Recycled Aggregates—Green Solutions, Smart Choices

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To understand concrete and asphalt recycling we must first go back to the beginning. Mining.

Sand and Gravel (Aggregate):

Sand and gravel comes from one of two sources: alluvial (rivers, streams lakes, ponds, etc.) or quarry (mountains). The type of rock that is encountered in these deposits is a discussion for another day because the rock varies in variety (quartz, granite, silicon, etc.) and hardness.

Sand and gravel are used in both concrete and asphalt.

Portland Cement:

Portland cement is mined and transported from many locations.

Oil:

Drilling for oil may also be considered a method of mining.

Concrete Production:

Concrete production uses two main sources of mined materials: Aggregate and Portland cement. Over the years there have been other chemicals added to aid in curing. For the purpose of this discussion we will address only the two above mentioned materials.

Add water to the aggregate and Portland cement, you have concrete.

Asphalt Production:

Asphalt production uses Aggregate along with liquid asphalt (oil). As with concrete there are other chemicals added to reduce stripping (oil not sticking to the sand and gravel) and produce a longer lifespan. Again, a discussion for another day.

Once the sand, gravel and oil are combined we add heat and have asphalt.

Note: CDOT has mandated the minimum and maximum temperatures allowed for asphalt. At the asphalt plant, the maximum temperature for the mix is between 275 and 300^{o} F.

Minimum delivered mix temperatures range between 235 and 280^{o} F. These temperatures vary based on asphalt grade.

How long does pavement last?

Roadway concrete is intended to last 30 to 50 years. The lifespan depends on subgrade, traffic and weather; all are of critical importance.

Roadway asphalt is intended to last 15 to 25 years. Once again, the actual lifespan depends on subgrade, weather and traffic.

We have now produced concrete and asphalt. What is next?

We Wait…

Sources of Concrete and Asphalt to Recycle

Roadway Concrete

Building Concrete:

Building concrete can last many years longer because it is not typically exposed to extreme weather or traffic. This concrete is protected by ground cover and structures above.

Reinforced Concrete Pipe (RCP):

RCP is very difficult to recycle because of the way it is constructed. Reinforcing wire is imbedded in the RCP and creates a nightmare once it is introduced to a crusher. The concrete is crushed but large pieces of the concrete remain attached to what becomes a big ball of wire.

Other Commercial & Residential Concrete:

Sidewalks, parking areas and other slabs are another source that are related to both roadway and building concrete.

Roadway Asphalt

Other Commercial & Residential Asphalt:

Once again, this type of asphalt is related to roadway asphalt in that it carries traffic. Most of the traffic, in this instance, is related to parking.

Now that we know from where asphalt & concrete come, we can look at how they are recycled.

Recycling Concrete and Asphalt

From Job Process:

Concrete or asphalt is demolished at jobsite.

Trucks are loaded.

Material is delivered to either a jobsite recycling location or to a third party for recycling.

Inspection upon Arrival at a Recycling Facility (Quality Control)

Inspection of incoming asphalt and concrete is critical to the quality of the recycled product. There are several reasons why some concrete & asphalt cannot be recycled:

1. Contamination from asbestos. Asbestos was used for many years as a waterproof coating on concrete.
2. Contamination from wood, steel or trash.
3. Styrofoam insulation. Styrofoam is sometimes used as an insulation for concrete.
4. Excessive steel in concrete. Light posts, caissons, pipes and excessive rebar in concrete.
5. Petromat. Thin asphalt slabs containing Petromat renders asphalt unrecyclable.
6. Commingled materials. Concrete and asphalt mixed together or containing an excessive amount of dirt (over 3%) renders them unrecyclable.

If any of the above exist the load is rejected.

Required Equipment

Both concrete and asphalt are hard materials. Due to this hardness, rock crushing equipment is required to recycle them.

The rock crushing equipment relates to: crushers, screens, conveyors, magnets, front end loaders and excavators.

Water trucks are used to help control dust on the internal roads.

Recycling Process (not typical of all recycling operations)

A pile is created from the dumped material.

A front end loader picks up the material from the pile and transports it to a rock crusher.

The crusher crushes the material to an 8” minus (less than the 8” size) then conveys the material to a scalper screen (used to separate larger material). This screen sizes to 3” minus.

If the conveyed material passes the above screen it is sent to a stockpile (finished product). If it does not pass it is sent to a second crusher.

Once discharged from the second crusher it is sent to a second screen.

If the material passes the second screen, it is conveyed to a stockpile (finished product).

If the material does not pass the second screen, it is sent to tertiary crusher (third crusher), then conveyed to a third screen.

If the material does not pass the third screen it is returned to the tertiary crusher. This process continues until all of the material passes the third screen.

The above process holds true for both concrete and asphalt. Concrete and asphalt are processed separately, not commingled.

During this process water sprays are used for dust suppression.

Markets

Typically, there are several sizes of concrete produced during the crushing and screening process. While asphalt can be produced in several sizes, it is typically produced in only one size (market requirements).

Markets for each produced recycled material have been developed over the years. Below are the uses for each material:

Concrete:

Aggregate base course (road base)

Retaining wall fill (inside the blocks in a wall)

Retaining wall backfill (around the wall, doesn't require compaction)

Landscaping (economic solution)

Trail construction (walking and hiking)

Erosion control

Soil stabilization

Slab underlayment

Sound wall construction

New concrete production

Asphalt:

New asphalt production

Economic parking solution (used instead of paving)

Trail construction (walking and hiking)

How Much Concrete and Asphalt are Available for Recycling?

According to the Environmental Protection Agency (EPA), ~465 million tons of concrete and asphalt debris are created each year, within the US.

The above is an interesting number because according to the United States Geological Survey (USGS), ~50 million tons of concrete and asphalt debris are recycled each year. This suggests that only ~11% of concrete and asphalt debris are recycled.

Asphalt is the most recycled Construction Debris (CD) waste in the world. It is believed that over 90% of all asphalt removed, including shingles, is recycled. Concrete is believed to have a 50 to 60% recycle percentage.

Considering the fact that the number one use for recycled concrete is road base and nearly all of the asphalt debris that is recycled goes into new asphalt or alternative parking solutions, there seems to be some discrepancy. Why?

The causes seem to lie within the data collection methods.

The USGS sends out a questionnaire each year asking what metals and materials (sand and gravel, recycled concrete, recycled asphalt) were produced. This is a “voluntary” survey.

The EPA collects data from so many different sources that analyses is next to impossible.

These entities are well intentioned and the people work tirelessly. However, in order to collect accurate data, **necessary to identify the true scope of the issue,** there needs to be a focused effort, including **mandatory** response to the questionnaire/survey.

Why Recycle Concrete and Asphalt?

1. Alluvial deposits in and around populated areas are being depleted.
    a. The further from the mountains the deposits are, the finer the material.
2. Permitting of new gravel pits and quarries has become difficult due to public objection (traffic and noise).
3. Reduction of fuel used to transport materials.
4. Landfill space.
5. Reduction of oil used in asphalt.
6. Economic gratification.

Economics

Economics are the prime reason most company enter into any business. Profit.

While recycling has another focus, the environment, economics are always in the forefront. If there is no profit, there is no recycling.

Concrete:

Recycled concrete can be produced at a lower cost than virgin aggregate for the following reasons:

1. No royalties paid to property owners.
2. Washing equipment not required.
3. Location of recycle plants (closer to job sites).
4. No reclamation costs.

Asphalt:

1. Reduction in the required amount of oil.
2. Reduction in the required amount of aggregate.

Efforts to reduce construction debris

The interest/effort you have put forth to reduce waste to zero is truly admirable; there will, however, always be a percentage that cannot be recycled for the reasons discussed.

Our goal (job) should be to reduce the amount of construction debris going into landfills to as low a percentage as possible.

Legislation that addresses the reduction of construction debris must focus on the impact to the economic constant we just discussed.

Accurate data on the quantity of debris and quantity being recycled, is necessary to draft effective legislation that enforces measures put in place, as well as, track progress.

Questions?