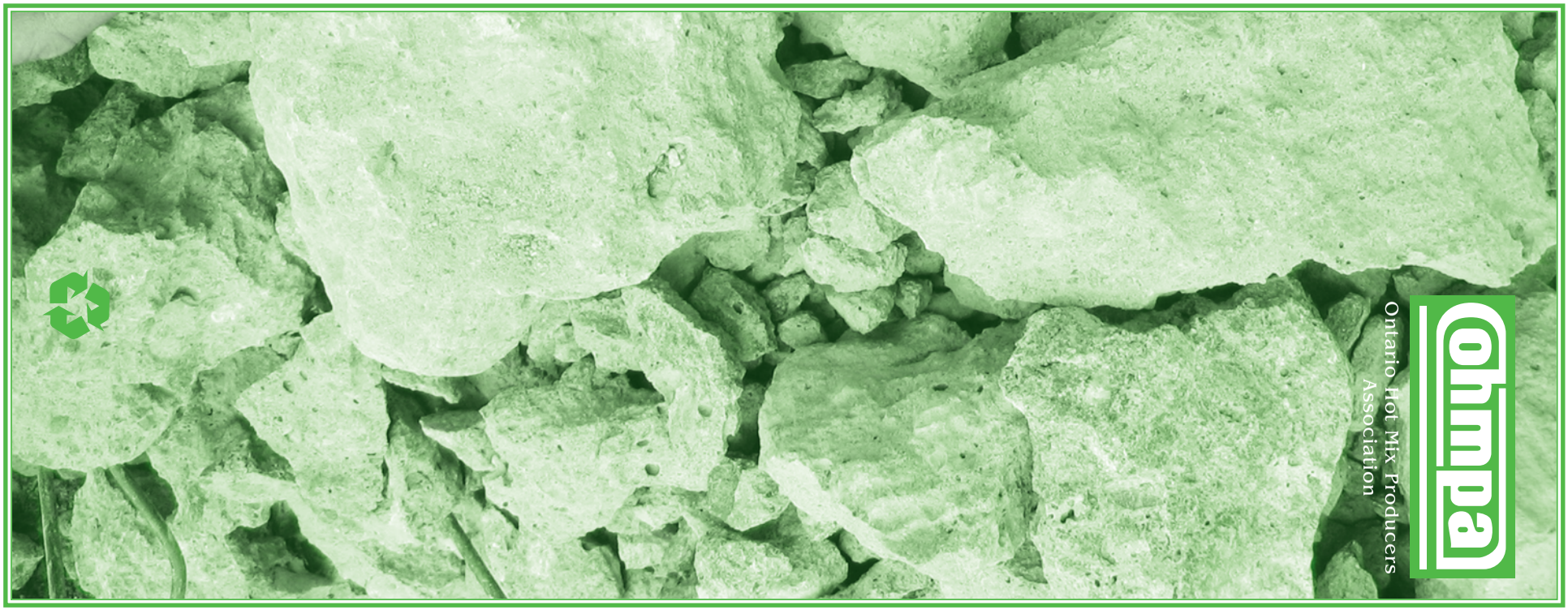
The ABCs of

RECYCLED AGGREGATE



Ontario Hot Mix Producers Association

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ABCs of Recycled Aggregates

Reusing and recycling aggregate:

- Preserves land – reduces the demand for virgin aggregates from pits and quarries
- Reduces energy consumption – it takes energy to produce virgin aggregate and even more energy to transport it to where it is needed. Recycling conserves energy and reduces greenhouse gases.
- Reduces waste – reusing aggregates reduces the amount of waste going to landfill.
- Reduces costs – in many cases, recycled aggregates cost less than virgin aggregates and transportation costs are reduced.

Where to Find Recycled Aggregates

The primary source of recycled aggregate is reclaimed concrete and asphalt.

Asphalt Pavement: Asphalt pavement is the most recycled material in North America. Nine out of ten tonnes of pavement removed during reconstruction is reused.

Asphalt pavement is recovered during the reconstruction of roads, parking lots, and runways.

The best way to recycle asphalt pavement is in new hot mix, which recycles both the aggregate and asphalt cement.

Crushed asphalt can also be used as an aggregate incorporated into granular base or sub-base up to a maximum of 30 percent. When used as an aggregate, the recovered asphalt is first crushed and screened and stored in stockpiles for future use. Crushed asphalt can also blended with crushed concrete up to a maximum of 30 percent.

Portland Cement Concrete: Portland cement concrete is recovered from the rehabilitation of bridges, sidewalks, roads and other structures. This material is then processed by crushing, removal of reinforced steel and screening.

Reclaimed concrete materials are typically processed and stockpiled as 19 mm and 50 mm crusher run aggregates and are used as an alternate to pit run or quarried granular materials such as Granular A and B. No special equipment or procedures are required for the material handling.

Crushed concrete replaces granular base, sub-base and backfull material from pits and quarries.

Recycled Aggregate Applications

Typical granular applications for recycled crushed concrete and asphalt aggregates include:

- 50 mm recycled aggregate as granular sub-base for pavements
- 19 mm recycled aggregate as granular base for pavements
- trench backfill material
- engineered fill
- stabilization of soft subgrades
- fill under concrete slab-on-grade
- pavement shoulders (MTO allows the use of up to 100% crushed asphalt)
- construction access roads, bicycle paths and trails, and rural driveways (100% crushed asphalt)

Using Recycled Aggregates in Ontario

Using recycled aggregates has gained widespread acceptance. Some of the agencies currently using recycled aggregates in road and pavement construction include:

- Ontario Hydro
- Town of Markham
- Town of Oakville
- Town of Richmond Hill
- Ontario's Ministry of Transportation
- City of Sudbury
- City of Brampton
- City of Toronto
- City of Hamilton
- City of Ottawa
- Region of York
- Regional Municipality of Hamilton Wentworth

Saving Costs and Improving the Environment

Using recycled aggregates reduces construction costs and improves the environment with no loss of quality or constructability.

- Reuses old construction materials
- Recycles materials into value added products
- Reduces emissions
- Reduces landfill materials
- Conserves energy
- Conserves natural resources
- Qualifies for LEED credits
- Saves costs
- Provides good drainage
- Readily compactable
- Ease of construction, especially In wet weather conditions
- Reduces haul distances and transportation time of both excavated & recycled materials

Using recycled aggregates materials saves costs and stretches construction dollars substantially. Not only do recycled aggregates cost less than virgin aggregates, but shorter haul lengths result in lower transportation costs as well.

Using recycled aggregates also helps improve the environment, extending oil and aggregate reserves, reducing fuel consumption in transportation and producing fewer emissions than the production virgin aggregates.

Most recycling depots are in or near urban centres close to construction projects, thus eliminating transportation of waste to distant landfills and eliminating long haul distances of virgin aggregates from remote pits and quarries. However, the space to stockpile large quantities of reclaimed aggregates in urban areas is often limited. Municipalities and other pavement owners are encouraged to use recycled aggregates in their construction projects, which in turn will help manage inventories at the recycling depot.

Gaining LEED Credits

The Leadership in Energy and Environmental Design Green Building Rating System™ encourages sustainable green building and development practices.

Road builders and developers can gain LEED credits by using recycled aggregates.

MR Credit 2.1 (Construction Waste Management: Divert 50% from Disposal) provides 1 credit if in the removal of asphalt pavement or concrete the entire quantity of the materials can be redirected to the manufacturing process and if this results along with other diversion activities in 50% of the total waste for the project being diverted. MR Credit 2.2.provides an additional credit if 75% of the total site waste is diverted.

MR Credit 4.1 (Recycled Content 10%) provides 1 credit if 10% of the project material comes from post consumer waste. Both recycled concrete and reclaimed asphalt pavement count as post consumer waste.

MR Credit 5.1 (Regional Materials: 10% Extracted, Processed and Manufactured Locally) provides credit for local materials. Virtually all recycled aggregates will meet the criteria of local materials. Under MR Credit 5.2, an additional credit is available if the total can be increased to 20%.

Recycled Aggregate Quality

Recycled aggregates materials meet the Ontario Provincial Standard Specifications for aggregate gradation and physical properties.

In terms of quality and performance, recycled aggregates are equivalent to natural aggregates. The physical properties of recycled aggregates are similar to crushed limestone and they are considered structurally equivalent to crushed limestone when used as a pavement base or subbase.

Recycled aggregates have less dust (defined as material passing 75 µm) than crushed limestone. With typically 2 to 3 percent less fines, recycled aggregates are easy to work with and readily compactable and are especially effective in wet weather conditions. Recycled aggregates also provide better subsurface drainage because of their higher coefficient of permeability.

Because recycled aggregates are 100 percent crushed, they are easier to work and much more compactable than pit run granular materials, which lack angularity.

Recycled Aggregate Environmental Properties

Recycled aggregates do not pose any significant environmental risks:

- meet all applicable leachate quality criteria (under O Reg 558-TCLP Metals & Inorganics) and do not exhibit any leaching problems
- do not contain toxic materials
- are considered environmentally safe.

Most recycled aggregates are processed at local aggregate supply yards or hot mix asphalt production facilities. The personnel on site are trained and experienced in the handling of these materials and all processing is carried out under a Certificate of Approval, ensuring that environmental requirements, including air emissions and noise restrictions, are met.

Specifications

The Ontario Provincial Standard Specifications (jointly owned and administered by the Ministry of Transportation, Ontario and the Municipal Engineers Association) set the standards for road construction in Ontario.

OPSS 1010, the specification governing aggregates, allows for 100 percent of the material to be composed of crushed recycled concrete. These materials may also contain up to 30 percent by mass of reclaimed asphalt concrete. The current specification was issued in April 2004.

1010.05.02 Granular A, Granular M, and Granular S

Granular A, Granular M, and Granular S may be produced by crushing one or more of the following:

a) Quarried bedrock;
b) Naturally formed deposits of sand, gravel, and cobbles;
c) RAP (Reclaimed Asphalt Pavement) up to 30% by mass;
d) RCM (Reclaimed Concrete Material);
e) Air-cooled blast-furnace slag or nickel slag; and
f) Glass or ceramic materials up to 15% by mass combined.

Granular A and Granular M may contain up to 100% RCM but shall not contain more than 30% by mass of asphalt coated particles and not more than a combined total of 15% by mass of glass and ceramic material. The combined amount of deleterious material shall not exceed a total of 1% by mass.

Granular A and Granular M containing RAP with steel slag aggregates shall be acceptable for unpaved gravel shoulders only.

1010.05.03 Granular B

1010.05.03.01 General

Granular B may be either Type I or Type II as described below.

1010.05.03.02 Granular B Type I

Granular B Type I may be produced from naturally formed deposits of sand, gravel, and cobbles or by crushing one or more of the following:

a) Quarried bedrock.
b) Air-cooled blast-furnace slag or nickel slag.
c) RCM.
d) RAP up to 30% by mass.
e) Glass or ceramic materials up to 15% by mass combined.

Granular B Type I may contain up to 100% RCM but shall not contain more than 30% by mass of asphalt coated particles. Granular B Type I may not contain more than a combined total of 15% by mass of glass and ceramic material. The combined amount of deleterious material shall not exceed 1% by mass.

RAP containing steel slag aggregates shall not be allowed.

1010.05.03.03 Granular B Type II

Granular B Type II shall only be obtained from crushing quarried bedrock, air-cooled blast furnace slag, or nickel slag. Steel slag and reclaimed materials shall not be used in the production of Granular B Type II.

Additional Information

To download additional copies of The ABCs of Recycled Aggregates and for more detailed information including gradation specifications and chemical test results, go to www.ohmpa.org. The ABC series is available under Training Resources / OHMPA Publications.

Additional information on aggregates is available at the Ontario Stone, Sand & Gravel Association's website:
www.ontariossga.com

OPSS 1010 PHYSICAL PROPERTY REQUIREMENTS

PHYSICAL PROPERTY REQUIREMENTS

LABORATORY TEST	MTO TEST NUMBER	GRANULAR A	GRANULAR S	GRANULAR B TYPE I AND TYPE II	GRANULAR M
Coarse Aggregate Petrographic Requirement	LS-609	(Note 1) (Note 2)	(Note 2)	(Note 1) (Note 2)	(Note 1) (Note 2)
Freeze-Thaw Loss, % maximum	LS-614	N/A	N/A	N/A	N/A
Fine Aggregate Petrographic Requirement	LS-616 LS-709	Refer to Note 3			
Micro-Deval Abrasion Coarse Aggregate loss, % maximum	LS-618	25	25	30 (Note 4)	25
Micro-Deval Abrasion Fine Aggregate loss, % maximum	LS-619	30	30	35	30
Plasticity Index	LS-704	0	0	0	0
Percent crushed, minimum	LS-607	50	50	N/A	50
2 or more crushed faces, % minimum	LS-617	N/A	N/A	N/A	N/A
Asphalt Coated Particles, % maximum	LS-621	30	30	(Note 5)	30

Notes:

1. Granular A, B Type I, or M may contain up to 15% by mass of crushed glass and ceramic material combined.
2. Granular A, B Type I, M, and S shall not contain more than 1% by mass of deleterious material. Granular O, Granular B Type II, and SSM shall not contain more than 0.1% by mass of wood. Petrographic classification of rock type need not be reported. This requirement is only to be reported when such material is present.
3. Test required for materials north of the French and Mattawa Rivers only. For materials with greater than 5.0% passing the 75 µm sieve, the amount of mica passing the 150 µm sieve and retained on the 75 µm sieve, shall not exceed 10% of the material in that sieve fraction unless either testing according to LS-709 determines permeability values to be greater than 1.0×10^{-4} cm/s or field experience shows satisfactory performance. Prior data demonstrating compliance with this requirement will be acceptable provided such testing has been done within the past five years and that field performance of these materials has been satisfactory.
4. The coarse aggregate Micro-Deval abrasion loss test requirements will be waived if the material has more than 80% passing the 4.75 mm sieve.
5. Granular B Type I may contain up to 30% asphalt coated particles. Granular B Type II shall not contain RAP or asphalt coated products.

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