The Current Status of Scrap Metal Recycling

Han Spoel

Although millions of tonnes of metals are recycled around the world every year, even more can be done if the proper economic incentives are present. Increasing the rate of recycle will slow the growth of primary production and reduce the potential for environmental overload. But to progress beyond the present state of affairs, public opinion, regulations and economics must combine to encourage the responsible reprocessing of metal wastes.

INTRODUCTION

The production and consumption of metals have grown dramatically during the 20th century. From the dawn of civilization until 1900, the world’s cumulative production of metals was about one billion tonnes; by 1950, five billion tonnes of metal had been produced. During the 1980s alone, production was 5.8 billion tonnes (Figure 1 and Table I). This massive increase, together with even faster increases in the production of other materials (e.g., plastics and paper) and their associated by-products of air, water and soil pollution have inspired the fervor of environmental and “green” forces during the past twenty years. As a result, the pressure is on to moderate the consumption of primary metals by recycling more and, thereby, polluting less.1-3

The largest tonnages of materials discarded by the metals industry are the wastes of mining, milling and primary smelting—amounting to several billion tonnes of waste per year around the world, much of it, fortunately for the industry, in remote locations. By comparison, the amounts of obsolete metal scrap are small: 200-300 million tonnes per year. Each extra tonne of metal recycled will also result in reduction of primary production waste—by perhaps 4 tonnes for iron, 200 tonnes for copper and 200,000 tonnes for platinum. In addition, 50 to 90% of the energy used in the production of primary metal is saved by recycling.

Once primary metal has been produced from ore, the metals industry and their industrial customers recycle the bulk of in-house and purchased new scrap. There is some leakage, such as metal contained in discarded remelt slags and drosses, plating wastes, grinding sludges and mixed scrap disposed of in the garbage by small plants. Combined it adds up to a substantial tonnage of potentially recoverable metal.

The major amount of discarded metal-containing scrap is post-consumer, or used scrap. There is a fantastic variety, ranging from the easiest to recycle (e.g., pure aluminum, or copper electrical conductors and large iron castings) to the presently impossible (e.g., laminated plastic/paper/metal foil packaging and many other consumer items containing only a small percentage of metal).

ECONOMICS, ENVIRONMENT AND REGULATIONS

The recycling of metals is not a new concept. Archaeologists have found evidence of recycling in some of the earliest metal works. Until only the most recent centuries, little primary metal was produced, and it was expensive in relation to the cost of labor and common materials such as wood. Hence, there was great economic incentive to recycle discarded or scrap metal articles. Even in 1900, the price of primary metals was four to eight times higher in relation to annual manufacturing wages (which increased 46 times from $487 in 1900 to $21,735 in 1988 in the U.S.) than it is today (Table II). (Aluminum is a special case as it was just becoming an industrial metal in 1900.) Coupled with this relative lowering of the cost of metals has been a great increase in the complexity of consumer products. As examples, compare the wood- or coal-fired cast iron stove of 100 years ago with today’s electric stove and microwave oven.

Clearly, the direct economic incentive to recycle is less than it was. Improved recycling technology has had to struggle to keep pace.

In a free market economy, scrap yards and secondary smelters will only recycle a metal if it is profitable to do so. Until quite recently, the economics of the scrap industry and the community at large coincided. If it paid the scrap yard to clean and segregate metal, well and good; if it was not profitable, then the scrap could be placed in the local landfill at negligible (apparent) cost. The wastes generated at the primary smelter were hardly considered. The regulations that scrap yard and secondary smelters had to comply with were bothersome but had no serious economic effect.

Today, the economics of the scrap trade differ significantly from that of the community as a whole. The recycler recovers his costs and hopes to make a profit from the margin between the buying price for scrap and the value of the recovered reusable metal. Costs have greatly increased beyond normal inflation. There is an incredible array of sometimes contradictory regulations, masses of paperwork to be done, local community opposition to recycling facilities, large potential liabilities for even inadvertent or small escapes of contaminants, and great and expensive confusion over the difference between a recyclable raw material and hazardous waste. The overall effect of these factors is to lower the value of all scrap, thereby making less likely the possibility that it will be recycled, particularly for formerly recycled scrap which is now classified as hazardous waste.

The recycler has to be seen as an essential link in the solution, rather than categorized as part of the problem. The community at large must devise ways to reward the recycler for recovering metals which would otherwise be dumped. If this is not done—and it is not easy—any number of further regulations can be passed without increasing the recy-
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rials. Though logical from the product
num, copper and magnesium have lower
rates of about 20%; zinc, if the number
were available, would be even lower.
The rates would be somewhat higher if
allowance were made for product life
cycle and the lower use of the metal at
the time of manufacture. For aluminum,
the corrected and crude recycle rate for
cans is 50–55%; for all other products, it
is no more than 25%. For copper and
magnesium, the corrected rates are close
to 30%; zinc is quite a bit less. Why so
low? Part of the problem may be the
result of incomplete statistics or confusion
and new scrap, another part is
due to destructive end-uses, such as pow-
der for explosives or rocket fuel, protec-
tive sacrificial coatings, or chemical
uses. Making all allowances, the recycle
rate remains disappointingly low. Auto-
mobiles, aluminum cans, and lead bat-
dies (discussed separately below) are
exceptions. For most other items, there is
no effective recycling network.
Scrap yards sorting and cleaning nonferrous scrap do not require the bulk handling facilities of the steel yards. They do require skilled and experienced sort-
ers, shears, and as many means of identi-
fication as possible, including a spec-
trometer. The value of the scrap sent to
the remelter is highly dependent on the
care with which it has been sorted. Sorted
scrap is remelted or resmelted by a vari-
ety of customers. Some grades, such as
clean aluminum clips, have many users;
others, such as certain spent oil refinery
catalysts, may be useable by only two or
three smelters in the world.
Recycling nonferrous metals is a
mosaic of niches. Each niche requires its
own solution for optimum recycling; the technical problems are challenging, but
the field attracts relatively little talent or
financial support.9,16

**NONFERROUS SCRAP**

The tonnage of nonferrous metals produced, including stainless steel, is only 7% that of ferrous metal, but unit
values are much higher. The number of nonferrous metals and alloys encountered is large. Because of high unit
values, use of these metals is minimized in products by improving alloys, down-
sizing and employing composite mate-
rials. Though logical from the product
designer's viewpoint, these efforts make recycling more difficult.

In Table III, it can be seen that the
recycle rate of old lead scrap in the U.S.
varies from about 50% for lead to less than one tonne per vehicle. The next
class of metal is aluminum, with
amounting to about 30 kg. There are also
substantial amounts of lead, copper and
zinc. The non-metals include plastics,
glass and rubber. Cars produced in 1990
have somewhat less iron and steel, much
more plastic, about 50 kg of aluminum and
less zinc. The recycling rate of automo-
Bing is high, over 90%.

The number of cars produced has
increased by a third in the last decade,
and the potential recovery of steel today
is about 25 million tonnes; for aluminum,
the figure is 750,000 tonnes. By the

## Table III. U.S. Metal Scrap Recycled Excluding Home or Run-Around Scrap 1986*

<table>
<thead>
<tr>
<th>Metal</th>
<th>Total Metal Consumption (1,000 tonnes)</th>
<th>Old Scrap Consumed (1,000 tonnes)</th>
<th>Old Scrap vs. Total Metal (%)</th>
<th>All Purchased Scrap + Exports (1,000 tonnes)</th>
<th>Purchased Scrap vs. Total Metal (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>83,600</td>
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<td>NA</td>
<td>44,800</td>
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<td>Al</td>
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<td>Cu</td>
<td>2,136</td>
<td>478</td>
<td>22</td>
<td>1,331</td>
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<tr>
<td>Pb</td>
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<td>566</td>
<td>50</td>
<td>665</td>
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</tr>
<tr>
<td>Mg</td>
<td>123</td>
<td>25</td>
<td>20</td>
<td>46</td>
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<tr>
<td>Ni</td>
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<td>NA</td>
<td>NA</td>
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<tr>
<td>Zn</td>
<td>1,294</td>
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<td>338</td>
<td>26</td>
</tr>
</tbody>
</table>

NA—not available.