Introduction

Aluminium has been recycled in the UK since the metal first began to be used commercially in the opening decades of the 20th Century. Since that time a large number of secondary refiners have been established, converting new and old aluminium scrap into foundry ingot, deoxidiser for the steel industry and master alloys. Good quality scrap, particularly of the wrought alloys, is recycled back into extrusion billet and rolling slab for the production of extruded and rolled products.

There are very good commercial reasons why this recycling has always taken place. The high intrinsic value of aluminium makes recycling economically attractive. Aluminium and its alloys can be melted and recast repeatedly without loss in quality with today’s technology. The recycling of good quality aluminium scrap back into new ingot takes place with an energy saving of 95% of the energy required to produce the same weight of aluminium through the primary smelter route. Thus, recycling saves raw materials and energy, reduces emissions and also reduces the demand on landfill sites.

The Process

A wide variety of aluminium scrap is processed by the secondary industry. New scrap is that surplus material that arises during the manufacture and fabrication of aluminium alloys, up to the point where they are sold to the final consumer. Thus extrusion discards, sheet edge trim, turnings and millings and drosses are all described as new scrap. On the other hand, old scrap is that aluminium material that is recovered when an aluminium article has been produced, used and finally discarded for recycling. Old scrap could be a used aluminium beverage can, a car cylinder head, window frames or electrical conductor cable.

Most new aluminium scrap comes into the secondary industry directly from the fabricators. It is, therefore, of known quality and alloy and is often uncoated. It can then be melted with little preparation, apart perhaps from baling. Old aluminium scrap comes into the secondary industry via a very efficient network of metal merchants who have the technology to recover aluminium from vehicles, household goods etc. This is often done using heavy equipment such as shredders, together with magnetic separators to remove iron and sink-and-float installations to separate aluminium from other materials. It is, for instance, the recovery of aluminium in this way that makes car-breaking economically feasible.

Old and new scraps are processed prior to melting by methods that depend on any contamination that may be present. Aluminium turnings are usually contaminated with oil, water and iron. They are therefore dried to remove oil and water and then magnetically processed to remove iron. Aluminium beverage cans are processed to remove the lacquer coating that would otherwise lead to an increase in fume emission during melting.

Several melting process are used depending on the scrap quality. Clean, uncoated scrap can be melted in a reverberatory furnace; finely divided scrap, such as turnings, are ideally charged via a sidewell where circulating molten metal rapidly draws them under the surface, thus minimising oxidation; contaminated lower grades of scrap are melted under a flux cover in a rotary furnace and aluminium components contaminated with other metals such as steel bolts can be melted in a sloping hearth furnace. Molten metal fluxing and filtration technology have been developed to produce aluminium alloys of the correct quality without undue environmental impact. Most secondary aluminium melting furnaces are fitted with fabric or ceramic filters to ensure that flue gases have a minimal content of dust and other substances as regulated by the Environment Agency.
The Product

Secondary aluminium refiners 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, to BS EN 1676 or LM Series, other international specifications, or to aerospace specifications, are used to produce aluminium castings. The casting processes include sand and permanent mould casting, high and low pressure die casting and investment casting.

Some secondary refiners produce deoxidiser for the steel industry, this material being in a variety of forms such as notched bars and granules. Some secondary refiners also produce hardeners or master alloys such as aluminium-manganese alloys for use by other sectors of the aluminium industry. These hardeners are used to adjust the composition of molten aluminium so that specified alloy compositions can be produced.

The wrought remelts take good quality old and new scrap and convert this into extrusion billet or rolling slab, usually of the same alloy. Good examples are the conversion of old and new extrusion scrap into billet for extrusion production, and used aluminium beverage cans into rolling slab for the production of more aluminium beverage cans.

Recycling Rates

New aluminium scrap, being readily identified and within the control of the industry, has a recycling rate of virtually 100%. From an ecology viewpoint, the recycling rate of old aluminium scrap is more interesting. The industry calculates that the recycling rate for old scrap is of the order of 75%. That means that of all the aluminium previously sold to end consumers in transport, packaging, engineering, building, etc., 75% of this aluminium is now being returned to the industry to be recycled. This calculation takes into account the life time of the product. For example, the average car in the UK is registered for 12 years. The potential arisings of aluminium from cars in any given year must then be calculated from the amount of aluminium used in cars 12 years previously. Aluminium used in building and construction will last in that end-use for more than 40 years. Taking all of the end uses into account it is possible to calculate the potential arising of old scrap in any given year and compare this with the actual amount of scrap collected. Some of the collected scrap is exported for recycling in other countries.

Most end uses of aluminium have very high recycling rates because the aluminium is of high value, recognized for what it is and can be recovered relatively easily. Recent work at the University of Delft has proved that aluminium used in building and construction has a recycling rate of 92-98%, depending on the type of building. The recycling rate of aluminium used in transport applications is over 95%. The extensive use of aluminium in cars, now an average of over 120 kg per car in Europe, means that the requirements of End of Life Vehicles Directive, in recycling, will be met by the aluminium components, which in turn should help to ensure compliance with the whole vehicle.

Currently, the End of Life Vehicles Directive requires 85% of the vehicles weight should to be recovered or re-used, rising to 95% by 2015.

For aluminium packaging, foil and beverage cans, the material is thinly spread across the whole population and the problem is one of recovery, so that recycling can take place. The aluminium industry works closely with local authorities to ensure the maximum recovery of aluminium from the waste stream, since it is a high value component. Once recovered, the industry has the infrastructure to recycle all of the recovered aluminium packaging. Recycling rates of aluminium packaging are of the order of 42% (latest figures available are for 2009), already exceeding the current 40% target in legislation.

The Structure of the UK Industry

Secondary aluminium refiners may be integrated into major aluminium companies or they may be entrepreneurial, independent companies. Because of the rapidly changing price of aluminium scrap and primary metal and the fluctuating market for cast foundry alloys, secondary refiners need to be very flexible in their buying and selling policies. The UK is unusual in that the arising of aluminium scrap more than meets the needs of the UK foundry industry. The secondary refiners have therefore developed export markets for their products. There is also a considerable export of aluminium scrap, particularly to China.

The wrought remelters are usually within the control of the integrated, global aluminium companies and most of the production of rolling slab and extrusion billet is used within their own supply chain.
ALFED member Recyclers can be contacted via http://www.alfed.org.uk/assocs.asp?action=display&ident=2

Further information on recycling can be found at http://recycling.world-aluminium.org/
and by downloading

Further information about aluminium and aluminium alloys, their production, fabrication and end use can be obtained from:

(1) European Aluminium Association in Brussels
www.eaa.net

(2) International Aluminium Institute in London
www.world-aluminium.org