Habashi, J Textile Sci Eng 2017, 7:6
DOI: 10.4172/2165-8064.1000327

Journal of Textile Science & Engineering

Short Communication Open Access

Alumina Production and the Textile Industry

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Abstract

The Bayer process used today for the production of alumina was originally discovered in Saint Petereburg in Russia in the Tentelev Chemical Plant for supplying mordants to the textile industry. Bayer replaced the Le Chatelier process for preparing aluminum hydroxide invented in 1855 by the sintering process by his method for preparing aluminum hydroxide by seeding in 1888 then by leaching bauxite under pressure in 1892 to recover sodium hydroxide. The process was used unviserally for the treating of bauxite for supplying the growing aluminum industry by alumina.

Keywords: Tentelev plant; Aluminum hydroxide; Le Chatelier process; Seeding; Pressure leaching; Bauxite

Introduction

Karl Josef Bayer (1847-1904) (Figure 1) was born in Bielitz few kilometers south west of Cracow in Silesia, at that time a Province of the Austrian Empire, now in Poland. Bayer went to school at his home town then went to Wiesbaden in Germany to work in the Laboratories of the famous chemist Remigius Fresenius (1818-1897). Then he went to Heidelberg to study chemistry at the University of Heidelberg under Professor Robert Bunsen (1811-1879) for three years. Bunsen's reputation stems from his discovery, together with the physicist Gustav Kirchhoff, of the spectroscopic method of analysis, and the discovery of the two metals rubidium and cesium by this new tool. Bunsen is also famous for the burner known by his name and now found in every chemical laboratory.

In Heidelberg, Bayer got the doctorate in 1871 on the properties of indium which was discovered few years earlier in 1863 in Germany. After obtaining his doctorate, Bayer returned to his home country Austria where he was appointed a lecturer at the University of Technology at Brunn now Brno in Moravia, the Czech Republic. He then left the University to establish a research and consulting laboratory in Brunn.

Technical Details

Bayer later gave up the consulting venture and packed to Saint Petersburg the capital of Russia. Russia at that time was open to foreigners with technical and artistic skills but was suffering from the reign of terror under Alexander III after the assasination of the Tsar Alexander II in 1881. In Russia, Bayer grew up his beard the way Russians do (Figure 2).

Figure 1: Bayer as a young man.

Bayer's years in Russia were the most fruitful and creative years [1-3]. He joined the Tentelev Chemical Plant near Saint Petersburg to work on problems of production of pure aluminum hydroxide for the dyeing of fabrics. The plant was using the Le Chatelier process (Figure 3) to produce aluminum hydroxide which was used as a mordant for dyeing cotton, wool, and silk. The textiles to be dyed were soaked in a solution of the naturally occurring alum (aluminum sulfate), then squeezed, dried and steamed where upon aluminum hydroxide is precipitated on the fibers. Thus treated, the textiles could be immersed in a dye solution to form a colored "lake". This was a standard method of dyeing at that time.

While in Tentelev, Bayer at the age of 41 made the discovery in 1888 that aluminum hydroxide could be precipitated from sodium aluminate solution if a seed of a freshly precipitated aluminum hydroxide were agitated vigorously in the cold solution (Figure 4). The product was pure and can be easily filtered and washed. The process was soon adopted by the Tentelev Plant. Four years later in 1892 he made his second discovery that alumina contained in bauxite could be dissolved selectively by

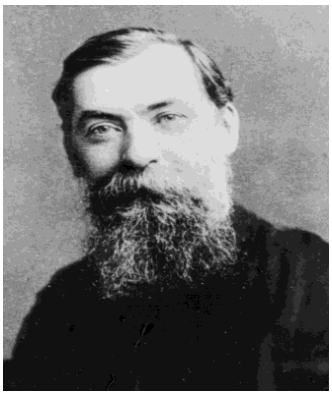

Figure 2: Bayer in saintpetersburg.

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Received November 03, 2017; **Accepted** December 05, 2017; **Published** December 07, 2017

Citation: Habashi F (2017) Alumina Production and the Textile Industry. J Textile Sci Eng 7: 321. doi: 10.4172/2165-8064.1000327

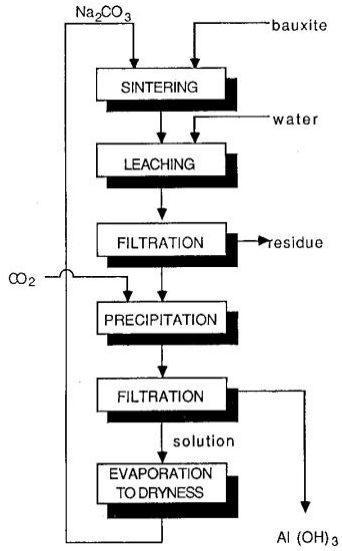

Figure 3: Le chatelier process for preparing aluminium hydroxide in 1855.

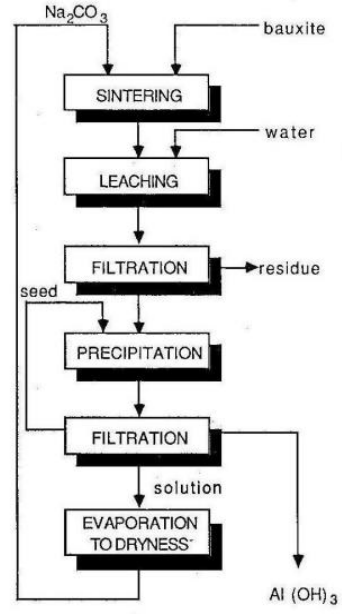

Figure 4: Bayers discovery for preparing aluminimum hydroxide by seeding in 1888.

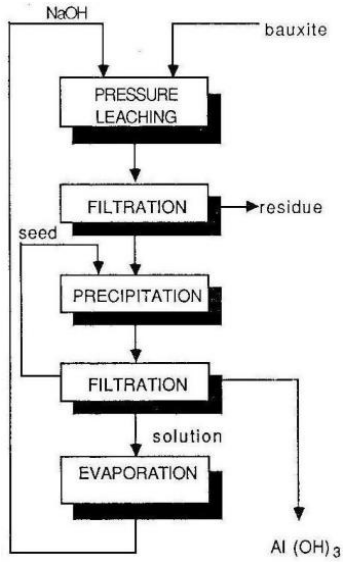

Figure 5: Bayers discovery of leaching bauxite under pressure in 1892.

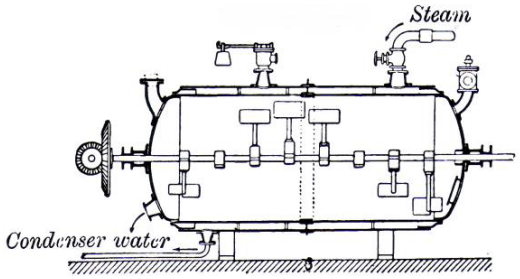

Figure 6: Pressure reactor.

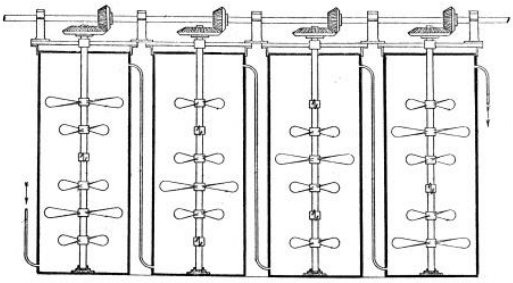

Figure 7: Seeding tank.

heating with a solution of sodium hydroxide under pressure in an autoclave to form sodium aluminate solution (Figure 5). He found also that the alkaline mother liquor obtained after the precipitation of aluminum hydroxide could be used. Bayer introduced pressure reactors (Figure 6) as well as precipitation tanks for seeding (Figure 7).

After seven years in Saint Petersburg, Bayer then moved to another chemical plant at Yelabuga on Kama River 200 kilometers east of Kazan in the Tatar region not far from Urals to build the second plant for alumina manufacture by his process. Bayer stayed only two years in Yelabuga; during this period he received numerous contracts from foreign countries to build alumina factories. The aluminun industry in Russia started only many years after the revolution; bauxite was first mined there in 1926 at a location called Bocksitogorsk which means bauxite city and is 150 kilometers east of Saint Petersburg. The reduction plant was constructed in 1932 at Volkhov not far from the deposits.

Conclusions

Bayer then returned to Austria with the intention to develop the aluminum industry in his country. He settled in Rietzdorf in southern Styria and devoted some time to scientific research. He died suddenly at the age of 57. Bayer is honored in his native country Austria by the medal bearing his name (Figure 8). It is awarded every six years to a distinguished researcher in the field of aluminum. The award ceremony takes place during the International Light Metals Congress which

Figure 8: Austrian medal bearing Bayers name.

Figure 9: Austrian stamp issued in 1987 showing Bayer at an old age.

Figure 10: Hungarian Bayers medal issued in 1987.

is held in Leoben and in Vienna. He is also honored by an Austrian postage stamp issued in 1987 showing Bayer at an old age (Figure 9). The Hungarian aluminum industry also issued in 1987 a medal in Bayer's honor to commemorate the hundred year's anniversary of depositing his first patent (Figure 10).

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