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 use, zinc also plays an important role during the end-of-life phase by reducing energy use, lowering emissions and minimizing waste disposal.

What are the current uses of zinc?

Refined zinc is used in a variety of applications. Galvanizing – coating steel with zinc to provide corrosion protection – represents the largest first use of zinc metal, accounting for 60% of total consumption (Figure 1). Other markets for zinc include alloying with copper (brass) or aluminum (die casting), rolled zinc sheet, compounds such as ZnO (used in fertilizers, paint, rubber and pharmaceuticals) and many other applications. These uses have not significantly changed over time; however, zinc consumption has more than doubled in the last 40 years. The majority of this growth has occurred in applications with long effective lifetimes, such as galvanizing and rolled zinc, where these products may stay in service up to 100 years. Primary end use markets for these products include construction, transportation, industrial, electronic, and agricultural applications.

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).

Figure 1. Global refined zinc consumption by first use.

Figure 2. Recycling circuit for zinc.
What are recycling indicators?

Two approaches commonly used to assess recycling rates for zinc are the End of Life (EoL) recycling rate and Recycled Content.

For zinc and other highly durable products, the EoL recycling rate is the preferred measure as it offers a more comprehensive approach by incorporating recycling efficiency, product lifetimes and historical production patterns. The EoL recycling rate quantifies the amount of zinc actually recovered at the end of product life (“old scrap”) and recycled into new zinc metal. It is estimated that approximately 45% of available zinc at the end of life is recovered and actually recycled (Table 2). For developed regions like Europe and North America the EoL recycling rate can equal or exceed 50%. For developing regions, the EoL recycling rate is 30-40% due to the lack of mature recycling networks and regulatory initiatives directed at reducing industrial waste.

Recycled Content, is the measure of recycled content in a given product. For metals, recycled content can be considered for the refined metal (e.g. slab zinc) or the sum of all material going into fabrication. The recycled content for refined zinc is currently about 8% (scrap combined with concentrate as feedstock at the smelter). When considering the sum of all material used to produce zinc-bearing goods, the recycled content jumps to approximately 25-30% because of the amount of secondary material that does not require further refinement and can be fed directly into the fabrication process (Table 2).

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 45% of old scrap coming to end of life is ultimately recycled (End of Life (EoL) Recycling Rate; Table 2). 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). 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 70% of total scrap available. Recycling rates are also useful in identifying areas for waste management optimization and to assess the benefits of policy measures.

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. 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.