Chapter 10

LIMITS OF METAL RECYCLING

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1. INTRODUCTION

The importance of recycling as a constituent of the metal supply is undisputed. Apart from the economic and ecological advantages of the application of secondary raw materials there is a set of factors, which limit expenditure and use of recycling. These are among other things the metal contents of the raw materials, the emergence of secondary wastes, the multiplicity of alloys, a rising number of composite materials and the effects of user-specific material treatment on the attainable metal quality.

For the presented non-ferrous metals aluminium, copper and zinc, the recycling is to be evaluated very differently, due to substantial differences in areas of application, resulting quantities and process technology. None of these metals alone could give representative results for an optimal recycling quota for metals.

This article deals with today’s and future recycling potentials, equally the limits of recycling are discussed. Here above all the availability and quality of secondary raw materials, as well as technological development of material processing and remelting and economic factors with their various effect connections are to be considered. Additionally, the evaluation of recycling concepts is made more difficult by the often misleading use of descriptive terms.

2. AVAILABILITY OF SECONDARY RAW MATERIALS

The supply of metal production with secondary raw materials is influenced by various parameters, which are described in the following by the example of aluminium. These are in particular aspects of time and quality that limit the availability of secondary material. An exact analysis of the existing metal flow and
the used technologies leads to an additional problem in recycling, i.e., the definition of recycling quotas and recycled metal contents that are used to describe and evaluate recycling activities. This article introduces technical-metallurgically based solutions.

The difference between the produced and used aluminium quantity in Germany is substantial, as shown in the metal statistics. Questions arise as to how the high metal demand of the processing industry is covered and what role the recycling plays. According to figure 10-1 the recycled content of production would amount to only 18%, whereby only the secondary aluminium production on cast alloy base is related to the entire metal supply of semi-finished wrought products and castings (WBMS, 1999). Indisputably, this leads to false conclusions.

For the correct definition of the terms of recycling, first a qualitative and quantitative description of scrap flows from the areas of application of aluminium is important, as well as their connection to existing recycling paths. Therefore, aluminium materials have to be distinguished into two groups of alloys. With the cast alloys the content of alloying elements, above all silicon and copper, is rather high. In comparison, wrought alloys are lower alloyed, usually with magnesium and manganese. Therefore, they should be separated and, if possible, should arrive well-sorted in the recycling cycle. The material separation however is limited by application and collection. Figure 10-2 shows the German application of aluminium partitioned by casting and wrought alloys, which is dominated by the traffic sector (GDA, 1998). In each of these areas of application, with the exception of the packaging area, casting and wrought alloys which are often mixed, result after their use.

Looking at individual areas of application, a further distinction must be made: On the one hand closed loop recycling exists if scraps are supplied to a comparable reapplication, e.g., beverage cans and window frames. Open loop recycling is present if secondary raw materials after remelting are supplied for another use, usually in form of other alloys. Here in particular the secondary smelters (refiners) are mentioned, which produce cast alloys for the automobile industry, for example from a mixture of different old and new scraps.

Beside these idealised cases, a special area exists in regard to materials and distribution considerations. Wrought alloys are often converted to cast alloys and so achieve a materials modification. From a distribution standpoint, production scrap is not only internally used, but also externally and thus does not remain in a closed loop. Well-sorted wrought alloy scrap is recycled directly by the remelters into rolling and extrusion ingots, which then enter into both closed and open recycling loops. Mixed and contaminated scrap is recycled exclusively by the refiners into cast alloys and usually goes into open recycling loops (Rombach, 1998).

While the product is in use, the metal is considered to be material stock. The entire stock quantity for aluminium is estimated at 700 Million tonnes worldwide. The distribution of the metal concerns spatial, material and time-based aspects. The depot characteristics of aluminium can be described on the basis of selected products, product groups or sections or types of use (tab. 10-1). For packaging material for example, a high spatial variation exists with small product size and high distribution at the same time. The material purity can be high (menu plate, beverage can), middle (cover caps, painted foils) or low (multi-layer foils, vapourised coated