



BXPA-6

Bauxite (Trombetas, Pará)

Original certificate: September, 2023

Revision: December, 2023

The BXPA-6 is a washed bauxite sample originating from Trombetas region, located in Pará State, Brazil. The raw material was oven-dried, crushed and pulverized to pass a 0.150 mm screen and then homogenized. This reference material is intended for use in calibration of a measurement system, assessment of a measurement procedure, quality control and value assignment to materials with similar matrices. A unit of BXPA-6 consists of 110 g of powdered ore, packaged in a glass bottle.

This material was characterized by means of an interlaboratory program involving twenty three competent laboratories using a variety of methods of demonstrable accuracy. Robust statistical methods [1] were used to estimate the property values and variability components. Certified values were assigned based on a minimum of five accepted data sets, suitable analytical methods suitable for the property value and fitness of the uncertainty associated with the property value for the intended use. The stated uncertainty is an expanded uncertainty, with coverage factor 2, estimated by the uncertainty due to material characterization [2].

Certified Values

Constituent	Unit	Mass fraction	Repeatability standard deviation [1]	Between-laboratory standard deviation [1]	No. sets of data	Minimum sample (g) ³	Analytical methods
Available alumina ¹	% m/m	51.79 ± 0.32	2.9E-01	2.1E-01	18	0.65	f, g, h
Reactive silica ²	% m/m	3.478 ± 0.059	8.8E-02	2.1E-02	18	0.65	c, d, e, f, g, i
Al ₂ O ₃	% m/m	55.85 ± 0.28	1.7E-01	2.2E-01	21	0.6	b, j, k
Fe ₂ O ₃	% m/m	8.912 ± 0.093	5.9E-02	7.3E-02	21	0.6	b, j, k
SiO ₂	% m/m	4.547 ± 0.039	3.6E-02	2.7E-02	20	0.6	e, j, k
TiO ₂	% m/m	1.187 ± 0.015	8.4E-03	1.2E-02	21	0.6	a, j, k
ZrO ₂	% m/m	0.0884 ± 0.0045	3.2E-03	2.3E-03	11	0.6	a, j, k
P ₂ O ₅	% m/m	0.0115 ± 0.0012	8.2E-04	8.1E-04	16	0.66	a, j, k
V ₂ O ₅	% m/m	0.0281 ± 0.0022	8.4E-04	1.3E-03	13	0.6	a, j, k
Cr ₂ O ₃	% m/m	0.0118 ± 0.0013	9.9E-04	6.1E-04	10	0.66	a, k
SO ₃	% m/m	0.0497 ± 0.0056	1.0E-03	3.4E-03	11	0.66	k
Total organic carbon	% m/m	0.066 ± 0.016	8.3E-03	7.4E-03	8	0.1	l, m, n

¹amount of alumina that is digested in a caustic solution (150 °C) at similar conditions of Bayer Process.

²amount of silica that reacts with sodium hydroxide (150 °C) at similar conditions of Bayer Process.

³minimum sample size used in the material characterization

ADDITIONAL INFORMATION ON COMPOSITION

Noncertified property values are provided for information only. Indicative values were assigned to property values derived from data that did not fulfill all the criteria required for certification.

Indicative Values

Constituent	Unit	Mass fraction	Repeatability standard deviation [1]	Between-laboratory standard deviation [1]	No. sets of data	Minimum sample (g) ^{*1}	Analytical methods
CaO	% m/m	0.0113 ± 0.0050	1.1E-03	2.7E-03	8	0.66	a, k
MgO	% m/m	0.0154 ± 0.0064	3.1E-03	2.8E-03	7	0.66	a, k
MnO	% m/m	0.0029 ± 0.0007	2.0E-04	2.5E-04	5	0.7	a, j, k
ZnO	% m/m	0.0032 ± 0.0017	5.3E-04	5.7E-04	4	1	a, k
K ₂ O	% m/m	0.0027 ± 0.0021	4.9E-04	7.2E-04	4	0.7	a, k
Na ₂ O	% m/m	0.0108 ± 0.0023	1.3E-03	1.2E-03	9	0.66	a, k
Ga ₂ O ₃	% m/m	0.0072 ± 0.0021	2.3E-04	7.3E-04	4	0.7	k

^{*1}Minimum sample size used in the material characterization

The mineral composition of BXPA-6 was identified by X-ray diffraction (XRD). The major mineral is gibbsite. Kaolinite and hematite were identified as minor minerals. Anatase, goethite, quartz, boehmite, zircon, diaspore, ilmenite and muscovite were detected as trace minerals.

INSTRUCTIONS FOR HANDLING AND USE

The material bottle must be opened only for sampling. The material must not be put in contact with other chemicals in order to avoid cross contamination. The contents of the bottle should be mixed (by rolling the bottle) before taking samples. Tightly recap the bottle after sampling.

The sample mass for analyses should not be less than the minimum sample size used in the material characterization. The property value and its associated uncertainty are only guaranteed if the minimum sample size is respected.

Analyses must be performed on samples that have been previously dried for at least 16 h in an oven controlled at 105 ± 2 °C.

STORAGE

The material must be stored in its original package, at room temperature in a clean and dry place.

HEALTH AND SAFETY INFORMATION

This material contains fine mineral particulate. Avoid dust dispersion, inhalation, eye contact or skin contact. Dispose of residual material in accordance with regulations pertaining for inorganic chemical and mineralogical waste.

METROLOGICAL TRACEABILITY

In the characterization process by an interlaboratory program, the selection of measurement methods as well as respective calibrants was based on the decision of each participating laboratory. A consequence of such an approach is that the metrological traceability chain(s) for each of the assigned values (combined from a number of results) cannot easily be described, but are expected to include independent sources of bias. Therefore, the demonstrated agreement of independent measurements resulting from the various methods, calibrants, and validation steps, using previously certified materials, results in certified values that are metrologically traceable to the SI units of mass and amount of substance.

ANALYTICAL METHODS

- a acid digestion / inductively coupled plasma optical emission spectrometry
- b acid digestion / titrimetry
- c caustic digestion / flame atomic absorption spectrometry
- d caustic digestion / flame atomic emission spectrometry
- e caustic digestion / gravimetry
- f caustic digestion / inductively coupled plasma atomic emission spectrometry
- g caustic digestion / inductively coupled plasma optical emission spectrometry
- h caustic digestion / titrimetry
- i caustic digestion / spectrophotometry
- j fused pellet /energy dispersive X-ray fluorescence spectrometry
- k fused pellet / wavelength dispersive X-ray fluorescence spectrometry
- l combustion / infrared spectrometry
- m oxidation - combustion / infrared spectrometry
- n oxidation / gravimetry
- o calcination /gravimetry
- p thermal gravimetric analysis

PARTICIPATING LABORATORIES

- Alcoa Alumínio- Laboratório Poços de Caldas, Andradadas, Brasil
- Alcoa Alumina San Ciprian- Laboratory Department, San Ciprian, Spain
- Alcoa Continuous Improvement Centre of Excellence - R&D Laboratory, Kwinana, Western Australia
- Alcoa Kwinana Mining - Laboratory, Kwinana, Western Australia
- Alcoa of Australia Wagerup - Refinery Laboratory, Wagerup, Western Australia
- Alcoa Pinjarra Refinery - Laboratory, Pinjarra, Western Australia
- Alcoa World Alumina Brasil Ltda - Laboratório Mina de Juruti, Juruti, Brasil
- ALS Geochemistry Brisbane, Stafford, Australia
- ALS Geochemistry Perth-Malaga, Malaga, Australia
- ALS Geochemistry Vancouver, North Vancouver, Canada
- ALS Minerals Loughrea, Loughrea, Ireland
- ALS Peru, Callao, Peru
- ALUMAR Consórcio Alumínio do Maranhão - Laboratório, São Luis, Brasil
- Centro de Tecnologia Mineral - Coordenação de Análises Minerais, Rio de Janeiro, Brasil
- Companhia Brasileira de Alumínio - Laboratório Químico, Alumínio, Brasil
- Hydro Alunorte - Laboratório, Barcarena, Brasil
- Hydro Paragominas - Laboratório, Paragominas, Brasil
- Instituto de Tecnología Cerámica - Laboratorio de Análisis Químico, Castellón, Spain
- Jamaica Bauxite Institute, Kingston, Jamaica
- Jamalco Laboratory, Clarendon, Jamaica
- L.A. Teixeira & Filho S/C Ltda, Andradadas, Brasil
- Mineração Rio do Norte - Laboratório Químico, Porto Trombetas, Brasil
- UC Rusal Alumina Jamaica Dbá Windalco, St. Catherine, Jamaica

PERIOD OF VALIDITY

The certified values are valid until September 2043, provided the BXPA-6 unit is handled and stored in accordance with instructions given in this certificate. This certification is nullified if the material is damaged, contaminated or otherwise modified. The stability of BXPA-6 will be monitored over the period of validity. Updates will be published on www.cetem.gov.br/crm.

FURTHER INFORMATION

The certification report is available upon request to CETEM. For details on the interpretation of measurement results on CETEM's certified reference materials, access the publication "Application Guide 1" at www.cetem.gov.br/crm.

CERTIFYING OFFICER

The technical and management aspects involved in the preparation, certification and issuance of the BXPA-6 were coordinated through the CETEM's Certified Reference Material Program.

Maria Alice Goes
Certified Reference Material Program Coordinator

REFERENCES

- [1] ISO 5725-5:1998. Accuracy (trueness and precision) measurement methods and results – Part 5: Alternative methods for determination of the precision of a standard measurement method. International Organization for Standardization (ISO), Geneva.
- [2] ISO 13528:2015 – Statistical methods for use in proficiency testing by interlaboratory comparisons. International Organization for Standardization (ISO), Geneva.