

GALLIUM



Indian Minerals Yearbook 2012

(Part- II : Metals & Alloys)

51st Edition

GALLIUM

(FINAL RELEASE)

**GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES**

Indira Bhavan, Civil Lines,
NAGPUR – 440 001

PHONE/FAX NO. (0712) 2565471
PBX : (0712) 2562649, 2560544, 2560648

E-MAIL : cme@ibm.gov.in
Website: www.ibm.gov.in

January, 2014

7 Gallium

Gallium is a strategic metal used in optoelectronic and defence applications. There is no primary source of gallium in the country. It is generally recovered from sodium aluminate liquors obtained in Bayer's alumina process during aluminium production. A small quantity of gallium is also recovered from residues obtained during zinc processing in some countries. Gallium occurs in trace amount in bauxite & zinc ores and is partly recoverable. It can also be extracted from polymetallic ores by leaching and from coal ash and coal. Bauxite deposits in the country contain gallium and it is recovered during its processing.

USES

Gallium is the backbone of the electronic industry. It expands by 3.1% when it solidifies. Gallium based compounds, such as Gallium arsenide (GaAs) and Gallium nitride (GaN), are semiconductors used in the electronic industry. It is also used in the manufacture of memory cells.

Optoelectronic devices such as LEDs, laser diodes, photodetectors and solar cells manufactured from GaAs continued to be the principal consumer of gallium worldwide. In the near future, use of GaAs is expected to increase, especially in communication markets. Increased use of cellular communications and direct broadcast satellite applications are expected to increase the demand of gallium.

Gallium is used in gallium nitride laser diodes and light-emitting diodes (LED). The new gallium nitride devices are used in high density data storage (compact disk players and digital video disk players), high quality laser printing, communications and lighting. Gallium nitride power transistors operate at high voltages and with a higher power density than current GaAs devices.

Gallium is used in some high temperature thermometers and a eutectic alloy of gallium,

indium and tin is widely available in fever thermometers, replacing mercury. It is also used as a component in low melting alloys and in creating brilliant mirrors. Gallium salts such as gallium citrate and gallium nitrate are used in medical imaging as radio contrast agents.

PRODUCTION

There is no large-scale gallium production in India. Gallium is recovered as a by-product while producing alumina. However, data on production is not available. As per Working Group Report of 12th Five Year Plan (2012-17), India produced around 55 kg gallium in recent past. Two plants namely, Hindalco Industries Ltd at Renukoot, Uttar Pradesh and National Aluminium Co. Ltd at Damanjodi Alumina Refinery, Odisha, recovered gallium.

Hindalco

It is having a capacity for gallium recovery at 55 kg per year at its Renukoot plant. The sodium aluminate liquor obtained in the Bayer's alumina process contains 0.012% gallium by weight. It is electrolysed with mercury as cathode. The amalgam is leached and the resultant sodium gallate solution is further electrolysed to produce gallium of 99.99% purity.

NALCO

Production of Red mud was 20,08,702 tonnes and 20,10,140 tonnes in 2009-10 and 2010-11, respectively. Average gallium as Ga₂O₃ content in bauxite is 0.0085% from which gallium content in red mud is estimated to be about 0.009 to 0.010% after considering losses through product alumina as impurity.

SUBSTITUTES

Liquid crystals made from organic compounds are used in visual displays as substitutes for LED. Researchers are also working to develop organic-based LED that may compete with GaAs

in future. Indium phosphide components can be substituted for GaAs-based infrared laser diodes in some specific wavelength applications. The GaAs competes with helium-neon lasers in visible laser diode applications. Silicon is the principal competitor for GaAs in solar cell applications. GaAs-based integrated circuits are used in many defence applications because of their unique properties and there are no effective substitutes for GaAs in these applications. In some bipolar transistor applications, silicon-germanium may substitute GaAs.

WORLD REVIEW

The world resources of gallium in bauxite are estimated to be over one billion kilograms. Besides, substantial quantity is available in zinc reserves in the world. However, only a small fraction of the gallium content in bauxite and zinc ores is economically recoverable.

Data on world production of primary gallium is not available. However, the United States Geological Survey has estimated total world primary gallium production to be about 78 tonnes, 182 tonnes and 216 tonnes in 2009, 2010 and 2011 respectively. China is believed to be leading producer followed by Germany, Kazakhstan, Ukraine, Rep. of Korea and Russia. Gallium was also recovered in Hungary & Japan. Refined gallium production including that from scrap refining was estimated at 378 tonnes. China, Japan, UK and USA were the principal producers of refined gallium. Gallium was recycled from new scrap in Canada, Germany, Japan, UK and USA. Roskill Information Services estimated worldwide gallium consumption at 218 tonnes in 2011. Neo Material Technologies estimated that 50% of gallium consumed worldwide in 2011 came from recycled sources.

The world demand has been strongest in opto-electronic applications, particularly in light-emitting displays. Because of the enhanced properties, GaAs-based integrated circuits are used in place of silicon in many defence applications. The cellular telephone market was responsible principally for the growth in the gallium consumption in the past few years.

China

China's primary gallium producers were Aluminium Corporation of China Ltd, Beijing Jia Semiconductor Material Co. Ltd, China Crystal Technologies Ltd, East Hope Mianchi Gallium Industry Co. and Zhuhai Fangyuan. China's total primary gallium production and production capacity in 2011 was estimated to be 200 tonnes and 280 tonnes respectively.

Canada

5 N Plus Inc (Montreal Quebec) had signed an MoU with Rio Tinto Alcan to recover primary gallium from Rio Tinto's Vaudrevil alumina facility in Quebec. Orbite Alumina Inc completed construction of pilot plant to recover alumina near Grande-Vallee, Quebec and planned to construct alumina refinery that would be commissioned in 2013 which would recover gallium and other metals.

FUTURE OUTLOOK

With the vast bauxite resources, India has potential for increasing alumina production with greenfield export-oriented plants which can contribute substantially in meeting the domestic demand of gallium by establishment of gallium recovery units. The demand for gallium is likely to increase with the growth of electronic industry in the country. Strategic importance of gallium makes it imperative for development of indigenous technology and also collaboration with foreign countries for refining and production. Zinc deposits, as alternative source, may sometimes in future, become important when easily accessible sources are used up.