ENVIRONMENTAL PRODUCT DECLARATION

as per /ISO 14025/ and /EN 15804/

Owner of the Declaration	**Türk Ytong Sanayi A.Ş.**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
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Ytong® Autoclaved Aerated Concrete Block and AAC Blocks for Floor Plates

Türk Ytong Sanayi A.Ş.

Institut Bauen und Umwelt e.V.

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This Declaration is based on the Product Category Rules:
Aerated concrete, 07.2014
(PCR tested and approved by the SVR)

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(President of Institut Bauen und Umwelt e.V.)

Dr. Alexander Röder
(Managing Director IBU)

Autoclaved Aerated Concrete (AAC) Block and AAC Blocks for Floor Plates

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Declared product / Declared unit
1 m3 AAC block and AAC Blocks for Floor Plates with an average gross density of 388 kg/m3

Scope:
This EPD and its LCA are relevant to AAC blocks and AAC Blocks for Floor Plates produced in the plants of TURK YTONG located in Antalya, Bilecik, Çatalca (Istanbul), Pendik (Istanbul) and Saray (Trakya), Turkey. The calculations are based on average production data collected during the year 2016 (from January to December). A weighted average was calculated as an annual representative value (12 months).

The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

Verification

The CEN Norm /EN 15804/ serves as the core PCR
Independent verification of the declaration according to /ISO 14025/
☐ internally ☒ externally

Prof. Dr. Birgit Grahl
(Independent verifier appointed by SVR)

Product

Product description / Product definition
The products mentioned are AAC blocks and AAC Blocks for Floor Plates in various formats made of autoclaved aerated concrete. AAC belongs to the porous steam-cured light-weight concrete group.

For the placing on the market of the product in the EU/EFTA (with the exception of Switzerland) Regulation (EU) No. 305/2011 (CPR) applies. The product needs a Declaration of Performance taking into consideration /EN 771-4:2015-11/, Specification for masonry units - Part 4: Autoclaved aerated concrete masonry units/ and the CE-Marking. For the application and use the respective national provisions apply.

Application
AAC blocks are used to form different types of load bearing and nonload bearing applications in all forms of walling including single leaf, cavity, partitions, retaining, basement and general use below ground level, including walling for fire protection, thermal insulation, sound insulation and the fabric of chimneys (excluding chimney flue units). AAC blocks for floor plates are used as infills in cast-in-situ infilled joist floor systems

Technical Data
AAC blocks and AAC blocks for floor plates demonstrate the following constructional performance:

Constructional data

Name	Value	Unit
Compressive strength acc. to /TS EN 772-1/	1.5 - 5	N/mm²
Tensile strength acc. to /TS EN 1351/	0.24 - 1	N/mm²
Modulus of elasticity acc. to /TS	750 - 2250	N/mm²

EN 1352/		
Thermal conductivity acc. to /TS EN 12664/	0.085 - 0.16	W/(mK)
Moisture content at 23 °C, 80%	4	M.-%
Shrinkage acc. to /TS EN 680/	0.2	mm/m
Water vapour diffusion coefficient acc. to /TS EN 1745/	5/10	
Cross dry density acc. to /TS EN 772-13/	300 - 600	kg/m³

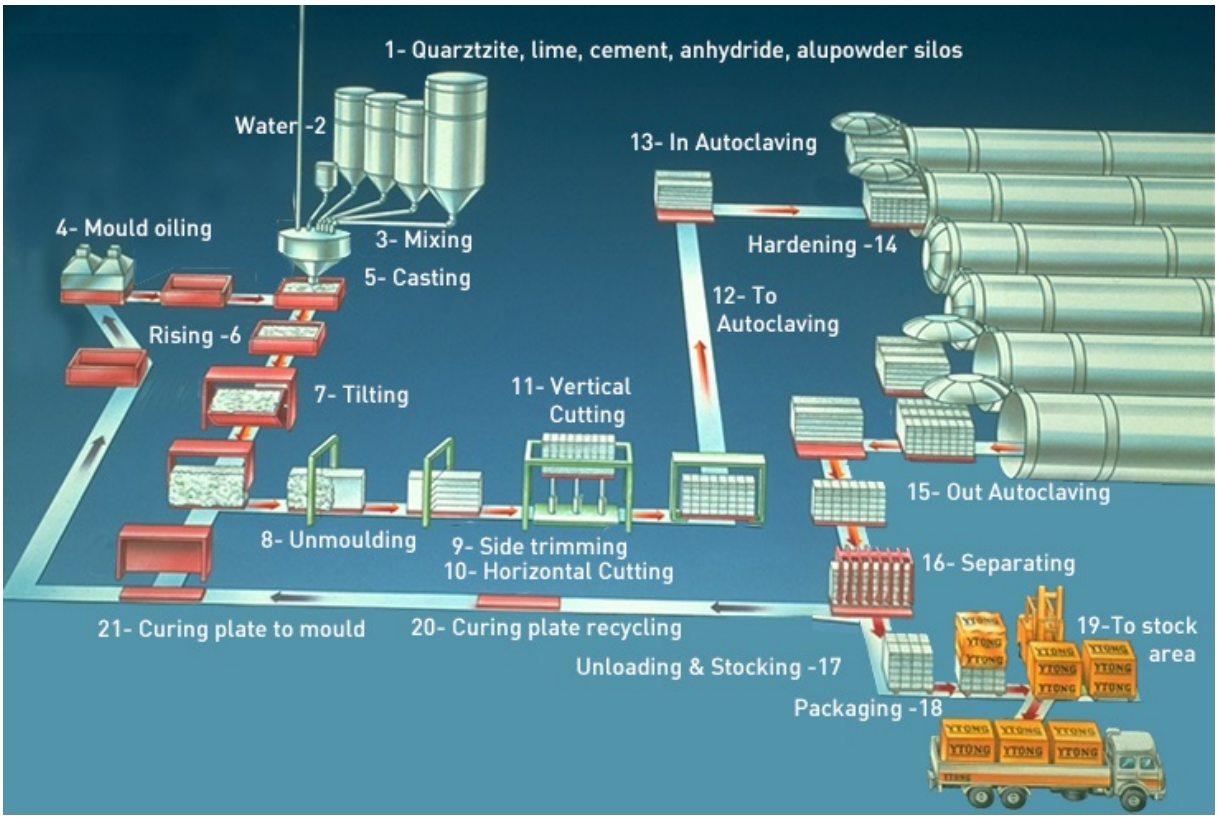
Base materials / Ancillary materials

- Portland Cement 15-30%
- Quicklime 10-20%
- Quartzite/Sand 50-70%
- Gypsum 2-5%
- Aluminium 0.05-0.1%

In addition, 40-60% water is used (based on the solid materials).

The ground quartzite is mixed with gypsum, cement produced according to /TS EN 197-1/, quicklime in accordance with /TS EN 459-1/ and AAC recycling materials (slurry and powder are recycled 100% in a closed loop) that has been reduced to small pieces, adding water and aluminum powder, in a mixer, until it becomes a slurry. It is then poured into a casting mould. The aluminum reacts in an alkaline milieu. Thus, gaseous hydrogen is formed which creates pores in the mass and escapes without leaving any residue. The pores usually have a diameter of (0.5-1.5 mm) and are filled exclusively with air. After setting once, semisolid raw blocks are created, from which the autoclaved aerated concrete building components are then cut with high precision.
The formation of the final qualities of the building component occurs during the subsequent steam-curing over 5-12 hours at approximately 190° C with approximately 12 bar pressure in steam pressure kettles or autoclaves, as they are called. The used substances create calcium hydro silicates, which corresponds to the naturally occurring mineral tobermorite. The reaction of the material is complete when removed from the autoclave. Therefore, the reaction does not take as long as the hardening of concrete. Once the steaming process is complete, the steam is used for other autoclave cycles. Thereby, energy is saved and harm to the environment due to hot exhaust steam and wastewater is avoided.

The production process is shown in the following figure:



According to the Sustainable Building Guideline of IBU the average life expectancy of AAC is 100 years.

Reference service life

In this study, Reference Service Life (RSL) is not taken into consideration during the calculations since the system boundary of this EPD is cradle-to-gate.

AAC does not change once it leaves the autoclaves. When used as intended, it is boundlessly stable.

Further Information

For further information, please contact Türk Ytong A.S. through its website at www.ytong.com.tr

LCA: Calculation rules

Declared Unit
The declared unit is defined as 1m3 of AAC block and AAC block for floor plates group. This declaration is classified as an average product as calculated from the overall production in several of the manufacturer's plants as 1d according to PCR Part A.

Declared unit

Name	Value	Unit
Declared unit	1	m^3
Conversion factor to 1 kg	0.002577	-
Gross dry density	388	kg/m^3

System boundary
Type of the EPD: cradle-to-gate

The system boundaries of this life cycle assessment study are considered as cradle-to-gate, since all the modules except A1-A3 product stage are not declared within the scope of this study. This means the system boundary covers Ytong AAC block and AAC block for floor plates products from extraction of raw material to the production of finished packed product at the plant gate.

The product stage contains A1 (extraction, processing, production of raw materials), A2 (Transport to the manufacturer and internal transport) and A3 (Manufacturing operations) modules. These are declared separately.

Background data
All relevant background datasets were taken from the /Ecoinvent/ database within /SimaPro/ software.

Comparability
Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to /EN 15804/ and the building context, respectively the product-specific characteristics of performance, are taken into account.
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LCA: Scenarios and additional technical information

A1, A2 and A3 modules are declared within the scope of this study. Hence, there are no scenarios provided below regarding the other modules A4, A5, B1-B7, C1-C4 and D.

In this study, closed-loop recycling was used. Ytong plants utilize recycled waste (slurry and powder) internally.

Type and amount of packaging materials:
A weighted average value of five plants of packaging materials used for $1m^3$ AAC Blocks is PE strech film (0.580kg), wooden pallet (0.881 piece), PE etiquette (0.000893kg) and ink(0.000449kg).

LCA: Results

The following table shows the impact estimate results which are relative expressions and do not predict impacts on category endpoints or the transgression of thresholds, safety margins or risks.

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
X	X	X	MND	MND	MND	MND	MNR	MNR	MNR	MND	MND	MND	MND	MND	MND	MND

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m3 AAC block and AAC block for floor plates

Parameter	Unit	A1	A2	A3
Global warming potential	[kg CO_2-Eq.]	1.40E+2	6.59E+0	2.49E+1
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	5.77E-6	1.24E-6	1.38E-6
Acidification potential of land and water	[kg SO_2-Eq.]	2.99E-1	3.30E-2	1.01E-1
Eutrophication potential	[kg $(PO_4)^{3-}$-Eq.]	3.73E-2	6.21E-3	5.85E-3
Formation potential of tropospheric ozone photochemical oxidants	[kg ethene-Eq.]	2.03E-2	1.18E-3	4.79E-3
Abiotic depletion potential for non-fossil resources	[kg Sb-Eq.]	1.16E-3	1.39E-5	6.15E-6
Abiotic depletion potential for fossil resources	[MJ]	7.36E+2	9.89E+1	3.56E+2

RESULTS OF THE LCA - RESOURCE USE: 1 m3 AAC block and AAC block for floor plates

Parameter	Unit	A1	A2	A3
Renewable primary energy as energy carrier	[MJ]	4.61E+2	1.24E+0	1.76E+1
Renewable primary energy resources as material utilization	[MJ]	1.04E+2	IND	IND
Total use of renewable primary energy resources	[MJ]	5.65E+2	1.24E+0	1.76E+1
Non-renewable primary energy as energy carrier	[MJ]	7.39E+2	1.01E+2	3.59E+2
Non-renewable primary energy as material utilization	[MJ]	2.53E+1	IND	IND
Total use of non-renewable primary energy resources	[MJ]	7.65E+2	1.01E+2	3.59E+2
Use of secondary material	[kg]	IND	IND	IND
Use of renewable secondary fuels	[MJ]	IND	IND	IND
Use of non-renewable secondary fuels	[MJ]	IND	IND	IND
Use of net fresh water	[m^3]	9.01E-3	1.75E-3	4.03E-1

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 m3 AAC block and AAC block for floor plates

Parameter	Unit	A1	A2	A3
Hazardous waste disposed	[kg]	1.58E-3	5.12E-5	1.93E-4
Non-hazardous waste disposed	[kg]	3.32E+0	3.69E+0	5.56E-1
Radioactive waste disposed	[kg]	3.18E-3	7.08E-4	8.31E-5
Components for re-use	[kg]	IND	IND	IND
Materials for recycling	[kg]	IND	IND	IND
Materials for energy recovery	[kg]	IND	IND	IND
Exported electrical energy	[MJ]	IND	IND	IND
Exported thermal energy	[MJ]	IND	IND	IND

Note: There are no direct radioactive wastes during the manufacturing processes. In the manufacturing stage (A3), the value acquired for radioactive waste generation mostly is in relation with the upstream processes of electricity and natural gas, respectively.

Requisite evidence
Radioactivity
All mineral raw materials contain small amounts of naturally radioactive substances. The measurements show that the natural radioactivity from a radiological point of view allows an unrestricted use of this building material.

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/PCR Part A/
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/PCR Part B/

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/TS EN 197-1/
Cement - Part 1: Composition, specifications and conformity criteria for common cements

/TS EN 459-1/
Building lime - Part 1: Definitions, specifications and conformity criteria

/TS EN 680/
Determination of the drying shrinkage of autoclaved aerated concrete

/TS EN 771-4/
Specification for masonry units - Part 4: Autoclaved aerated concrete masonry units

/TS EN 12664/
Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Dry and moist products of medium and low thermal resistance

/TS EN 1745/
Masonry and masonry products - Methods for determining thermal properties

/CPR/
No305/211 Construction Products Regulation

/TS EN 772-1/
Determination of compressive strength

/TS EN 772-13/
Determination of net and gross dry density of masonry units (except for natural stone)

/TS EN 1352/
Determination of static modulus of elasticity under compression of autoclaved aerated concrete or lightweight aggregate concrete with open structure

/TS EN 1351/
Determination of flexural strength of autoclaved aerated concrete

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