Environmental Product Declaration

Austrian Arabian Ready Mix

EPD for concrete produced at Austrian Arabian Ready Mix Jebel Ali Batching Facilities located in Dubai, United Arab Emirates
# Environmental Product Declaration of Ready Mixed Concrete

**Austrian Arabian Ready Mix**  
Jebel Ali Batching Facilities

## NRMCA Certified Environmental Product Declaration

This environmental product declaration was conducted in accordance with ISO 14025:2006

<table>
<thead>
<tr>
<th>Internal Verification</th>
<th>External Verification</th>
<th>X</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Declared Product:</th>
<th>This Environmental Product Declaration (EPD) covers concrete mixes produced by Austrian Arabian Ready Mix</th>
</tr>
</thead>
</table>

| Declaration Owner: | Austrian Arabian Ready Mix  
Jebel Ali Industrial Area 2  
261187  
UAE Dubai  
Phone number: +971 4 8803223, +971 4 8802327 |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------|

| Concrete Consultant: | Grey Matters Consultancy  
P.O. Box: 283079  
Dubai Investment Park  
Dubai - UAE  
Tel: +971 4 8849525  
Fax: +971 4 8849524  
http://www.greymatters.ws/ |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------|

| Program Operator: | National Ready Mix Concrete Association  
900 Spring St. Silver Spring, MD 20910  
301-587-1400  
www.nrmca.org/sustainability |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------|

| LCA and EPD Developer: | Athena Sustainable Materials Institute  
119 Ross Ave. #100 Ottawa, ON K1Y 0N6  
613-729-9996  
www.athenasmi.org |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------|

| Product Category Rule: | The Carbon Leadership Forum PCR: Product Category Rules (PCR) for ISO 14025 Type III Environmental Product Declarations (EPDs) for Concrete Version 1.1 dated December 4, 2013, Serves as the PCR for this EPD.  
www.carbonleadershipforum.org. |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------|

<table>
<thead>
<tr>
<th>PCR review was conducted by:</th>
<th>Nicholas Santero, PE International; Holly Lahd, EL Analytics and Medgar Marceau, Morrison Hershfield; December 4, 2013</th>
</tr>
</thead>
</table>

| Independent LCA Reviewer and EPD Verifier: | This EPD was independently verified by NSF International in accordance with ISO 14025 and ISO 21930. The life cycle assessment was independently reviewed in accordance ISO 14044 and the referenced PCR.  
Independent verification of the declaration, according to ISO 14025: 2006  
☐ Internal  
☐ External  
Third Party Verifier  
Paula Bernstein, Long Trail Sustainability |
|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|

<table>
<thead>
<tr>
<th>Date of Issue:</th>
<th>October 25, 2018</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Period of Validity:</th>
<th>October 25, 2023</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>EPD Number:</th>
<th>NRMCAEPD:10024</th>
</tr>
</thead>
</table>
Description of Company
Austrian Arabian Ready Mix Concrete Company LLC (AAC) is a 100% subsidiary of Arabtec Holding (PJSC), the leading construction firm in the United Arab Emirates. Arabtec Construction and AAC since its inception have executed a diverse and far reaching portfolio of major projects covering several industries.

AAC is also certified to ISO 9001: 2015 Quality Management System, ISO 14001:2015 Environment Management system and is certified to BS OHSAS 18001:2007 for its Health and Safety Management System. Besides the above AAC – Jebel Ali facilities are certified to NRMCA, registered with TRAKHEES and certified to DCLD – Certificate of Conformity requirements for Ready Mix Concrete plants.

AAC specializes in the production and delivery of superior Ready Mix Concrete. With state-of-the-art four batching plants that are strategically located at Jebel Ali Industrial Area (Dubai) & two batching plants at Al Hyal - Fujairah, AAC is at the forefront of the industry suppliers.

One of the major objectives of AAC is to adopt the latest technology to produce sustainable, green and high quality concrete products, incorporating quality raw materials, including highly effective cement additives (such as Silica Fume, Granulated Blast Furnace Slag and Pulverized Fly Ash, etc.) which induce greater durability and flexibility to the concrete. This has become a major concern in the Middle East due to the aggressive nature of our climatic conditions. The Louvre Museum at Abu Dhabi was one such path breaking example of casting significant portion of the works with cement replaced up to 80% with ground granulated blast furnace slag (GGBS) thus providing a highly durable and sustainable solution to the clients/engineers requirements.

Description of Product
Products covered by this EPD satisfy general purpose concrete as used in residential, commercial and public works applications in Dubai, UAE. This EPD reports the impacts for different ready-mixed concrete products (listed in Table 1 on the following page) in accordance with the following:

- Dubai Municipality Circular 202: Use of Eco-friendly Cementitious Materials in Concrete
- ACI 211: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
- ACI 318: Building Code Requirements for Structural Concrete
- ASTM C94: Standard Specification for Ready-Mixed Concrete
- CSI MasterFormat Division 03-30-00: Cast-in-Place Concrete
- UNSPSC Code 30111500: Ready Mix Concrete
This EPD is intended for use in Business to Business (B-to-B) communication. The scope of this EPD is cradle-to-gate and considers the following life cycle stages.

- **A1 - Raw Material Supply**: Includes all upstream processes related to extraction, handling, and processing of the raw materials and intermediate component products as well as fuels used in the production of concrete. Component products include cement, supplementary cementitious materials, aggregate (coarse and fine), water, admixtures and other materials or chemicals used in concrete mixtures.
- **A2 - Transportation**: Accounts for the transportation of all input materials and fuels from the supplier to the gate of the concrete plant.
- **A3 - Manufacturing (Core Processes)**: Includes all core processes and the energy and water used to store, move, batch and mix the concrete and operate the concrete plant as well as the transportation and processing of wastes from these core processes.

### Table 1. Declared Product Range Classification

<table>
<thead>
<tr>
<th>Product ID</th>
<th>Description</th>
<th>Compressive Strength (MPa @ 28 days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG2182</td>
<td>C25/20 OPC + 66% GGBS (Cube)</td>
<td>25</td>
</tr>
<tr>
<td>RG2181</td>
<td>C50/20 OPC + 66% GGBS (Cube)</td>
<td>50</td>
</tr>
<tr>
<td>RG2263</td>
<td>C16/20 OPC + 66% GGBS (Cyl/Cube)</td>
<td>20</td>
</tr>
<tr>
<td>RG2264</td>
<td>C16/20 OPC + 66% GGBS (Cyl/Cube)</td>
<td>20</td>
</tr>
<tr>
<td>RG2189</td>
<td>C40/50 OPC + 60% GGBS + 4% MS (Cyl/Cube)</td>
<td>50</td>
</tr>
<tr>
<td>RG2190</td>
<td>C50/60 OPC + 60% GGBS + 5.4% MS (Cyl/Cube)</td>
<td>60</td>
</tr>
<tr>
<td>RG2265</td>
<td>C60/75 OPC + 65% GGBS + 7.3% MS (Cyl/Cube)</td>
<td>75</td>
</tr>
<tr>
<td>RG2205</td>
<td>C20/10 OPC + 66% GGBS - (Cube)</td>
<td>20</td>
</tr>
<tr>
<td>RG2336</td>
<td>C60/75 OPC + 65% GGBS + 9% MS (Cyl/Cube)-MSA 10mm - Flow</td>
<td>60</td>
</tr>
<tr>
<td>RG2063</td>
<td>Type A &amp; B C20/20 OPC + 36% GGBS</td>
<td>20</td>
</tr>
<tr>
<td>RG2254</td>
<td>C16/20 OPC + 36% GGBS (Cyl/Cube)</td>
<td>20</td>
</tr>
<tr>
<td>RG2255</td>
<td>C35/45-F OPC + 66% GGBS (Cyl/Cube)</td>
<td>45</td>
</tr>
<tr>
<td>RG2245</td>
<td>C50/60-F OPC + 65% GGBS + 6% MS (Cyl/Cube)</td>
<td>60</td>
</tr>
<tr>
<td>RG2246</td>
<td>C35/45-S OPC + 50% GGBS (Cyl/Cube)</td>
<td>45</td>
</tr>
<tr>
<td>RG2244</td>
<td>C50/60-S OPC + 35% GGBS + 5.4% MS (Cyl/Cube)</td>
<td>60</td>
</tr>
</tbody>
</table>
Methodology of Underlying LCA

Declared Unit
The declared unit is 1 cubic meter of ready mixed concrete product. Key product variables include:

- **28-day strength** – Six different specified compressive strengths were considered: 16 MPa, 20 MPa, 25 MPa, 40 MPa, 50 MPa, and 60 MPa;
- **Slag cement (GGBS)** – Varies (lower for higher strength concrete);
- **Admixture use** – The use of high range water reducing admixture varies;
- **Aggregate use** – The use of crushed coarse and natural fine aggregates varies;

Product (mix design) components include: portland cement, slag cement, natural and crushed aggregates, admixtures and batch water.

Scope of LCA
A summary of life cycle stages included in the EPD is as follows:
1. Raw Material Supply (upstream processes): Extraction, handling and processing of the raw materials used in the production of concrete: cement, supplementary cementitious materials, aggregate (coarse and fine), water, admixtures and other materials or chemicals used in concrete mixtures.
2. Transportation: Transportation of these materials from the supplier to the ‘gate’ of the concrete producer.
3. Manufacturing (core processes): The energy used to store, batch, mix and distribute the concrete and operate the facility (concrete plant)

A summary of life cycle stages excluded from the EPD is as follows:
1. Production, manufacture and construction of buildings capital goods and infrastructure
2. Production and manufacture of concrete production equipment, concrete delivery vehicles, earthmoving equipment, and laboratory equipment
3. Personnel—related activities (travel, furniture, office supplies).
4. Energy use related to company management and sales activities.
Environmental Product Declaration of Ready Mixed Concrete

Building Life Cycle Information Modules

<table>
<thead>
<tr>
<th>Product stage</th>
<th>Construction Process stage</th>
<th>Use stage</th>
<th>End-of-life stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport</td>
<td>Manufacturing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1</td>
<td>A2</td>
<td>A3</td>
<td>A4</td>
</tr>
</tbody>
</table>

*Figure 1. Life cycle stage schematic – alpha-numeric designations as per CLF PCR 2013 (adapted from CEN 15978:2011)*

Cut-off Rules

The cut-off criteria for all activity stage flows considered within the system boundary conform with ISO14044:2006 and section 3.3 of the CLF PCR 2013. Specifically, the cut-off criteria were applied as follows:

- All inputs and outputs for which data are available are included in the calculated effects and no collected core process data are excluded.
- A one percent cut-off is considered for renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process. The sum of the total neglected flows does not exceed 5% of all energy consumption and mass of inputs.
- All flows known to contribute a significant impact or to uncertainty (e.g., portland cement and admixtures) are included.
- The cut-off rules are not applied to hazardous and toxic material flows – all of which are included in the life cycle inventory.

Allocation

The applied allocation procedures conform with ISO 14044:2006 clause 4.3.4.
Limitations

The limitations of this EPD include:

• This EPD does not report all of the environmental impacts due to manufacturing of the product, but rather reports the environmental impacts for those categories with established LCA-based methods to track and report. Unreported environmental impacts include (but are not limited to) factors attributable to human health, land use change, and habitat destruction.
• In order to assess the local impacts of product manufacturing, additional analysis is required.
• This EPD reports the results of an LCA or the ‘cradle-to-gate’ analysis. Thus, declarations themselves are not comparative assertions, defined as an environmental claim regarding the superiority or equivalence of one product versus a competing product that performs the same function. An EPD does not make any statements that the product covered by the EPD is better or worse than any other product.
• The EPD participants may participate in other sustainability or environmental best practice programs. However, no such additional environmental claim or declaration is conveyed in this EPD.
• EPDs of concrete mixtures may not be comparable if they do not comply with this standard and data from this EPD. The data cannot be used to compare between concrete mixes, construction products or concrete mixtures used in different concrete products unless the data is integrated into a comprehensive LCA. For example, precast concrete, concrete masonry units and site cast concrete all have different manufacturing processes whose impacts are attributed to different LCA stages. This precludes direct comparison between mixtures used in these different products unless all lifecycle phases are included.
• Life cycle impact assessment (LCIA) results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.
• This EPD was created using industry average data for upstream materials. Variation can result from differences in supplier locations, manufacturing processes, manufacturing efficiency and fuel type used.

Data Sources and Data Quality Assessment
This EPD is based on foreground LCI data collected from the participating company’s production facilities for the calendar year 2017. All upstream material, resource and energy carrier inputs have been sourced from various industry-average datasets and literature. Many of these data sets are defaulted to those specified for use in the CLF PCR 2013. Tables 2 to 4 describe each LCI data source and the data quality for each data source.
### Table 2. A1 - Raw Material Supply

<table>
<thead>
<tr>
<th>Materials</th>
<th>LCI Data Source</th>
<th>Geography</th>
<th>Year</th>
<th>Data Quality Assessment</th>
</tr>
</thead>
</table>
| **Cement (lbs)**                 | Results for 1 kg Cement in United Arab Emirates as modeled in WBCSD-CSI tool for EPDs of concrete and cement. UAE-specific clinker factors and kiln fuels assumed in model. | UAE       | 2014-2015 | • **Technology:** good  
Process represents average cement production in UAE  
• **Time:** good  
Data is within 4 years  
• **Geography:** very good  
• **Completeness** good  
Data is based on an average of national production  
• **Reliability:** very good |
| **Slag Cement (lbs)**           | Slag Cement Association N. America EPD Slag Cement, 2015                       | N. America | 2013-2014 | • **Technology:** good  
Process models ground granulated blast furnace slag  
• **Time:** good  
Data is within 3 years  
• **Geography:** fair  
• **Completeness** good  
• **Reliability:** very good, third-party verified EPD |
| **Crushed Aggregates (lbs)**    | ecoinvent process: “Gravel, crushed, at mine” ecoinvent 3  
Modified with UAE electricity | EU/UAE     | 2004    | *CLF PCR 2013 Default Data*  
• **Technology:** good  
Processes represent aggregate, with and without crushing. Dust emissions are estimated from limestone mining.  
• **Time:** fair  
Data is twelve years old but technology remains consistent across the industry  
• **Geography:** good  
Swiss production (modified with UAE Electricity).  
• **Completeness:** very good  
• **Reliability:** very good  
Data is verified by ecoinvent. |
| **Natural Aggregates (lbs)**    | ecoinvent process: “Gravel, round, at mine”, ecoinvent 3  
Modified with UAE electricity | EU/UAE     | 2004    | *CLF PCR 2013 Default Data*  
• **Technology:** very good  
Processes represent admixture production for use in concrete  
• **Time:** fair  
Data is within eleven years  
• **Geography:** good  
• **Completeness** good  
Data from European admixture producers  
• **Reliability:** good  
• Profiles have undergone an independent review |
| **Admixtures (lbs)**            | EFCA EcoProfile (325)  
CLF PCR 2013 Default            | EU         | 2006    | *CLF PCR 2013 Default Data*  
• **Technology:** very good  
Processes represent admixture production for use in concrete  
• **Time:** fair  
Data is within eleven years  
• **Geography:** good  
• **Completeness** good  
Data from European admixture producers  
• **Reliability:** good  
• Profiles have undergone an independent review |
### Table 3. A2 - Transportation

<table>
<thead>
<tr>
<th>Process</th>
<th>LCI Data Source</th>
<th>Geography</th>
<th>Year</th>
<th>Data Quality Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road (t*km)</td>
<td>ecoinvent 3 Transport, freight, lorry, unspecified [GLO] market for Alloc Def</td>
<td>Global</td>
<td>2015</td>
<td>• <strong>Technology</strong>: good&lt;br&gt;Processes represents global average&lt;br&gt;• <strong>Time</strong>: very good&lt;br&gt;Data is within two years&lt;br&gt;• <strong>Geography</strong>: fair&lt;br&gt;• <strong>Completeness</strong>: good&lt;br&gt;• <strong>Reliability</strong>: good&lt;br&gt;Data is from ecoinvent database</td>
</tr>
</tbody>
</table>

### Table 4. A3 - Manufacturing

<table>
<thead>
<tr>
<th>Process</th>
<th>LCI Data Source</th>
<th>Geography</th>
<th>Year</th>
<th>Data Quality Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity (kWh)</td>
<td>Energy source breakdown: International Energy Agency electricity statistics for 2014 UAE electricity generation¹&lt;br&gt;Electricity generation processes: ecoinvent V3</td>
<td>UAE/Global</td>
<td>2014/2015</td>
<td>• <strong>Technology</strong>: very good&lt;br&gt;Process represents production of electricity in the UAE in 2014. (See % contribution by source below)&lt;br&gt;• <strong>Time</strong>: very good&lt;br&gt;Electricity production data and breakdown is within two years&lt;br&gt;• <strong>Geography</strong>: very good&lt;br&gt;• <strong>Completeness</strong>: good&lt;br&gt;Data is representative of UAE production&lt;br&gt;• <strong>Reliability</strong>: good&lt;br&gt;ecoinvent has verified the data</td>
</tr>
</tbody>
</table>

¹ UAE electricity statistics:
https://www.iea.org/statistics/?country=UAE&year=2016&category=Key%20indicators&indicator=ElecGenByFuel&mode=chart&categoryBrowse=false&dataTable=ELECTRICITYANDHEAT&showDataTable=true
### Table 4. A3 - Manufacturing

<table>
<thead>
<tr>
<th>Process</th>
<th>LCI Data Source</th>
<th>Geography</th>
<th>Year</th>
<th>Data Quality Assessment</th>
</tr>
</thead>
</table>
| Diesel and Gasoline (liters)        | ecoinvent 3                                                                      | Global    | 2015 | - **Technology:** very good  
  Process represents combustion of fuel oil in a condensing boiler.  
- **Time:** very good  
  Data is within two years  
- **Geography:** fair  
- **Completeness:** good  
  Data is representative of US conditions  
- **Reliability:** good  
  Data is from ecoinvent database  
  *Gasoline represents a small portion of the weighted average energy mix (<1%)* |
| Hazardous Solid Waste, (lbs)       | ecoinvent 3, Hazardous waste, for incineration (GLO) | Global    | 2008 | - **Technology:** good  
  Processes model Swiss production (no US process in USLCI database).  
- **Time:** fair  
  Data is within ten years.  
- **Geography:** fair  
- **Completeness:** very good  
- **Reliability:** very good  
  Data is verified by ecoinvent. |
| Non-Hazardous Solid Waste, (lbs)   | ecoinvent 3, Waste concrete (GLO) | Global    | 2008 | - **Technology:** good  
  Processes model Swiss production (no US process in USLCI database).  
- **Time:** fair  
  Data is within ten years.  
- **Geography:** fair  
- **Completeness:** very good  
- **Reliability:** very good  
  Data is verified by ecoinvent. |
<table>
<thead>
<tr>
<th>UAE Purchased Electricity source grid mix</th>
<th>LCI Data Set</th>
<th>kWh production per kWh at user</th>
<th>% of electricity production in UAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil</td>
<td>Electricity, high voltage [RoW]</td>
<td>electricity production, oil</td>
<td>Alloc Def</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>Electricity, high voltage [RoW]</td>
<td>electricity production, natural gas, at conventional power plant</td>
<td>Alloc Def</td>
</tr>
<tr>
<td>Solar</td>
<td>Electricity, low voltage [RoW]</td>
<td>electricity production, photovoltaic, 570kWp open ground installation, multi-Si</td>
<td>Alloc Def</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Data Quality

Data quality/variability requirements, as specified in the CLF PCR 2013 sections 3.5 and 3.6, are applied. This section describes the achieved data quality relative to the ISO 14044:2006 requirements. Data quality is judged on the basis of its completeness, reproducibility, representativeness, and reliability.

Completeness: All relevant specific processes, including inputs (raw materials, energy and ancillary materials) and outputs (emissions and production volume) were considered and modeled to represent the specified and declared RMC products. The relevant background materials and processes were taken from ecoinvent v3 LCI databases and were modified with UAE-specific electricity inputs before they were modeled in SimaPro software v.8.0.1, 2014.

Reproducibility: Internal reproducibility is possible since the data and the models are stored and available in a SimaPro database for all background processes, and in Athena’s proprietary concrete LCA calculator* for all production facility and mix-specific calculations. A considerable level of transparency is provided throughout the LCA report as the specifications and material quantity make-up for the declared RMC products are presented and key primary and secondary LCI data sources are summarized. The provision of more detailed data to allow full external reproducibility was not possible due to reasons of confidentiality. *Athena has developed a proprietary tool that allows the calculation of PCR-compliant LCA results for ready-mixed concrete product mix designs. The tool scales results for base-unit technosphere inputs (i.e. 1 kg portland cement, 1 kWh electricity, etc.) to replicate the reference flow conversions that take place in SimaPro.

Representativeness: The representativeness of the data is summarized as follows.

- Time related coverage of the manufacturing processes’ primary collected data: 2017 (12 months).
- Upstream (background) LCI data was either the CLF PCR 2013 specified default or more appropriate LCI datasets as found in the UAE-adjusted ecoinvent v3 database.
- Geographical coverage for the cement and RMC plant operations is United Arab Emirates; other upstream and background processes are based on global average data.
- Technological coverage is typical or average – specific to the participating facilities for all primary data.

Reliability: The degree to which the sources, data collection methods and verification procedures used to obtain the data are dependable. For core manufacturing processes the reliability of the information and data is deemed to be very good as these were derived from primary data from ready-mixed concrete producers and subsequently reviewed by Athena for plausibility. All other LCI data have been incorporated in accordance with the default CLF PCR 2013 requirements or derived from ecoinvent databases, which have been verified by ecoinvent.
Life Cycle Assessment Results

Environmental Indicators and Inventory Metrics

This EPD supports 15 life cycle impact assessment indicators and inventory metrics as listed in Table 5. As specified in the CLF PCR 2013, Section 8., the US EPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI), version 2.1, 2012 impact categories were used to calculate mandatory category indicators.

<table>
<thead>
<tr>
<th>#</th>
<th>LCIA Indicators</th>
<th>Abbreviations</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Global Warming Potential (climate change)</td>
<td>GWP</td>
<td>kg CO2-eq</td>
</tr>
<tr>
<td>2</td>
<td>Ozone Depletion Potential</td>
<td>ODP</td>
<td>kg CFC-11-eq</td>
</tr>
<tr>
<td>3</td>
<td>Acidification Potential</td>
<td>AP</td>
<td>kg SO2-eq</td>
</tr>
<tr>
<td>4</td>
<td>Eutrophication Potential</td>
<td>EP</td>
<td>kg N-eq</td>
</tr>
<tr>
<td>5</td>
<td>Photochemical Ozone Creation/Smog Potential</td>
<td>POC P</td>
<td>kg O3-eq</td>
</tr>
<tr>
<td>6</td>
<td>Total primary energy consumption</td>
<td>PEC</td>
<td>MJ (HHV)</td>
</tr>
<tr>
<td>7</td>
<td>Depletion of non-renewable energy resources</td>
<td>NRE</td>
<td>MJ (HHV)</td>
</tr>
<tr>
<td>8</td>
<td>Use of renewable primary energy</td>
<td>RE</td>
<td>MJ (HHV)</td>
</tr>
<tr>
<td>9</td>
<td>Depletion of non-renewable material resources</td>
<td>NRM</td>
<td>kg</td>
</tr>
<tr>
<td>10</td>
<td>Use of renewable material resources</td>
<td>RM</td>
<td>kg</td>
</tr>
<tr>
<td>11</td>
<td>Concrete batching water consumption</td>
<td>CBW</td>
<td>m³</td>
</tr>
<tr>
<td>12</td>
<td>Concrete washing water consumption</td>
<td>CWW</td>
<td>m³</td>
</tr>
<tr>
<td>13</td>
<td>Total water consumption</td>
<td>TW</td>
<td>m³</td>
</tr>
<tr>
<td>14</td>
<td>Concrete hazardous waste</td>
<td>CHW</td>
<td>kg</td>
</tr>
<tr>
<td>15</td>
<td>Concrete non-hazardous waste</td>
<td>CNHW</td>
<td>kg</td>
</tr>
</tbody>
</table>

Table 5. Life Cycle Category Indicators and Inventory Metrics
Impact Assessment Results

<table>
<thead>
<tr>
<th>MIX ID</th>
<th>GWP</th>
<th>ODP</th>
<th>AP</th>
<th>EP</th>
<th>POCP</th>
<th>PEC</th>
<th>NRE</th>
<th>RE</th>
<th>NRM</th>
<th>RM</th>
<th>CBW</th>
<th>CWW</th>
<th>TW</th>
<th>CHW</th>
<th>CNHW</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG2182</td>
<td>229.20</td>
<td>3.33E-05</td>
<td>7.92</td>
<td>0.67</td>
<td>93.03</td>
<td>2920.28</td>
<td>2883.95</td>
<td>36.32</td>
<td>2394.88</td>
<td>1.68</td>
<td>0.18</td>
<td>0.09</td>
<td>1.32</td>
<td>0.00</td>
<td>40.41</td>
</tr>
<tr>
<td>RG2181</td>
<td>274.38</td>
<td>3.60E-05</td>
<td>9.77</td>
<td>0.85</td>
<td>113.34</td>
<td>3313.54</td>
<td>3269.94</td>
<td>43.60</td>
<td>2178.62</td>
<td>2.19</td>
<td>0.15</td>
<td>0.09</td>
<td>1.57</td>
<td>0.01</td>
<td>40.44</td>
</tr>
<tr>
<td>RG2263</td>
<td>208.06</td>
<td>3.11E-05</td>
<td>7.32</td>
<td>0.61</td>
<td>85.95</td>
<td>2691.82</td>
<td>2658.97</td>
<td>32.86</td>
<td>2254.23</td>
<td>1.48</td>
<td>0.15</td>
<td>0.09</td>
<td>1.17</td>
<td>0.00</td>
<td>40.40</td>
</tr>
<tr>
<td>RG2264</td>
<td>207.76</td>
<td>3.10E-05</td>
<td>7.32</td>
<td>0.61</td>
<td>85.91</td>
<td>2686.77</td>
<td>2653.96</td>
<td>32.81</td>
<td>2253.94</td>
<td>1.48</td>
<td>0.15</td>
<td>0.09</td>
<td>1.17</td>
<td>0.00</td>
<td>40.40</td>
</tr>
<tr>
<td>RG2189</td>
<td>272.50</td>
<td>3.58E-05</td>
<td>12.48</td>
<td>1.02</td>
<td>142.95</td>
<td>3266.90</td>
<td>3225.91</td>
<td>40.99</td>
<td>2213.49</td>
<td>2.11</td>
<td>0.15</td>
<td>0.09</td>
<td>1.58</td>
<td>0.01</td>
<td>40.43</td>
</tr>
<tr>
<td>RG2190</td>
<td>273.09</td>
<td>3.59E-05</td>
<td>9.72</td>
<td>0.84</td>
<td>112.81</td>
<td>3273.63</td>
<td>3231.84</td>
<td>41.79</td>
<td>2192.31</td>
<td>2.14</td>
<td>0.15</td>
<td>0.09</td>
<td>1.58</td>
<td>0.01</td>
<td>40.44</td>
</tr>
<tr>
<td>RG2265</td>
<td>258.97</td>
<td>3.51E-05</td>
<td>9.75</td>
<td>0.83</td>
<td>113.10</td>
<td>3227.85</td>
<td>3183.98</td>
<td>43.88</td>
<td>2187.49</td>
<td>2.08</td>
<td>0.12</td>
<td>0.09</td>
<td>1.38</td>
<td>0.01</td>
<td>40.45</td>
</tr>
<tr>
<td>RG2205</td>
<td>207.30</td>
<td>3.09E-05</td>
<td>7.32</td>
<td>0.61</td>
<td>85.91</td>
<td>2678.91</td>
<td>2653.96</td>
<td>32.73</td>
<td>2248.31</td>
<td>1.48</td>
<td>0.15</td>
<td>0.09</td>
<td>1.17</td>
<td>0.00</td>
<td>40.40</td>
</tr>
<tr>
<td>RG2336</td>
<td>251.72</td>
<td>3.35E-05</td>
<td>11.12</td>
<td>0.91</td>
<td>127.60</td>
<td>3133.03</td>
<td>3089.46</td>
<td>43.57</td>
<td>2078.45</td>
<td>2.07</td>
<td>0.14</td>
<td>0.09</td>
<td>1.39</td>
<td>0.01</td>
<td>40.45</td>
</tr>
<tr>
<td>RG2063</td>
<td>274.70</td>
<td>3.57E-05</td>
<td>7.37</td>
<td>0.70</td>
<td>87.09</td>
<td>3083.57</td>
<td>3052.58</td>
<td>30.99</td>
<td>2410.10</td>
<td>1.92</td>
<td>0.15</td>
<td>0.09</td>
<td>1.77</td>
<td>0.00</td>
<td>40.39</td>
</tr>
<tr>
<td>RG2244</td>
<td>371.87</td>
<td>4.32E-05</td>
<td>9.83</td>
<td>0.97</td>
<td>115.24</td>
<td>3900.50</td>
<td>3859.88</td>
<td>40.62</td>
<td>2381.16</td>
<td>2.79</td>
<td>0.15</td>
<td>0.09</td>
<td>2.43</td>
<td>0.00</td>
<td>40.42</td>
</tr>
</tbody>
</table>

Table 6. Summary Results (A1-A3): Austrian Arabian Ready Mix concrete, per cubic meter
References

American Concrete Institute (ACI) 211: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete

American Concrete Institute (ACI) 318: Building Code Requirements for Structural Concrete


Carbon Leadership Forum (December 4, 2013). Product Category Rules (PCR) for ISO 14025 Type III Environmental Product Declarations (EPDs) of Concrete v1.1.

Carbon Leadership Forum Clarification #1 (April 10, 2014), Clarification #2 (July 17, 2014) and Clarification #3 (June 1, 2015) to: PCR for ISO 14025 Type III Environmental Product Declarations (EPDs) of Concrete v1.1.

Construction Specifications Institute (CSI) MasterFormat Division 03-30-00 Cast-in-Place Concrete

EN 15804:2012 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.


ISO 14025: 2006 Environmental labeling and declarations - Type III environmental declarations - Principles and procedures.


National Ready Mixed Concrete Association 2013. Program Operator Instructions for Environmental Product Declarations v1.2.
