Technology News

From the Bureau of Mines, United States Department of the Interior

Technology news describes tested developments from Bureau of Mines programs. It is published to encourage the transfer of this information to the minerals industry and its application to commercial practice. Mention of company or product names is for documentation only and does not imply endorsement of a specific firm or product.

Bureau of Mines research is performed and reported under mandate of the United States Congress. For a free subscription to Technology News, write to Office of Technology Transfer, Bureau of Mines, MS 620, 810 7th St. NW., Washington, DC 20241-0001.

No. 415, January 1993

Graphite-From-Kish Process

Objective

Develop a technology for producing high-quality flake graphite from the steelmaking waste known as kish.

Approach

Treat the waste kish as an ore and apply mineral processing techniques of physical beneficiation and chemical purification to produce a range of graphite products competitive with the natural mineral.

Background

Graphite is a naturally occurring form of carbon with a unique combination of properties that make it indispensable in a very wide range of industrial and consumer applications. It has high electrical and thermal conductivity and remains stable to extremely high temperatures. It has a low coefficient of friction and is nearly impervious to corrosion. The steel industry is dependent on graphite in clay-, magnesia-, and alumina-bonded refractories for crucibles, bricks, facings, and coatings. Electrical uses include graphite brushes in motors and generators, and electrodes in batteries. The transportation industry needs graphite for clutch and brake linings, and all industries depend on graphite in seals, gaskets, lubricants, and coatings. The consumer sees graphite in composite plastics and in the common pencil.

As with all natural minerals, the availability of graphite is diminishing and costs are rising as quality decreases. Furthermore, the United States is totally dependent on foreign sources for this vital material.

This valuable commodity is available from a renewable resource within the very industry that is its largest user. In the steelmaking process, molten iron tapped from the blast furnace contains dissolved carbon at a saturation concentration of about 6 pct. The liquid iron cools somewhat as it is transported and purified before entering the steelmaking furnace. On cooling, the iron cannot hold as much carbon in solution, and some of it comes out in the form of graphite flakes. Part of the graphite burns away, but much of it is wafted throughout the steel plant, where it falls as a continuous rain. More graphite is skimmed from the surface of the molten iron just before it is poured into the steel furnace. The graphitic material, which is contaminated by iron, slag, and oxide fume, is called kish. It has been swept, vacuumed, and shoveled from steel plants and buried as a nuisance waste for decades.

Kish is a potential resource of sufficient quantity to meet the U.S. demand for graphite several times over. Whether it becomes a real resource depends on the answers to three questions:

1. Is it technically feasible to recover graphite from kish?
2. Is graphite from kish suitable for the many needs now met by the natural mineral?
3. Can a graphite-from-kish process be economically competitive with recovery from natural sources, either now or in the future?

The U.S. Bureau of Mines undertook research to answer those questions.

Description of Process

After sampling and evaluating kish from several different steel plants, an extensive laboratory investigation was made to determine the best methods for concentrating and purifying kish graphite. A full treatment process was developed, which consists of screening, concentration by hydraulic classification, acid leaching to remove contaminants, and final drying and sizing of the graphite product. Product purity can be tailored to user specifications to better than 99 pct. The process includes waste treatment operations and regenerates acid for leaching. Byproducts are granular iron suitable for recycle and wallboard-grade gypsum. The final process waste has less than one-tenth the volume of the kish and is safe for landfill disposal.

Test Results

The kish process is simple and uses proven technology. Technical feasibility has been demonstrated at laboratory scale. Evaluation of the graphite products by a variety of industrial users has been overwhelmingly positive. Kish graphite appears to be equal to, and in some uses better than, natural graphite. Preliminary economic estimates based on laboratory work indicated the process can be competitive in the current market.

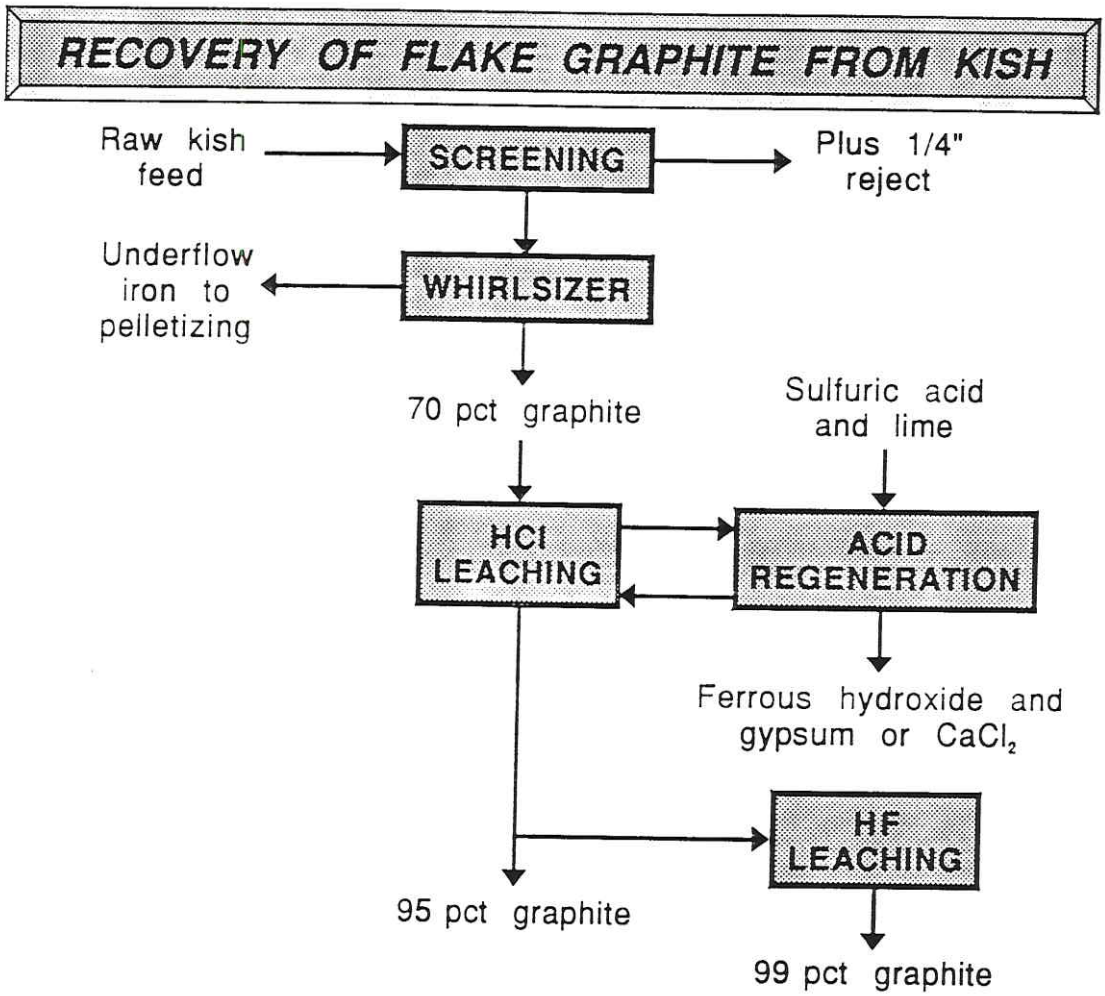
Current Status

Under a cooperative agreement, a major steel producer is constructing a 1-ton-per-day pilot plant to obtain final engineering data and to make a firm assessment of processing costs.

For More Information

Additional information or answers to technical questions may be obtained by contacting the principal researcher for this process:

Larry J. Nicks
Reno Research Center
U.S. Bureau of Mines
1605 Evans Avenue
Reno, NV 89512-2295
(Telephone: 702-334-6674)



Kish processing utilizes simple, proven technology to recover high-quality flake graphite from the waste material. After initial screening, the kish is classified in water to make a graphite concentrate, which is leached with acids to achieve the desired purity. A wide range of graphite flake sizes can be produced with purities to over 99 pct.