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BUTYL ACETATE

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Basic information

This declaration is the Type III Environmental Product Declaration (EPD) based on ISO 14040 and EN 15804 and verified according to ISO 14025 by an external auditor. It contains the information on the impacts of the declared construction materials on the environment. Their aspects were verified by the independent body according to ISO 14025. Basically, a comparison or evaluation of EPD data is possible only if all the compared data were created according to ISO 14040 and EN 15804 (see point 5.3 of the standard).

Life cycle analysis (LCA): A1-A3 (Cradle to Gate)
The year of preparing the EPD: 2021
Service Life: not relevant
PCR: ITB-PCR A
Declared unit: 1 ton of product
Reasons for performing LCA: B2B
Representativeness: Turkish production, year 2020/21

Product description

Adokim was established in Antalya as part of ADO Group companies in 2018 and its production facilities were put into operation in March 2020. As the first local company to produce ethyl and butyl acetate in Turkey, it has become a touchstone in the chemical industry in its field. Adokim operates a controlled and managed production facility with a state-of-the-art and full automation system with an annual production capacity of 60,000 tons of ethyl acetate and butyl acetate. As the first local company producing ethyl and butyl acetate in Turkey, it aims to reduce dependence on these products abroad and to ensure that foreign exchange reserves remain in Turkey by bringing ethyl and butyl acetate products imported over 60,000 tons per year to our country's industry.

Butyl acetate covered by this EPD (Normal Butyl Acetate) with the formula $C_6H_{12}O_2$ is an ester with a colorless and fruity odor and is flammable. n-Butyl acetate, also known as butyl ethanoate, is an ester that is a colorless, flammable liquid at room temperature. Butyl acetate is often used as a high-boiling solvent of moderate polarity. It is also used as a solvent in nail polish along with ethyl acetate. It is used to transform the resin to solution to make the application easier while adjusting the fluidity of paint. It is used in Lak and other products due to its dissolver characteristic. It is used in production of adhesives and plays a role as a dissolver in this area. In Pharmaceutical Industry it is used as dissolver raw material in some product and bulk products in pharmaceutical industry. It is used during extraction procedure. It is used in food as flavorer since it has a fruity smell. Also, it is used in the production of synthetic fruit powders. It is used in leather manufacturing, coating of suede and nubuck leathers. It is used as dissolver during the production procedures of products such as perfumes and nail polishes. It is used as antirust in cleaning sector and for vehicle maintenance since it is a non-toxic product. It is used in air maintenance of air-condition units and during the production of air filters. It is used in safety glass production utilized in areas such as cars etc. It is used in product manufacturing in plastic sector.

Butyl Acetate Specifications are:

- Chemical Name: Butyl Acetate (N-Butyl Acetate)
- Appearance: Colorless, Transparent Liquid
- Chemical Formula: $C_6H_{12}O_2$
- Cas No: 123-86-4
- EINECS No: 204-658-1
- Purity degree: 99.7%
- Density: 0.88 g / cm^3
- Flash Point: 22.5˚C
- Boiling Point: 125.5 ˚C
- Molecular Weight: 116.16 g / mol
- pH: 6.2 (10 g / l, H_2O, 20 ° C)

Technical Information and Safety Data Sheet is available at manufacturer web-site.

Life Cycle Assessment (LCA) – general rules applied

Declared Unit

The declared unit is 1 tone of Butyl Acetate. The product is an intermediate product in the production of many final products from various sectors of the industry, so it is impossible to define its usage scenarios.

System boundary

The life cycle analysis of the declared product covers “Product Stage” A1-A3 modlues in accordance with ISO 14040, EN 15804 and ITB PCR A.

Allocation

The allocation rules used for this EPD are based on general ITB PCR A. Production is the line process in factory located in in Antalya (Turkey). Allocation was done on product mass basis where the specific technology input and output data were hard to separate. The impacts from raw materials extraction and processing are allocated in A1 module of the EPD (including input materials, and energy carriers production, transportation, emissions and wastes resulting from the production). 100% of impacts from line production were inventoried and allocated to products Municipal waste and waste water of factory were allocated to module A3 (mass based). Energy supply was inventoried for whole production process. Emissions in the factory are calculated and were allocated to module A3 (allocation masss based). Energy supply was inventoried for whole factory and 100% was allocated to the product assessed mass based. Emissions in the factory are assessed using Turkish emission factors for energy carriers were allocated to module A3.

System limits

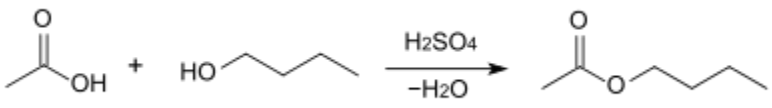
The life cycle analysis of the declared products covers “Product Stage”, A1-A3 (Cradle to Gate) accordance with ISO 14040, EN 15804 and ITB PCR A. All materials and energy consumption inventoried in a factory were included in calculation. In the assessment, all significant parameters from gathered production data are considered, i.e. all chemicals used per reaction, utilized thermal energy, internal fuel and electric power consumption, direct production waste, and all available emission measurements. It can be assumed that the total sum of omitted processes does not exceed 5% of all impact categories. Environmental impacts relating to personnel, infrastructure, and production equipment not directly consumed in the process are excluded from the system boundary

A1 and A2 Modules: Raw materials supply and transport

Butanol, Acetic Acid, Methane Sulfonic Acid as materials produced in A1 are products manufactured in typical chemical processes by specific suppliers from the world. Data on transport of the different chemical input materials to the manufacturing plants is declared by a producer. Means of transport include trucks and sea freight from USA and China. All required sea distances were estimated. For calculation purposes European fuel averages are applied for trucks.

A3: Production

The production process mainly uses electricity and gas. Input chemicals are Butanol, Acetic Acid, Methane Sulfonic Acid. Grid Electricity is used for production line, lighting of buildings and external storages. Natural Gas is used in production line and for central heating. Butyl acetate is commonly manufactured by the Fischer esterification of butanol (or its isomer to make an isomer of butyl acetate) and acetic acid with the presence of catalytic sulfuric acid under reflux conditions with this reaction:



Production process is presented in Figure 1.

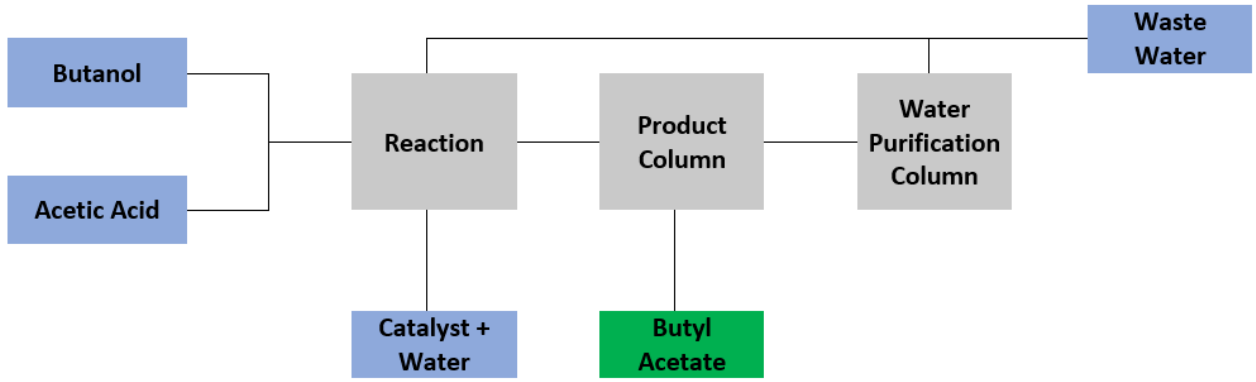


Figure 1. A schematic diagram of the industrial process

A4: Transport to consumer

Not included

End of life scenarios (C and D modules)

Not applicable

Data collection period

The data for manufacture of the declared products refer to period between 01.07.2020 – 01.07.2021 (1 year).

Data quality

The values determined to calculate A3 originate from verified Progress LCI inventory data. A1 values were prepared considering Ecoinvent v.3.8 data base.

Assumptions and estimates

All production processes (A3) inputs and outputs were assigned to different types of products with mass based allocation approach.

Calculation rules

LCA was done in accordance with ITB PCR a document. Characterization factors are CML ver. 4.8 based. ITB-LCA algorithms were used for impact calculations. A1 was calculated based on data from the database A3 and A2 are calculated based on the LCI questionnaire provided by the manufacturer (using Ecoinvent data for transport, sea freight and Euro5 trucks). Emission of greenhouse gases was calculated using the IPCC 2013 GWP method with a 100 year horizon. Emission of acidifying substances, Emission of substances to water contributing to oxygen depletion, Emission of gases that contribute to the creation of ground-level ozone, Abiotic depletion, and ozone depletion emissions where all calculated with the CML-IA baseline method

Data bases

The background data for the processes come from the following databases: Ecoinvent v.3.8 (Butanol, Acetic Acid, Methane Sulfonic Acid, packaging), energy Turkish electricity mix and combustion factors for fuels from Turkish Life Cycle Inventory Database and Ecoinvent. Specific (LCI) data quality analysis was a part of the audit. The time related quality of the data used is valid (5 years).

Additional information

The electricity mix represents the average Turkish specific electricity supply for final consumers, including electricity own consumption, transmission/distribution losses and electricity imports from neighbouring countries. Turkish electricity mix used is 0.16kg CO_2/MJ.

Life Cycle Assessment (LCA) – Results

Declared unit

The declaration refers to the unit DU– 1 ton of Butyl Acetate (table 1).

Table 1. System boundaries (life stage modules included) in a product environmental assessment

Environmental assessment information (MA – Module assessed, MNA – Module not assessed, INA – Indicator Not Assessed)																
Product stage			Construction process		Use stage							End of life				Benefits and loads beyond the system boundary
Raw material supply	Transport	Manufacturing	Transport to construction site	Construction-installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction 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
MA	MA	MA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA

Table 2. Environmental product characteristic – 1 ton of Butyl Acetate

Environmental impacts: (DU) 1 ton of Product					
Indicator	**Unit**	**A1**	**A2**	**A3**	**A1-A3**
Global warming potential	kg CO_2	4.14E+03	1.03E+02	4.98E+01	4.30E+03
Depletion potential of the stratospheric ozone layer	kg CFC 11	1.45E-04	1.67E-05	1.27E-05	1.74E-04
Acidification potential of soil and water	kg SO_2	1.58E+01	1.93E+00	2.04E-01	1.79E+01
Formation potential of tropospheric ozone	kg Ethene	4.74E+00	4.97E-02	4.38E-02	4.83E+00
Eutrophication potential	kg $(PO_4)^{3-}$	2.61E+00	2.16E-01	2.10E-02	2.85E+00
Abiotic depletion potential (ADP-elements) for non-fossil resources	kg Sb	2.57E+01	4.10E-01	2.17E-01	2.63E+01
Abiotic depletion potential (ADP-fossil fuels) for fossil resources	MJ	9.20E+04	1.58E+03	7.06E+02	9.43E+04
Environmental aspects: (DU) 1 ton of Product					
Indicator	**Unit**	**A1**	**A2**	**A3**	**A4**
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ	INA	INA	INA	0.00E+00
Use of renewable primary energy resources used as raw materials	MJ	INA	INA	INA	0.00E+00
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ	2.73E+03	4.03E+00	5.12E+01	2.79E+03
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ	INA	INA	INA	0.00E+00
Use of non-renewable primary energy resources used as raw materials	MJ	INA	INA	INA	0.00E+00
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ	9.96E+04	1.64E+03	2.75E+02	1.02E+05
Use of secondary material	kg	4.64E-03	0.00E+00	0.00E+00	4.64E-03
Use of renewable secondary fuels	MJ	1.72E-03	0.00E+00	0.00E+00	1.72E-03
Use of non-renewable secondary fuels	MJ	1.62E-03	0.00E+00	1.04E-02	1.20E-02
Net use of fresh water	m^3	1.90E+01	1.38E+00	4.70E+00	2.51E+01
Other environmental information describing waste categories: (DU) 1 ton of Product					
Indicator	**Unit**	**A1**	**A2**	**A3**	**A4**
Hazardous waste disposed	kg	2.76E-02	9.40E-03	3.61E-01	3.98E-01
Non-hazardous waste disposed	kg	1.67E+01	5.81E+01	1.21E+00	7.60E+01
Radioactive waste disposed	kg	4.25E-02	1.00E-02	5.73E-05	5.26E-02
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	kg	3.96E-02	0.00E+00	1.02E-01	1.42E-01
Materials for energy recover	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00

INTERPRETATION

The estimated in accordance to ISO 14040 carbon intensity (GHG/GWP) of Butyl Acetate production in the production phase (A1-A3) is 4.3 ton of CO_2 /1 ton of product. 96% of this carbon comes from the production of chemical input materials.

VERIFICATION

The process of verification of this EPD was in accordance with ISO 14025 and ISO 21930. After verification. this EPD is valid for a 5-year-period. EPD does not have to be recalculated after 5 years if the underlying data have not changed significantly.

The basis for LCA analysis was ISO 14040,EN 15804 and ITB PCR A
Independent verification corresponding to ISO 14025 (subclause 8.1.3.) [X] external [ ] internal
External verification of EPD: Ph.D. Eng. Halina Prejzner LCA. LCI audit and input data verification: Ph.D. D.Sc. Eng. Michał Piasecki. m.piasecki@itb.pl Verification of LCA: Ph.D. Eng. Justyna Tomaszewska. j.tomaszewska@itb.pl

The EPD owner has the sole ownership, liability and responsibility for the EPD and input data. EPDs within the same product category but from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with ISO 14040.

Normative references

- Atilgan. B.; Azapagic. A. Assessing the Environmental Sustainability of Electricity Generation in Turkey on a Life Cycle Basis. Energies 2016, 9, 31.
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- Sigma-Aldrich Co., Butyl acetate. Retrieved on 2014-06-28.
- ITB PCR A General Product Category Rules for Construction Products
- ISO 14025:2006. Environmental labels and declarations – Type III environmental declarations – Principles and procedures
- ISO 21930 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services
- ISO 14044 Environmental management – Life cycle assessment – Requirements and guidelines
- Riemenschneider. Wilhelm; Bolt. Hermann M. "Esters. Organic". Ullmann's Encyclopedia of Industrial Chemistry. Weinheim: Wiley-VCH. doi:10.1002/14356007.a09_565.pub2
- .EN 15804 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products
- Ecoinvent / Ecoinvent Centre. www.Eco-invent.org
- TLCID/ Turkish Life Cycle Inventory Database. Turkish Center for Sustainable Production Research and Design (SÜRATAM). www.surdurulebiliruretimmerkezi.org

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Thermal Physics, Acoustics and Environment Department
02-656 Warsaw, Ksawerów 21

CERTIFICATE № 277/2021
of TYPE III ENVIRONMENTAL DECLARATION

Product:

Butyl Acetate

Manufacturer:

ADOKIM CHEMICAL COMPANY

AOSB, 3.Kısım Neighborhood. 35. Road, No:3/11, 07040 Döşemealtı, Antalya/TURKEY

confirms the correctness of the data included in the development of
Type III Environmental Declaration and accordance with the requirements of the standard

PN EN 14025+A1

Environmental labels and declarations -
Type III environmental declarations -
Principles and procedures

This certificate, issued for the first time on 13th December 2021 is valid for 5 years
or until amendment of mentioned Environmental Declaration

Head of the Thermal Physic, Acoustics and Environment Department
Agnieszka Winkler-Skalna, PhD

INSTYTUT TECHNIKI BUDOWLANEJ

Deputy Director
for Research and Innovation
Krzysztof Kuczyński, PhD

Warsaw, December 2021