

## The Quality of Bauxites from Bosnia & Herzegovina and Montenegro Processed by the Alumina DOO Zvornik between 2014 and 2018

Željko Ostojčić<sup>1</sup>, Vladimir Damjanović<sup>2</sup>, Zoran Obrenović<sup>3</sup> and Radislav Filipović<sup>4</sup>

1. QC Sector Director

2. Senior R&D engineer

3. QC and Development Director

4. Marketing and Production Director

Alumina DOO, Zvornik Bosnia and Herzegovina

Corresponding author: zeljko.ostojic@birac.ba

### Abstract



The majority of bauxite used as raw material in Alumina DOO Zvornik refinery originates from Bosnia and Herzegovina (B&H) and from Montenegro. Over the past 5 years, about 4 million tonnes of bauxite from B&H and Montenegro have been processed. Bauxites mostly come from mines in the areas of Milići, Srebrenica, Jajce, Mrkonjić Grad, Široki Brijeg, Nikšić and Posušje. Mineralogical analyses confirm that bauxite from B&H and Montenegro are mainly boehmitic. Some mixed gibbsitic-boehmitic bauxites are present in the Herzegovina region, and diasporic-boehmitic bauxite is present in the Jajce and Nikšić mines. By chemical composition, the weight % of Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>, CaO and ZnO are the most important for processing bauxite in Alumina DOO using the Bayer process. Characterisation of bauxite from these sites by the Alumina DOO Laboratory have confirmed their commercial viability, especially for the production of alumina and aluminum hydrate for non-metallurgical purposes, and for the production of various types of zeolites.

**Keywords:** Bauxite, Bayer, Chemical Analysis, Mineralogical Analysis.

### 1. Bauxite

From the beginning of alumina production in Zvornik (in 1978), local mines were the main source of bauxite ore. Initially, the geographically closest mines, Milići (Vlasenica) and Srebrenica provided ~95% of refinery needs. The closure of alumina refineries in ex-Yugoslavia (Podgorica, Obrovac, Kidričevo and Mostar) and in Hungary and Romania, has resulted in Alumina DOO has become the only user in this region. Over the past 5 years (2014-2018) about 4 million tonnes of bauxite from Bosnia and Herzegovina (B&H) and Montenegro (MN) has been processed. Other than bauxites from mines in Milići and Srebrenica, Alumina DOO used bauxite from mines in the areas of Jajce, Mrkonjić Grad, Široki Brijeg, Nikšić (MN) and Posušje. Figure 1 shows the approximate geographical location of these bauxite mines.

#### 1.1. Geology of B&H and Montenegrin Bauxites

Bauxite is quite widespread in B&H and Montenegro. Deposits in B&H are located in western and eastern Herzegovina (reserves of about 80 million tonnes), central Bosnia surrounding Jajce and Mrkonjić Grad, western Bosnia in Bosanska Krupa and Mountain Grmeč (reserves of about 20 million tonnes), and eastern Bosnia, between Srebrenica and Milići (reserves of about 50 million tonnes) [1]. In Herzegovina, the economically most important bauxite deposits are from the Eocene age lying in Karst depressions of upper Cretaceous limestone (floor), and the roof is represented by different lithological elements of the older Eocene [2]. Bauxites of central Bosnia in Ljuša, Liskovica, Poljane, Bešpelj, and Crvena Stijena are from different ages (Triassic, Jurassic, and Cretaceous). Bauxites of western Bosnia are also from different ages (Cretaceous

and Jurassic), while bauxites of eastern Bosnia between Vlasenica and Srebrenica (Braćan, Šumarnica and Kosturi) are from the upper Cretaceous.

According to the stratigraphic nomenclature, bauxites in Montenegro are classified as Triassic, Jurassic, Cretaceous and Eocene. The red karst bauxites of Montenegro are found in carbonate rocks of Mesozoic and Paleocene (reserves of about 130 million tonnes) [1], [3].

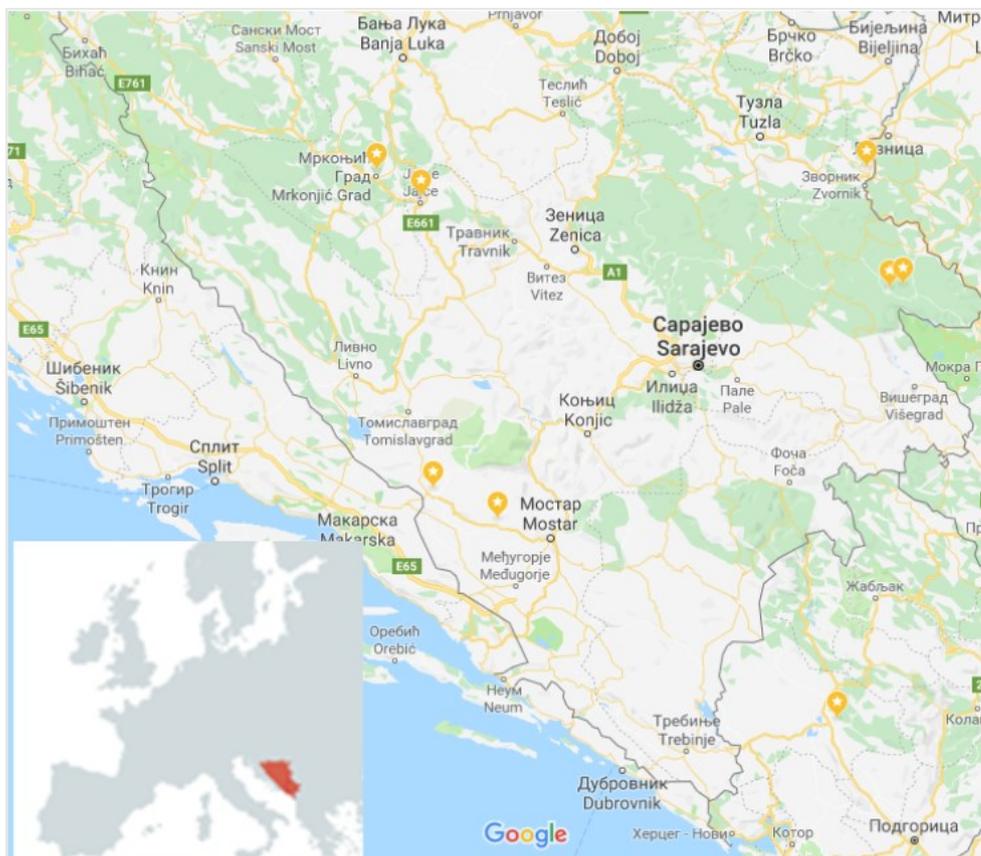
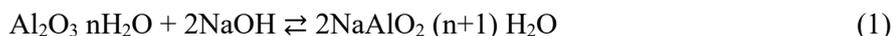


Figure 1. Approximate geographical position of Alumina DOO Zvornik and bauxite mines (Google Maps).

## 1.2. Digestion of Bauxite in Alumina DOO

Of the existing processes for the production of alumina, the most dominant is the hydro-metallurgical Bayer process, which was implemented in Alumina Zvornik in 1978. The process can essentially be represented by the following reaction:



During bauxite digestion, the equilibrium of the above reaction is moved from left to right, and during decomposition (precipitation) of the Bayer liquor, the equilibrium is moved in the opposite direction.

Raw Bauxite is shipped by trucks and railway to the refinery. It is unloaded at the primary bauxite storage area in stockpiles dedicated to a mining location. Since all the bauxites that arrive at the refinery's Mineral Preparation facility differ in quality, in terms of A/S (alumina to silica ratio - wt%  $\text{Al}_2\text{O}_3/\text{SiO}_2$ ), mineralogical composition (boehmite, diaspor, and gibbsite), chemical composition, granulometry and moisture, they have to be homogenised to produce a consistent

## 6. Reference

1. R. Vračar, Ž. Živković, Extractive metallurgy of aluminium, Ekstraktivna metalurgija aluminijuma, *Naučna Knjiga*, Beograd, 1993, 14-54.
2. Mevlida Operta, Mine resources of Bosnia and Herzegovina, Rudni resursi Bosne i Hercegovine - stanje i perspektive, *Zbornik radova 3. Kongresa geografa BiH*, 2012, 579-580.
3. M. Pajović, Geology and genesis of red bauxites of Montenegro, Geologija i geneza crvenih boksita Crne Gore. *Posebna izdanja Geološkog glasnika knjiga XVII*, Podgorica, 2000, 242.
4. ISO 8685:1992(en) Aluminium ores - Sampling procedures.
5. MA.BM.004 Internal method – Bauxite sample preparation - modified JUS B.G8.520.92 i ISO 6994:1986.
6. ISO 6607:1985 Aluminium ores - Determination of total silicon content - Combined gravimetric and spectrophotometric method.
7. SRPS B.G8.512:1982 Bauxite - Determination of Aluminium oxide content potenciomtrically, Određivanje sadržaja aluminijum-oksida potenciomtrijski.
8. MA.BM.029 Internal method – Metal Analysis AAS - Shimadzu Atomic absorption spectrophotometry cookbook.
9. Gordana Ostojić et al., Chemical-mineralogical characterization of bauxites from different deposits, *Contemporary Materials*, V-1, 2014, 86-94.
10. Rajko Aleksić, Radislav Filipović, Procedure for alumina production in Alumina DOO, *Internal procedure PR-02,00-01*, Zvornik 2018.