Steel

Michael D. Fenton, a U.S. Geological Survey mineral commodity specialist, has compiled the following information about steel, a metal critical to the industrial base of the United States.

About 96 million metric tons of steel was produced in the United States last year — more than any other metal. And the $3.46 billion of iron and steel scrap exported was also the highest of any metal scrap export, helping to reduce the U.S. trade deficit.

As to when the first iron was used is lost to antiquity. It may have been recovered from meteorites. Later, iron metal was derived from iron oxides in a smelting procedure similar to that used to produce copper from copper oxides. After the beginning of the Iron Age, about 3,200 years ago, knowledge of iron- and steel-making spread from the ancient Middle East through Greece to the Romans and then to Europe. The first furnace to operate successfully in North America was in 1646, in what is now Saugus, Mass. The size and efficiency of furnaces increased rapidly until the mid-19th century, when the Bessemer converter was invented. Because it could convert batches of up to 25 metric tons or more of molten iron into steel, it made the modern age of steel possible.

Pig iron is a high-carbon alloy made by smelting iron ore in a blast furnace with carbonaceous material, usually coke, as a reducing agent. Limestone is added to the iron ore-coke mix to remove impurities. Iron is refined in a basic oxygen converter to steel, which is then passed through continuous casting machines that produce plates, sheets, bars and other flat-rolled products. Steel is also made by recycling ferrous scrap in an electric arc furnace.

Although there are thousands of proprietary grades and hundreds of standard grades of steel based on chemistry, three major categories of steel exist: carbon, alloy and stainless. About 91 percent of the U.S.- made steel is carbon steel, which actually contains no more than 2 percent carbon. The construction, automotive, shipbuilding, containers, and packaging, appliances, machinery and equipment industries are the primary consumers of this type of steel. Alloy steel, about 6 percent of annual steel production, contains as much as 4 percent alloying elements, including chromium, copper, molybdenum, nickel, titanium, tungsten and vanadium. Alloy steels are used to manufacture specialty machine parts and tools, among other applications. Chromium and usually nickel are added to steel to make it highly corrosion resistant, forming stainless steel, which is about 3 percent of annual U.S. steel production.

China led the world in steel production in 2006, producing 420 million metric tons, or 35 percent of the world’s total, and maintains 32 percent of global steel-making capacity. Japan was second in steel production, accounting for 114 million metric tons, or 9 percent of both the world’s total and capacity. The United States was third, accounting for 96 million metric tons, or 8 percent of both the world total and capacity. For the first time, steel production exceeded consumption in China in 2006. This caused Chinese steel exports to reach a record high, 110 percent greater than that of 2005, while steel imports were down 28 percent compared with those of 2005. The net result was an influx of steel products into the United States from countries having excess steel-making capacity that would normally have exported to China. China states that it is attempting to reduce steel production by closing low-capacity mills having high energy consumption and high

pollution, raising power charges to mills and consolidating smaller, less-efficient mills. Company consolidation continues throughout the steel industry worldwide, with larger companies now beginning to dominate the industry.

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Steel is an alloy consisting mostly of iron. Image from USGS.