

Environmentally sound production: Recycling options for castings and forgings

Introduction

Producers of castings and forgings use to a high extent non-renewable resources extracted by mining activities. The metals most often applied in casting and forging products are e.g. iron, copper, aluminium, nickel and cobalt. Because metals are non-renewable, recycling of used metals is an attractive option for producers of castings and forgings.

Because castings and forgings come in all types, sizes and shapes, it is difficult to draw a comprehensive list of suggestions for the recycling of metals in the castings and forgings industry. In general, one can think of the following issues:

- **Recycling infrastructure:** In regions where there is no recycling infrastructure, producers may consider cooperation with environmental organisations to collect products that can no longer be reclaimed. In some countries there is a legal obligation for recycling.
- **Shape of the scrap:** The shape of the scrap (the recyclable metal part) should be suitable for the furnace of the producer; massive and odd-shaped scrap may not fit. Some types of furnace do not require precise sizing of the scrap.
- **Quality of the scrap:** The quality of the scrap should be considered in relation to its new destination. New scrap (the surplus material discarded during manufacturing) is generally 'cleaner' and suitable for more purposes than 'old' scrap collected by recyclers.
- **Type of metal:** Each metal has its own characteristics, such as resistance to corrosion and erosion, heavy or light, toxic or non-toxic. These are also determinant factors for the recycling destination.

In this document, several existing recycling practices related to the castings and forgings industry illustrate the points listed above. The following examples have been described:

- Recycling of old aluminium scrap by the castings industry
- Recycling of aluminium
- Titanium scrap recycling and titanium castings, India

Recycling of old aluminium scrap by the castings industry

The castings industry produces a wide variety of aluminium products. Aluminium is widely recognised as a valuable metal. This contributes to its high rate of recycling all over the world, probably the highest of all metals. Today recycled aluminium accounts for one-third of global aluminium consumption worldwide. Recycling is an essential part of the aluminium industry and makes sense economically, technically and ecologically. Efficiency of aluminium recycling thus translates into high recycling rates for the various applications. The castings industry uses up a large part of recycled aluminium.

Aluminium destined for recycling can be described with two categories: new and old scrap.

New scrap is the surplus material that is discarded during the manufacturing and fabrication of aluminium alloys (e.g. the splinters of sheet edge trimmings). Old scrap is aluminium material that is recovered when an aluminium article has been produced, used and finally discarded at the end of its useful life. Such scrap could be e.g. used beverage cans, car cylinder heads, window frames from a demolished building or old electrical conductors.

Old scrap comes to the recyclers via a network of metal merchants who have the technology to recover aluminium from motor vehicles, household appliances, etc. This is often done using heavy equipment such as shredders, normally together with magnetic separators to remove iron, and sink-and-float installations to separate the aluminium from other materials.

The recycling of old scrap is usually carried out by secondary aluminium refiners. These companies convert most of their materials into foundry ingot, generally based on the aluminium-silicon alloy system with additions of other metals such as copper and magnesium. These ingots, fabricated according to recognised national or international specifications, go into the manufacture of aluminium cast components. A significant share of the secondary aluminium refiners' output is also delivered in a molten form by road tanker to large foundry users thus eliminating the need for further melting operations.

Alloy 'hardeners' are also being produced. These ingots, with a high known percentage content of alloying metals, are used by other sectors of the aluminium industry such as primary smelter cast houses or remelt units located at semi-finished aluminium plants.

Recycling of metal castings and foundry sand

The metal casting industry offers enormous possibilities for conserving non-renewable natural resources. Metal castings use up to 20 million tons of recycled metal as their primary feed stock to minimize waste. These metals otherwise would have been disposed of in landfills. Recycling foundries convert society's unwanted products into new and useful castings. Foundries using sand to make moulds and cores continually recycle it through reclamation systems. Otherwise, more than 100 million tons of sand would have ended up in landfills if it weren't reclaimed.

The Ohio Cast Metals Association (OCMA) is a large producer of metal castings. OCMA is working together with the Ohio Environmental Protection Agency and the Department of Transportation to use foundry sand that can no longer be reclaimed. The company is developing applications for recycling sand such as low-strength concrete, and continues to work on other reuses.

➔ [More information](#) on their experiences can be found on the corporate website, as well as details for further contact.

Titanium scrap recycling and titanium castings

In India, there are companies for the mining, processing and exporting of titanium ores. However, no commercial facility for production of titanium sponge existed. Import of titanium sponge is an unattractive option, due to high prices. In order to meet the domestic demand for titanium sponge, the Technology Information, Forecasting & Assessment Council (TIFAC) has developed the project 'Recycling of Titanium Scrap'. The project was part of TIFAC's Home Growing Technology Programme, which aims to increase industrial know-how and expertise in India.

The project provided in the installation of a melting furnace at Midhani (Hyderabad), a public sector company operating under the Ministry of Defence. Midhani is the only manufacturer in the country producing commercially pure titanium and a host of titanium alloys for a wide range of industrial applications, both of commercial and strategic nature.

The objective of the project was aimed at recycling of plant scrap as part replacement of titanium sponge and expensive alloying materials for manufacturing commercially pure titanium and alloy titanium ingots. The technology includes conversion of scrap into slab/billets for direct rolling. Titanium, being light, corrosion and erosion resistant, is well suited for chemical, petrochemical, nuclear, marine and aerospace applications. In addition, due to its non-toxic property, it finds extensive applications in medical implants that has a niche market of high commercial value.

The unique features of the type of furnace installed are threefold:

- it can be used for scrap consolidation
- it can convert scrap to billets/slabs and useful castings at a comparatively low investment cost while meeting the desired quality requirements
- it does not require precise sizing of scrap.

In the context of Midhani the third aspect is great importance, because the bulk of the scrap is massive and odd shaped. The project has booked several successes so far, among which the identification of 15 potential users of titanium castings.

➔ [For more information](#) on the project and TIFAC, please see the provided external link