When the components of C&amp;D fines are dominated by soil and small pieces of rock, brick and concrete, another potential reuse market is clean fill material.</td>
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Markets

Hot Mix Asphalt Pavement

Millings from asphalt roads and asphalt shingles are heavily recycled into new HMA pavement. Asphalt roofing products typically contain 19-36% asphalt by weight and are utilized as a binder and as an aggregate in HMA production. Because of its adhesive characteristics, flexibility, and ability to form strong cohesive mixtures with mineral aggregates, RAP is widely used in the HMA industry for producing paving materials.

Fuel

Since asphalt has an energy value of approximately 20,000 BTU/lb, asphalt products can be used as a fuel supplement. The recovery of the BTU value of waste shingles is an established market in Europe, while the concept has only recently been applied in the US.

Other Markets

The use of recycled asphalt products as cold patch is a practice that has been employed extensively in some regions of the US. Cold patch generally consists of asphalt, aggregate, and a solvent to create and emulsion for the matching mix used to fill potholes and patch roads. The mixture leads to several improvements in these rural roads, including minimizing dust, reducing vehicle noise, and requiring less road maintenance.

Research is being conducted to use recycled asphalt shingles to make new roofing shingles. Members of the Asphalt Roofing Manufacturers Association (ARMA) conducted factory-scale tests to evaluate the performance of equipment used for recycling asphalt shingles into new shingles.

Environmental Concerns

Asphalt products made from petroleum products that can be a source of environmental pollutants, affecting humans and ecological systems. A general description of the three primary environmental concerns related to asphalt products are discussed in Table 1. Direct exposure risks are measured as the amount of substances at the point of contact (direct indigestion, dermal contact, or inhalation of materials). The risk of chemicals transferring from a material to water is measured by a procedure that simulates leaching conditions.

Table 1. Description of the three major environmental concerns regarding asphalt products.

<table>
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<th>Environmental Concern</th>
<th>General Description</th>
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<td>Asbestos</td>
<td>In the demolition of older buildings, asbestos may be found because it was used with asphalt shingles or other asphalt based roofing materials. However, it is a minimal concern as the use of asbestos has significantly decreased over time. In a 2017 CDRA study, only one sample out of 14 was reported to contain any asbestos with the overall asbestos content being less than 1% for that sample.</td>
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<td>Leaching</td>
<td>When RAP or shingles are stored or used in an encapsulated form (e.g., fill material), chemicals leaching from contact with water could be a concern. However, studies on asphalt product leachate has generally shown concentrations below RSLs for heavy metals and PAHs.</td>
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<td>Direct Exposure</td>
<td>The presence of some chemicals associated with asphalt products might be sufficiently elevated to raise concerns with respect to reuse where direct exposure is an issue. The three main contaminants restricting reuse are arsenic, lead, and PAHs. However, maximum allowable concentrations vary by state and regulatory agencies should be consulted prior to reusing a material.</td>
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The CDRA contracted with the University of Florida to conduct research with two main objectives: identify the impact of asphalt products on PAHs concentrations and determine the bioaccessibility fraction of PAHs in asphalt and C&D fines. Asphalt products analyzed to determine their individual concentrations of PAHs, these included: new asphalt shingles, aged asphalt shingles, new asphalt pavement, RAPs, and Bitumen. Additionally, the relationship between PAHs and asphalt content was further measured by mixing clean soil with various quantities of asphalt products (e.g. 1% and 10% by mass). The total extractable PAHs concentrations for the pure asphalt products were analyzed to determine their individual concentrations. The BaP-equivalent PAHs exceeded Florida, Ohio, and EPA RSLs in new asphalt pavement and RAP, however the concentration in the new asphalt pavement was below Texas risk thresholds. In the 1% and 10% mix ratio, the BaP-equivalent PAHs in RAP exceeded EPA RSLs, however, the concentration was lower in the 1% asphalt product mix. Compared to new shingles, the aged shingles tend to have lower concentrations for BaP-equivalent PAHs, revealing that weathering can reduce the amount of PAHs present. The results of the study indicate PAHs concentrations tend to decrease when reducing the percentage of asphalt. Some detections of low molecular weight PAHs might be due to the long term exposure of aged asphalt shingles to air pollutant deposition.

The bioaccessibility of PAHs concentrations in asphalt products and C&D fines was measured to evaluate the fraction of PAHs that could impact humans and ecological systems. This research determined the bioaccessibility fractions in C&D fines are lower than the assumed 100% typically used by regulatory agencies to develop risk thresholds. The average PAHs bioaccessibility percentages of the asphalt products used in the study were below 10% in all cases except the new asphalt shingles, which were between 20% and 40%. The low bioaccessibility indicates that asphalt products may have a very low health risk to the human body, meaning risk thresholds are over conservative in their bioaccessible fraction assumption with respect to PAHs in asphalt products. Furthermore, the results for 100%, 10% and 1% mix ratios for each sample showed the PAHs bioaccessibility was either decreasing or stayed approximately at the same level.

In addition to PAHs bioaccessibility of asphalt products, C&D fines from two facilities were analyzed. The bioaccessible fraction ranged from less than 10% to 40% in one sample and the second sample reached fractions as high as 80%. Newly made fines had more PAHs with a high molecular weight that exhibit a higher bioavailable fraction compared to older fines. But in terms of low molecular weight PAHs, most of the PAHs bioaccessibility were approximately the same for old and new fines. This might be due to the relatively more mobilized property of the low molecular weight PAHs compared with the high molecular weight PAHs. The results of the study show there is a correlation between asphalt product content and PAHs concentrations, but the associated risk is relatively low for most PAHs. C&D recyclers can measure the bioaccessibility of their fines to demonstrate a more appropriate bioavailable fraction to better represent the potential risk of reusing their material. This will lead to developing more markets for C&D fines and reducing the amount of material being disposed in a landfill.

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