BLACKSTONE MINING COMPANY

Zinc: The new oil

Reducing dependence on fossil fuels through zinc-based production of hydrogen energy

GEM: The Green Energy Machine

Blackstone Mining Company seeks Patent for closed-circuit zinc oxide and hydrogen fuel production processes that carry no environmental impact

A REVOLUTION IN HYDROGEN FUEL PRODUCTION will soon unfold in the Bennett Mountains, 80 miles southeast of Boise, Idaho. Blackstone Mining Company is developing a unique method for the production of clean hydrogen fuel by processing zinc ore.

The project, known as the Green Energy Machine (GEM), seeks to create the first self-sustaining hydrogen fuel generator by processing zinc ore and other minerals – with no environmental impact.

Project description

In the initial project phase, GEM is working with 30,000 tons of stockpiled ore at the Blackstone mine. The stockpile represents a minute fraction (0.007%) of the mine's 3.9 million tons of proven and probable zinc-rich reserves. The thermo-chemical reaction of vaporizing zinc allows GEM to produce clean hydrogen fuel in a self-perpetuating processing cycle with no toxic emissions. The by-products of the process are zinc oxide, copper, silver, and gold.

An ore sample from the Blackstone stockpile. The green areas are copper; the dark grey/black areas are zinc and silver; and the light brown areas contain native silver inside a lattice of chalcopyrite.

The process involves heating finely ground ore in electric kilns at around 1000°C, vaporizing the zinc (zinc fuming) and introducing water into the resulting vapor stream. The reaction produces hydrogen fuel and zinc oxide; the latter precipitating as a nontoxic compound used in the manufacturing of rubber, cosmetics, pharmaceuticals, food supplements, and electronics.

Blackstone Mine location map

GEM will begin as a six-ton-per-day pilot plant, generating about 100 kilowatts of electricity from the zinc vapor/water reaction, and creating enough energy to operate the kilns and auxiliary equipment for the processing circuit. A diesel-powered generator would burn about 100 gallons or more per day to process an equal amount of ore.

Based on hydrogen's energy-to-weight ratio (2.8 times greater than fossil fuel) it is estimated that 60 pounds per ton of zinc will produce enough hydrogen to operate the GEM generators for the pilot sized operation continuously without the need for fossil fuels.

Ore from the Blackstone stockpile will be graded prior to introduction to the GEM processing circuit to ensure the zinc content is above 60 pounds per ton — the minimum for self-sufficiency.

The polymetallic values in the Blackstone ore stockpile have an estimated combined value of about $27 million at current metals prices. Besides being energy self-sustaining, GEM is projected to be economically self-supporting from the sale of zinc oxide and zinc powder, as well as copper, silver, and gold matte.

Energy vs. volume

While the energy-to-weight ratio of hydrogen is higher than that of fossil fuels, it requires four times the mass to store the gas. For example, a diesel fuel tank with a 2,500-gallon capacity would run Blackstone GEM generators for about 10 days. A similarly sized hydrogen storage tank would run the generators for approximately four days.

GEM hydrogen fuel will be staged in above-ground storage tanks, allowing sufficient capacity for at least one week of operations. GEM hydrogen production will save about $22,000 a month in fuel — bringing GEM's monthly operating costs to about $25,000 — while eliminating the need for fossil fuels.

GEM economics

The market value of zinc oxide depends on grade, particle size, and purity. Prices typically vary between $5 per pound for industrial grade to $45 or more per pound for cosmetic, pharmaceutical, electronic, and nanoparticle reagents.

Engineering reports from past Blackstone lessees indicate the average values of the metals in the stockpiled ore are 0.106 ounces of gold, 23.53 ounces of silver, 96 pounds of copper, and 170 pounds of zinc per ton. Based on a 6-ton-per-day ore feed with zinc oxide selling at $5 per pound, the gross return for all metals would be $2,760 per day. The gold, silver, and copper by-products would return $2,200 daily at current metals prices. Total GEM pilot plant output is projected at $120,000 per month.

By-product recovery

The GEM processing circuit combines zinc fuming and direct smelting in which -200 mesh ore is roasted in an electric powered kiln at about 1000°C,

vaporizing the zinc content. The zinc vapors are captured in a filtration system commonly known as a bag-house. Introducing water to the zinc vapor stream creates hydrogen and precipitates zinc oxide.

The remaining roasted ore (calcine) is mixed with reagents, fired at temperatures above 1300°C, and poured as a matte of copper, silver, gold, and lead. The matte is then sent to a third-party refinery for final separation and certification.

Traces of palladium and small amounts of nickel have been reported in the Blackstone ore stockpile. If these metals are present in economic quantities, the slag will be reprocessed in a high-temperature reactor for subsequent recovery. Fully processed slag is expected to be recycled for use as asphalt aggregate ("glassphalt") or other construction materials.

Green chemistry

The chemistry of producing hydrogen through the dissociation of zinc oxide is well known. In 2005, a team of scientists at the Weitzman Institute in Israel introduced an energy self-sufficient hydrogen production process by dissociating zinc oxide with a solar reactor to produce zinc powder. The powder was mixed with 350°C water to produce hydrogen, reprecipitate the zinc oxide for further dissociation, and then reused to produce more hydrogen.

Promising as this research was, the project did not address the production of the zinc oxide catalyst used to make the zinc powder nor did it address the energy required to create the compound. In contrast, GEM hydrogen production begins at the source through the vaporization of zinc ore. By increasing zinc content above the 3 percent (60 lbs/ton) required for self-sustainability, GEM can produce an excess of hydrogen. The extra fuel can be used for firing a high-temperature reactor for disssociating zinc oxide into zinc powder.

Zinc powder is easier to handle and can be safely transported to power plants and fuel depots where hydrogen fuel could be easily generated using the zinc powder/water reaction. Instead of coal- or gas-fired power plants, zinc powder is a far more efficient and inexpensive energy source.

With fewer than 60 hydrogen fuel stations in the United States, the widespread use of hydrogen-powered vehicles has been stunted. Zinc powder offers a viable method for hydrogen production at local hydrogen fueling stations, ultimately clearing the way for widespread distribution and an excellent alternative to fossil fuel vehicle pollution. In the not-too-distant future, drums of zinc powder could become the replacement for barrels of oil.

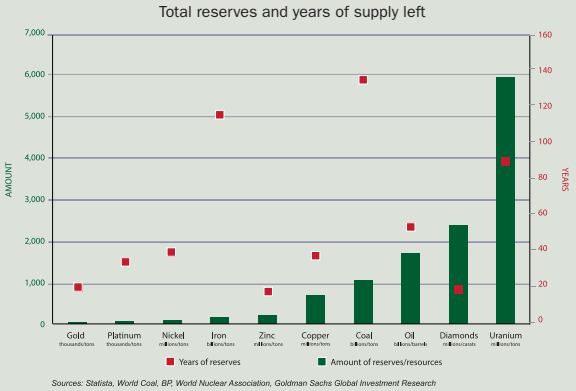
Mobile zinc powder/water generation

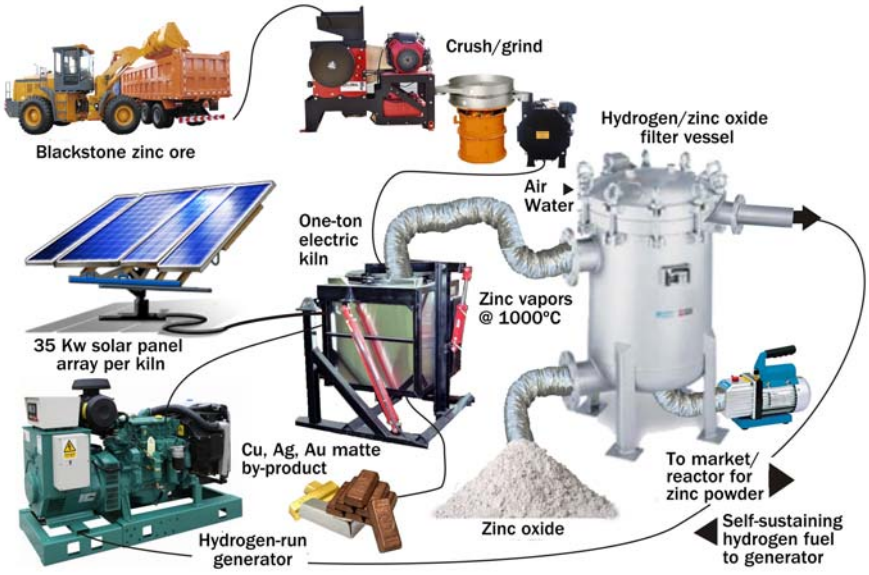
While the goal in Phase One is the self-sufficient production of zinc oxide, zinc powder, copper, silver, and gold, the project will also be well positioned to produce alternative fuels. While Blackstone's GEM facility is a fixed structure, the technology is portable. Blackstone zinc powder can become the renewable resource for compact, transportable hydrogen generators.

Severe drought conditions in the Western states have resulted in strict water conservation restrictions. The portable GEM hydrogen production cycle can use sea or waste water for the zinc powder reaction, producing

Goldman Sachs: Are we running out of zinc?

A March 2015 Goldman Sachs research report indicates that the world has only about 20 years' worth of known minable reserves of gold, diamonds, and zinc. Other experts suggest that the zinc supply may be even less than Goldman Sachs estimates, based on recent and anticipated major mine closures in China and Australia.





Schematic of the Blackstone Mine ore processing circuit

potable water as a by-product and creating another benefit of the hydrogen production process.

The federal government has provided more than $100 billion in loans, guarantees, tax credits, and other incentives to support projects for reducing greenhouse gases, air pollution, and non-fossil fuel transportation. The initiatives include a mandate to triple the government's use of renewable sources for electricity by 2020. Even in its infancy, GEM will undoubtedly benefit from the government's drive for the production of clean energy and potable water.

Financing

While the sale of zinc oxide, copper, silver, and gold is expected to be profitable, capital is required to fund installation and initial operation of the GEM facility. The Company plans to pursue an equity offering, government financing, and crowdfunding (subject to regulatory approval).

The Company plans to offer up to 3,000,000 convertible preferred shares at $1.00 per share, open only to accredited investors. The shares carry a refinery coupon entitling shareholders to a 20 percent pro-rata cash share of profits from GEM refinery returns and zinc oxide sales.

The Company also intends to apply for government grants or loans applicable to the GEM project. To the extent possible, the Company will pass through tax credits and green energy financial incentives resulting from GEM development.

> "In the future, drums of zinc powder could replace barrels of oil.

In addition to installation and initial operation of GEM, proceeds will also be used to pursue the Company's patent applications for GEM and its zinc powder/water mobile hydrogen generation plant design.

About the company

Blackstone Mining Company was incorporated in 1903 by former Idaho Governor James Hawley and his partners. The Blackstone Mine is a 100-acre complex consisting of five federally patented mining claims, which the Company owns in fee simple title. The mine contains nearly 3.9 million tons of proven and probable reserves valued at $824 million at current metals prices.

Exploratory drilling to date has only been in the upper reaches of the property (278 vertical feet). Based on laboratory tests at the University of Idaho School of Mines and elsewhere, the primary minerals are silver inside a lattice of chalcopyrite, sphalerite, malachite, chrysocolla, and galena in a series of parallel quartz structures approximately 40 to 110 feet wide along a 7,500-foot strike. Geologists familiar with the property believe that the Blackstone ore body is an intrusion from the Idaho batholith with vein structures having an estimated depth of 6,500 feet or more.

For more information, contact Jim Hawley, **(702) 204-7699** or email **jimh@blackstonemine.com.**

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