

CSA A23.1:2024 provides definitions of recycled concrete materials in the context of their reuse as recycled aggregates in concrete. The material definitions are:

Reclaimed concrete material (RCM)

Concrete material made from end-of-life concrete with minimal tolerable contamination from non-concrete materials obtained from the demolition of built concrete elements. (CSA A23.1:2024 Clause 3).

Examples of RCM: sidewalks, concrete pavements, concrete infrastructure, and concrete from buildings not contaminated by foreign materials.

RCM is subcategorized into two types:

- **RCM Type 1** — where a single source of concrete (such as a section of concrete pavement) is utilized in the production of RCM and for which there is an expectation of greater consistency; and
- **RCM Type 2** — where multiple sources of concrete are processed together at a single production site to produce RCM.

Note: RCM does not include construction and demolition waste containing foreign materials.



RCM

Returned hardened concrete (RHC)

Concrete material made from unused plastic concrete from known sources that has been returned directly to the concrete plant or obtained from in-plant concrete waste streams, which is allowed to harden and then processed by crushing. (CSA A23.1:2024 Clause 3). RHC is subcategorized into two types:

- **RHC Type 1** — where the RHC is from a single source and known to have been produced from non-reactive aggregates; and
- **RHC Type 2** — where the RHC is from multiple sources or is known to have been produced with reactive aggregate utilizing mitigation measures



RHC

Mix Design Considerations when using Recycled Concrete Aggregates

CSA A23.1:24 Clause 4.2.3.4 provides requirements for RCA being used as partial replacement of normal-density coarse aggregates in concrete, as follows:

- **Types of Aggregate:** Normal-density coarse aggregate shall consist of crushed stone, gravel, air-cooled iron blast-furnace slag, returned hardened concrete (RHC), reclaimed concrete material (RCM), or a combination of these materials conforming to the requirements of CSA A23.1.
- **Maximum allowance in blended aggregates:** A maximum of 30% RHC or RCM is allowed for use in a blended aggregate, unless otherwise directed by the owner.
- **Disclosure requirement:** Where RHC or RCM is used as a component of the aggregate, the concrete producer shall declare the type used and the maximum percentage used.
- **Limitations of Class of Exposure applications:** Concrete containing RCM type 2 is limited to use in exposure classes C-4, F-2, N, A-4, R-1, R-2 and R-3. Concrete containing RHC and RCM Type 1 have no limitations on exposure class classification.



RCA promotes circular economy principles in construction.

Additional Testing for Recycled Concrete Aggregates

When using RCA in concrete, CSA outlines additional testing that must be done, including:

- Where RHC or RCM is to be used in a blend with virgin aggregates, the virgin aggregates shall meet the requirements of **CSA A23.1 Table 12 (attached)** prior to the blending with RHC or RCM.
 - RHC or RCM shall meet the additional requirements of Table 12 and A23.2-27A for their use prior to blending with virgin aggregates for use in concrete.
 - When multiple sources of coarse or fine aggregates are blended, the owner shall specify whether:
 - Each individual source of the blend shall individually meet the deleterious limits and physical requirements of CSA A23.1;
 - The blended aggregate shall, in the combined blended proportions, meet the deleterious limits and physical requirements of CSA A23.1;
 - In addition, Recycled Concrete Aggregates must comply with the requirements outlined in **CSA A23.2-30A Table 2 (attached)** prior to their use in concrete.
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CSA A23.2-30A Table 2
Additional testing required for RHC and RCM aggregates prior to blending with
virgin aggregate in addition to testing required in Table 1
(See Clause 8.5.2)

Property	Test required	Test frequency [†]	Test validity	Coarse aggregate	Fine aggregate	Time required to conduct the test
Petrographic examination for deleterious materials in Table 12	A23.2-15A	One per month	*	Table 12	N/A	One day
Micro-Deval abrasion	A23.2-29A	Every two weeks	*	Table 12	N/A	One day
Sulphate content (SO ₄)	A23.2-3B	One per month	*	Table 12	N/A	One week
Water soluble chloride	A23.2-4B	One per month	*	Table 12	N/A	One week

**For aggregates composed of RHC Type 1 or RCM Type 1, the validity period shall be 6 months. For RHC Type 2 or RCM Type 2, the validity period shall be 3 months.*

[†]For low-volume production sites (less than 5,000 tonnes/year) or sites which operate periodically for a limited duration (less than one month), a minimum of 5 tests for each of CSA A23.2-15A, CSA A23.2-29A, CSA A23.2-38, and CSA A23.2-48 shall be performed each calendar year. Tests shall be performed at appropriate intervals to represent the entire production period or each production lot, respectively.

Source: Table 2, CSA A23.1-30A, CSA A23.1:24/CSA A23.2:24, Concrete materials and methods of concrete construction/Test Methods and Standard Practices for concrete. © 2024 Canadian Standards Association. Please visit store.csagroup.org

Table 12
Limits for deleterious substances and physical properties of aggregates

(See Clauses 4.1.1.1.6, 4.2.3.2.2, 4.2.3.4.3, 4.2.3.5.1, 4.2.3.5.3.2, 4.2.3.7, 0.1.2, 0.2, 0.3.2 and 0.3.3.)

CSA test method	Property	Maximum percentage by mass of total sample		
		Fine aggregate	Coarse aggregate	
			Concrete exposed to freezing and thawing	Other exposure conditions
	Standard Requirements			
A23.2-3A	Clay lumps ^{b,j}	1.0	0.3	0.5
A23.2-4A	Low-density granular materials ^{c,i}	0.5	0.5	1
A23.2-5A	Material finer than 80 µm	3.0 ^d	1.0 ^e	1.0 ^e
A23.2-13A	Flat and elongated particles Procedure A, ratio 4:1; or Procedure B	--	20	20
	Flat particles	--	25	25
	Elongated particles	--	45	45
	Elongated particles (for pavements and high-performance concrete)	--	40	40
A23.2-23A A23.2-29A	Micro-Deval test ^f	20	17	21
A23.2-24A	Unconfined freeze-thaw test ^g	--	6	10
A23.2-16A A23.2-17A	Impact and abrasion loss ^h	--	50	50
	Alternative requirements			
A23.2-9A	MgSO ₄ soundness loss	16	12	18
	Additional requirements for recycled concrete aggregates (RCM and RHC) ^k			
A23.2-15A	Petrographic examination total deleterious materials		1.0	1.0
	Ceramic tile, bathroom porcelain, glass, wood, and paper		0.0	0.0
	Plaster, gypsum, and gypsum board		0.0	0.0
A23.2-3B ^l	Sulphate content (SO ₄), %		0.4	0.4
A23.2-4B ^m	Water soluble chloride, %		0.05	0.05
A23.2-29A	Micro-Deval abrasion, loss %		21	21

^a Limits for deleterious substances not listed in this table, such as coal, ochre (ironstone), shalestone, siltstone, or argillaceous limestone, shall be specified by the owner to encompass deleterious materials known to be present in

(Continued)

Table 12 (Continued)

a particular region. In the absence of such information, aggregate shall be accepted or rejected in accordance with Clause 4.2.3.10.

^b Clay lumps are defined as fine-grained, consolidated, sedimentary materials of a hydrous aluminosilicate nature.

^c A liquid with a relative density of 2.0 is generally used to separate particles classified as coal or lignite. Liquids with relative densities higher or lower than 2.0 might be required to identify other deleterious low-density materials.

^d This limit shall be 5% if the clay size material (finer than 2 µm) does not exceed 1% of the total fine aggregate sample. The amount of material of clay size shall be determined by performing a hydrometer analysis in accordance with ASTM D7928 on a sample washed through an 80 µm sieve.

^e In the case of crushed aggregate, if material finer than the 80 µm sieve consists of the dust of fracture, essentially free from clay or shale, the maximum shall be 2.0%.

^f CSA A23.2-23A, a test for fine aggregate, is rapid, has excellent precision, and has a significant correlation with the MgSO₄ soundness test. For more information, see Rogers et al. (1991).

^g CSA A23.2-24A, a test for coarse aggregate, has good precision and shows fair correlation with the MgSO₄ soundness test. For further information, see Rogers et al. (1989).

^h The abrasion loss shall not be greater than 35% when the aggregate is used in concrete paving or for other concrete surfaces subjected to significant wear. This does not refer to air-cooled iron blast-furnace slag coarse aggregate. The abrasion loss requirements for coarse aggregate shall be waived provided that the material meets the alternative requirements for Micro-Deval detailed in this table.

ⁱ The Micro-Deval test requirements for fine aggregate or the freeze-thaw requirements for coarse aggregate shall be waived provided that the material meets the alternative requirements for MgSO₄ soundness loss detailed in this table. For aggregates containing returned hardened concrete (RHC) or reclaimed concrete material (RCM), the MgSO₄ soundness loss test {CSA A23.2-9A} and the unconfined freeze-thaw test {CSA A23.2-24A} are inappropriate and the tests shall not apply.

^j If the coarse aggregate when tested in accordance with CSA A23.2-15A does not show the presence of either clay lumps or low-density granular materials, the requirements for testing in accordance with 3A and 4A may be waived.

^k With the exception of Micro-Deval abrasion loss that applies to all RHC or RCM use, other limits apply to RHC aggregates used above 10% by mass or RCM aggregates when tested prior to blending with virgin aggregates.

^l Requirement to test applies to RCM aggregates when used above 10% by mass.

^m Requirement to test for chloride applies to RCM intended for use in concrete containing steel reinforcement and to RHC known to have been made with chloride-bearing admixtures.

Notes:

1. See CSA A23.2-30A, Clause 10.2 for D-cracking.
2. For certain aggregates, such as limestone and dolomites from the St. Lawrence Lowlands in the province of Quebec, the unconfined freeze-thaw limit of 9 instead of 6 has been found to be satisfactory for exposure classifications F-1, F-2, C-XL, A-XL C-1, and C-2 and the limit of 13 instead of 10 for other exposure conditions (see Clause 10.3 of CSA A23.2-30A).
3. For aggregates, such as limestone and dolomites from the St. Lawrence Lowlands in the province of Quebec, the Micro-Deval limit of 19 instead of 17 has been found satisfactory for exposure classifications F-1, F-2, C-XL, A-XL, C-1, and C-2 (see Clause 10.3 of CSA A23.2-30A). These higher limits will be accepted only if the aggregate producers can demonstrate that the annual production shows less than 2.0% of poor and deleterious material, as determined by CSA A23.2-15A.
4. For Notes 2 and 3, see reports by Beaulieu (2016), Gagne (2017), Santerre (2017), and Fournier et al. (2021) for information on the St. Lawrence Lowlands limestones and dolomites.
5. The owner shall specify Procedure A or Procedure B for determination of particle shape of coarse aggregate.
6. If the Micro-Deval limits in this table for fine aggregate are met, then the tests for clay lumps and low-density granular materials may be waived.

Source: Table 12, CSA A23.1:24/CSA A23.2:24, Concrete materials and methods of concrete construction/Test Methods and Standard Practices for concrete. © 2024 Canadian Standards Association. Please visit store.csagroup.org

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