

Virgin aggregates are newly extracted materials, such as sand, rock, stone, and gravel, that are used as building supplies for different projects. Virgin materials can be bought from a local mine, but many extraction companies also ship them to specified project sites.

Recycled aggregates are produced by crushing concrete, and sometimes asphalt. After the removal of contaminants through a process of screening, air separation and size reduction, the crushed aggregate can then be used for a variety of purposes including for pavements, curbing, and bridge foundations. Using this process of recycling the aggregate reduces the need for 'virgin aggregate'. This in turn detracts from the impact of the aggregate extraction operation.

Environmental, Health and Safety Concerns

- While there are clear reasons as to why recycled aggregates are becoming increasingly popular, there are also associated environmental and health safety risks.
- Standard building materials like concrete and steel are significant contributors to the building industry's sizeable environmental impact
- Gravel extraction requires a great deal of resources and can be massively harmful to the environment.
- Demolition waste can contain high concentrations of heavy metals including arsenic, boron, cadmium, chromium, nickel, cobalt, lead, manganese, mercury, molybdenum, selenium, thallium and vanadium.
- Because recycled aggregate from demolition is mixed, it is difficult to know its composition and thus the hazards involved in each case.
- Additionally, storing and processing demolition waste for recycling into aggregate involves a high risk of releasing heavy metals, fly ash, oil products, fibre content, spills, asbestos, paint and coatings, biological content, and more. Therefore, these facilities should not be in open air, nor in proximity to ground or surface water.
- Minimizing the environmental impact, energy and CO2 intensity of concrete used for construction is increasingly important as resources are declining and the impact of greenhouse emissions becoming more evident.

Alternative Options

Agro-waste

- *Created by either crushing agro-waste materials into fine and coarse aggregates or burning them into ash, and then combining them with cement.*
- *Materials commonly used include sugar cane bagasse, rice husk, sugar cane straw, palm oil fuel, sawdust, and corn and tobacco waste.*
- *This organic and sustainable method also reduces landfill, burying and dumping issues.*
- *Research on the utilization of agro-waste as an aggregate substitution is generally new and more research is needed, however agro-waste has already proven that the addition of wastes is not only advantageous to the environment, but also brings about a great performance of concrete properties.*

Hempcrete

- *A product made by combining hemp hurd, lime binder and water to create a mixture that is used in walls, roofs, and floors of buildings as a type of bonded cellulose insulation.*
- *A lightweight, vapour-permeable material that is hygroscopic, fire resistant, pest resistant, and made entirely from natural materials.*
- *Weighs approximately 1/7 of concrete and has typical strength of 45 Psi (1 MPa).*
- *Provides extraordinary thermal performance, which continues to help the environment by reducing the fuel used for heating and cooling during the lifetime of the building.*
- *Cost is higher than concrete but with long term energy savings.*
- *This material can be considered the ideal alternative to traditional building materials.*

Mycelium

- *Mycelium is 100% organic, compostable and biodegradable fungi material with industrial-level strength.*
- *It is also non-toxic, insulating, and becomes incredibly durable and resistant to water, mold, and fire when dry.*
- *It grows incredibly quickly and actually binds to the substrate that it is combined with, meaning that you can grow it to shape (similar to the way in which concrete may be cast to shape).*
- *What sets mycelium apart from other materials is its ability to regenerate at a quick rate.*
- *There is just one disadvantage to mycelium as a construction material: it cannot carry much weight. However, buildings require many parts that don't have to carry much weight, which is where mycelium can be most useful.*

Alternative Options

Ferrock

- *Ferrock is created from waste steel dust and silica from ground up glass. The iron within the steel dust then reacts with CO₂ and rusts to form iron carbonate.*
- *Iron carbonate is fused into the matrix of Ferrock and, like concrete, after it's dried, it retains its hard, rock-like qualities.*
- *The iron carbonate binds carbon dioxide from the atmosphere into the Ferrock.*
- *Ferrock is 5 times stronger than concrete, it can withstand more compression before breaking and is far more flexible than concrete.*
- *It is unique because it becomes even stronger in salt water environments, making it ideal for marine-based construction projects.*
- *Ferrock is typically cheaper than concrete as it is sourced from waste materials.*

Timbercrete

- *Timbercrete is a blend of sawmill waste, cement, sand, binders and a non-toxic deflocculating additive, which is cured using the sun and wind into a unique building block.*
- *It's then converted into bricks, blocks, panels and pavers that are used for residential, industrial and commercial building projects as well as landscaping design.*
- *It is about 2.5 times lighter than concrete, more cost effective, and completely safe, non-toxic, and fireproof.*
- *Compared to concrete products, it has an improved insulation value and thermal mass, meaning that it will store thermal energy more efficiently and release it more slowly.*
- *It also has a semi-flexible quality that improves its engineering diversity and application, and can be nailed or screwed just like timber.*

Gjenge Makers

- *This company produces lightweight and low-cost bricks that are made of recycled plastic with sand and that are 5-7 times stronger than concrete material.*
- *The fibrous structure of the plastic makes it not only more lightweight but also less brittle than concrete.*
- *The building material has a melting point higher than 350°C and can be used for both residential and commercial construction.*
- *Gjenge bricks are also one of the more affordable options on the market, as they cost approximately \$7.70 per square meter (as opposed to \$98 per square yard for concrete produced in the U.S.)*
- *Currently, the company (located in Nairobi, Kenya) produces approximately 1,500 bricks per day.*

Links:

- <https://buildabroad.org/2016/09/27/ferrock/>
- <https://buildabroad.org/2016/10/04/timbercrete/>
- <https://www.biobasedpress.eu/2020/04/mycelium-as-a-construction-material/>
- <https://www.certifiedenergy.com.au/emerging-materials/emerging-materials-ferrock>
- <https://www.greenbiz.com/article/one-farms-trash-construction-sites-treasure>
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- <https://worldarchitecture.org/article-links/egmeg/kenyan-startup-founder-nzambi-matee-recycles-plastic-to-make-bricks-that-are-stronger-than-concrete.html>
- <https://www.buildwithrise.com/stories/mycelium-fungi-as-a-building-material>
- <https://www.cbc.ca/radio/spark/why-fungi-could-be-the-future-of-environmentally-sustainable-building-materials-1.5479660#:~:text=What%20about%20mycelium%20makes%20it,that%20you%20combine%20with%20it.>
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- <https://www.enviromate.co.uk/blog/eleven-green-building-materials-way-better-concrete>
- <https://www.mdpi.com/2071-1050/12/17/6971/pdf>
- https://www.researchgate.net/publication/292981939_A_Review_on_Recycled_Aggregates_for_the_Construction_Industry
- <https://www.ukhempcrete.com/wp-content/uploads/2016/11/Hempcrete-FAQs-UK-Hempcrete.pdf>
- <https://www.wise-geek.com/what-are-the-different-types-of-recycled-aggregate.htm>