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2009 The Inherent Recycled Content of Today's Steel

This paper provides an overview of the methods used to produce steel in North America today, and describes steel's inherent recycled content. Contemporary technologies produce steel in two ways, both of which require old steel to make new.

The basic oxygen furnace (BOF) process uses 20 to 35 percent old steel to make new. It produces products—such as automotive fenders, encasements of refrigerators, and packaging like soup cans, five-gallon pails, and 55-gallon drums—whose major required characteristic is drawability.

The electric arc furnace (EAF) process uses more than 80 percent old steel to make new. It produces products— such as structural beams, steel plates, and reinforcement bars—whose major required characteristic is strength.

Many are surprised to learn that steel is the world's, as well as North America's, most recycled material, and in the United States alone, almost 66 million tons of steel were recycled or exported for recycling in 2009. This is done for economic as well as environmental reasons. It is always cheaper to recycle steel than to mine virgin ore and move it through the process of making new steel. However, it should also be clearly understood that many steel applications are durables, and even though two out of every three pounds of new steel are produced from old steel, the fact that cars, appliances, and bridges last a long time makes it necessary to continue to mine virgin ore to supplement the production of new steel. Economic expansion, domestically and internationally, creates additional demand that cannot be fully met by available scrap supplies.

Unlike other competing industries, recycling in the steel industry is second nature. The North American steel industry has been recycling steel scrap for over 170 years through the network of some 2,500 scrap processors and 12,500 auto dismantlers. Many have been in the business for more than 100 years. The pre-consumer, post-consumer, and total recycled content of steel products in the United States can be determined for the calendar year 2009 using information from the American Iron and Steel Institute (AISI), the Institute of Scrap Recycling Industries (ISRI), and the U.S. Geological Survey. Additionally, a study prepared for the AISI by William T. Hogan, S.A., and Frank T. Koelble of Fordham University is used to establish pre- and post-consumer fractions of purchased scrap.

The steel and iron industries enjoy an open-loop recycling capability, with available scrap typically going to the closest melting furnace. This open-loop recycling allows, for example, an old car to be melted down to produce a new soup can; then, as the new soup can is recycled, it is melted down to produce a new car, appliance, or perhaps a structural beam used to repair some portion of the Golden Gate Bridge. For this reason, average industry statistics more accurately portray the overall impact of industry recycling activity than those of an individual company.

Basic Oxygen Furnace

Domestic basic oxygen furnace (BOF) facilities consumed a total of 8,722,000 tons of ferrous scrap in the production of 24,977,000 tons of raw steel during 2009. Based on U.S. Geological Survey statistics, 1,454,000 of these ferrous scrap tons had been generated as unsalable steel product within the confines of these steelmaking sites. In the steel industry, these tons are a mix of "runaround scrap" and pre-consumer scrap. (The "runaround scrap" is specifically excluded from recycled content since it is scrap that is recovered within the same steel mill process that generated it.) Estimates by the Steel Recycling Institute identify about 80% of this unsalable steel as pre-consumer scrap, equating to 1,163,200 tons (1,454,000 x 80%). Additionally, these operations reported that they consumed 58,000 tons of obsolete scrap (buildings and warehouses dismantled on-site at the mill) during this timeframe. This volume is classified as post-consumer scrap.

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The New Steel

Steel Recycling Institute

As a result of the above, based on the total scrap consumed, outside purchases of scrap equate to 7,210,000 tons [8,722,000 - (1,454,000 + 58,000)]. According to the Fordham University study, the post-consumer fraction of the purchased ferrous scrap would be 83.4%, while 16.6% of these purchases would be pre-consumer. This equates to 1,196,860 tons of pre-consumer scrap (7,210,000 x 16.6%) which is mainly generated by manufacturing processes for products made with steel.

Therefore, the **total recycled content** to produce the 24,977,000 tons of raw steel in the BOF is:

8,722,000 / 24,977,000 = 34.9%
(Total Tons Ferrous Scrap / Total Tons Raw Steel)

Also, the **post-consumer recycled content** is:

(7,210,000 - 1,196,860) + 58,000 = 6,071,140
and
6,071,140 / 24,977,000 = 24.3%
(Post-Consumer Scrap / Total Tons Raw Steel)

Finally, the **pre-consumer recycled content** is:

(1,163,200 + 1,196,860) / 24,977,000 =
2,360,060 / 24,977,000 = 9.4%
(Pre-Consumer Scrap / Total Tons Raw Steel)

Electric Arc Furnace

The electric arc furnace (EAF) facilities consumed a total of 35,909,000 tons of ferrous scrap in the production of 38,700,000 tons of raw steel during 2009. Based on U.S. Geological Survey adjusted statistics, 1,462,000 of these ferrous scrap tons had been generated as unsalable steel product within the confines of these steelmaking sites. Again, in the steel industry, these tons are a mix of "runaround scrap" and pre-consumer scrap. Estimates by the Steel Recycling Institute identify about 80% of this unsalable steel as pre-consumer scrap, equating to 1,169,600 tons (1,462,000 x 80%). Additionally, these operations reported that they consumed 88,000 tons of obsolete scrap (buildings and warehouses dismantled on-site at the mill) during this time frame. This volume is classified as post-consumer scrap.

As a result, based on the total scrap consumed, outside purchases of scrap equate to 34,359,000 tons [35,909,000 - (1,462,000 + 88,000)]. According to the Fordham University study, the post-consumer fraction of the purchased ferrous scrap would be 83.4%, while 16.6% of these purchases would be pre-consumer. This equates to 5,703,600 tons of pre-consumer scrap (34,359,000 x 16.6%) which is mainly generated by manufacturing processes for products made with steel.

Therefore, the **total recycled content** to produce the 38,700,000 tons of raw steel in the EAF is:

35,909,000 / 38,700,000 = 92.8%
(Total Tons Ferrous Scrap / Total Tons Raw Steel)

Also, the **post-consumer recycled content** is:

(34,359,000 - 5,703,600) + 88,000) = 28,743,400
28,743,400 / 38,700,000 = 74.3%
(Post-Consumer Scrap / Total Tons Raw Steel)
and

Finally, the **pre-consumer recycled content** is:

(1,169,600 + 5,703,600) / 38,700,000 =
6,873,200 / 38,700,000 = 17.8%
(Pre-Consumer Scrap / Total Tons Raw Steel)

The above discussion and calculations demonstrate conclusively the inherent recycled content of **steel produced today in North America**. To buy domestic steel is to "Buy Recycled."

Understanding the recycled content of steel, one should not attempt to select one steel producer over another on the basis of a simplistic comparison of relative scrap usage or recycled content. After its useful product life, steel is recycled back into another steel product. Thus steel with about 30% recycled content or with about 90% recycled content are both complementary parts of the holistic cradle-to-cradle infrastructure of steelmaking, product manufacture, scrap generation and recycling.

Steel is truly the most recycled material.