

Zinc Recycling

Closing the Loop



Zinc is an essential element for all living organisms. Its unique metallurgical and chemical properties have also made it the material of choice for an extensive range of applications in modern society. At the end of their useful life, the contained zinc recovered from these products can be recycled without loss of its metallurgical characteristics or value. Further, while the attributes of zinc contribute significantly to sustainability during the use phase, since zinc recycling is a critical and beneficial supplement to primary metal production, zinc also plays an important role during the end-of-life phase by reducing energy use, lowering emissions and minimizing waste disposal.

Two approaches commonly used to assess recycling rates for zinc are the recycled content and end of life recycling rate.

Recycled Content, as its name implies, is the measure of recycled content in a given product. For metals, recycled content is considered at the metal production stage (e.g. slab zinc). The recycled content for zinc is about 15% of global refined metal production. Zinc's combination of relatively long service life (>40 years on average) and strong consumption growth over time (Figure 1), puts it at a disadvantage when comparing its recycled content against materials like paper, glass or plastic whose uses are often short-lived consumables.

For zinc and other highly durable products, **End of Life Recycling Rate** is the preferred measure as it offers a more comprehensive approach by incorporating recycling efficiency, product lifetimes and historical production patterns. It quantifies the amount of zinc actually recovered at the end of product life ("old scrap") and recycled into new zinc products, and requires an understanding of historical production and consumption levels, product lifetimes and collection rates. It is estimated that 60% of available zinc at the end of life is recovered and actually recycled.

FIGURE 1: Estimated Global Refined Zinc Consumption by End Use

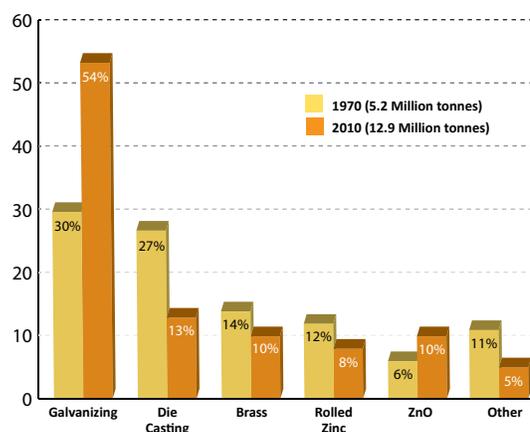
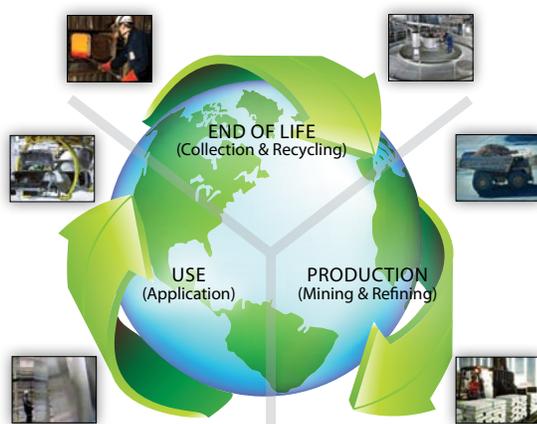


FIGURE 2: Recycling Circuit for Zinc



What are the current uses of zinc?

Galvanizing - coating steel with zinc to provide corrosion protection - is the largest use of zinc metal accounting for over 50% of total consumption. Other markets for zinc include diecasting, brass (alloying with copper), rolled zinc sheet, compounds (fertilizers, paint, rubber and pharmaceuticals) and batteries (Figure 1). The uses of zinc have not significantly changed over time; however, refined zinc consumption has more than doubled in the last 40 years to over 13 million tonnes annually. The majority of this growth has occurred in applications with long effective lifetimes, such as galvanizing, where these products may stay in service up to 100 years.

What are the sources for zinc recycling?

A systematic life cycle for zinc is illustrated in Figure 2. Zinc containing products such as galvanized steel become a source of recycling feedstock at the end of their useful lives (“old scrap”). These products are collected and processed based on scrap availability, metal composition (e.g., purity, alloy, etc.) and ease of processing. Additionally, due to potential losses during manufacturing and fabrication (e.g., drosses, residues, off-cuts, etc.), zinc becomes available for recycling during the processing phase (“new scrap”). Depending on the composition of the scrap being recycled, it can either be re-melted or returned to the refining process (Table 1).

TABLE 1: Sources and type of secondary zinc

SCRAP SOURCE	TYPE OF SCRAP			RECOVER PROCESS
	RESIDUES AND DROSSES (NS)	WHOLE PRODUCTS (OS)	STEEL FILTER DUST (OS)	
Brass	✓	✓	-	Remelting
Die Casting	-	✓	-	Remelting
Galvanizing	✓	-	✓	Remelting (NS) Refining (OS)
Rolled Zinc	✓	✓	-	Remelting
Other	✓	✓	✓	Remelting (NS) Refining (OS)

OS = Old scrap; NS = New scrap

How much zinc is recycled?

Understanding the intricate pathway from production through end of life allows recycling rates for zinc to be quantified for the overall industry, or by end use sector. About 60% of old scrap coming to end of life is ultimately recycled (End of Life Recycling Rate). The recycling rates are significantly higher for some products such as zinc sheet roofing and brass (well over 90%), while some uses cannot be recycled (zinc oxide used in pharmaceutical products). For developed regions, such as Europe and the United States, recycling rates are considerably higher due to existing state-of-the-art technology and end of life policy measures. The “old scrap ratio” can be calculated as the fraction of zinc from old scrap in the overall recycling flow. Considering end of life efficiencies for zinc, “old scrap” accounts for approximately 45% of total scrap available (Table 2). Recycling rates are also useful in identifying areas for waste management optimization and to assess the benefits of policy measures (e.g., Life Cycle Assessment).

TABLE 2: Typical Recycling Rate Indices

INDICATOR	DESCRIPTION	ESTIMATED GLOBAL RECYCLING RATE
Recycled Content (RC)	Fraction of zinc scrap (new and old) in the total metal input of metal production (primary and secondary)	15%
Old Scrap Ratio (OSR)	Fraction of zinc from old scrap in the overall recycling flow	45%
End of Life Recycling Rate (EOL-RR)	Fraction of zinc recycled at end of life relative to the amount of zinc available at end of life	60%

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What is the zinc industry doing to advance zinc recycling?

Due to the value of zinc as a commodity, the industry continues to advance technologies for recovering zinc from products at end of life. For example, the global capacity to recover zinc from galvanized steel scrap (steel filter dust) is continually growing. In addition, the International Zinc Association (IZA) has developed models to quantify zinc recycling rates to demonstrate the recyclability of products and effectiveness of recycling programs. Further, the IZA continually generates and monitors information on the effectiveness of zinc recycling to help communicate and promote the many ways zinc contributes to a sustainable society.



More detailed information is available on the IZA website at www.zinc.org.

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