Assessment of the Impact of Rising Levels of Residuals in Scrap

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INTRODUCTION
Steel is the most widely used raw material in the World due to its high tensile strength and low cost. It is a major component used in buildings, infrastructure, automobiles, machinery, ships and appliances. One of the unique properties of steel is that it can be recycled over and over again without sacrificing product quality.

Steel scrap recycling conserves raw materials, energy, and landfill space. The steel industry recycles millions of metric tons per year of steel cans, automobiles, appliances, construction materials, and other steel products. The primary source of obsolete steel is the automobile. The re-melting of scrap requires much less energy than the production of iron and steel products from iron ore. Consumption of iron and steel scrap by re-melting reduces the burden on landfill disposal facilities and prevents the accumulation of abandoned steel products in the environment.

Each tonne of scrap recycled saves 1.5 tonnes CO2, 1.4 tonnes of iron ore and 740kg of coal. A tonne of steel produced by recycled scrap consumes about one third the energy that it takes to make steel from virgin raw materials. It is estimated that we currently recycle over 85% of all steel products that reach the end of their life. Today we recycle around 630 million tonnes of steel every year (saving 945 million tonnes of CO2 annually) – this is more than all other materials combined, making it the unexpected recycling champion. We could recycle even more steel, but due to its extended life span, steel often remains in products for many years, so we have to wait for them to reach the end of their lives before we can get the steel back to recycle it into new products.1

Steel is produced by the integrated route (coke oven-blast furnace- Basic oxygen furnace) which uses primarily virgin material (Iron ore) but can also utilize up to approximately 30 % scrap in the BOF. The electric arc furnace route can use 100 % scrap but, in many operations, pig iron and DRI/HBI are also used in order to produce higher quality products.

The chemistry of the steel required for these various applications varies greatly. Some elements cannot be refined from steel and thus tend to accumulate as steel is recycled. These elements include copper, nickel, molybdenum and tin. Chrome is also considered a residual in some cases though Chrome can be refined from steel if carbon levels are below 0.3 wt %. Figure 1 from IIMA shows the typical chemistry requirements for various steel products. It can be seen that the acceptable level of residuals vary considerably depending on the end use of the steel. It is also clear that the various grades of steel scrap have grossly different levels of residuals.

It is also clear that residuals will rise in steel scrap over time. Even though shredded automotive scrap is sourced from dismantled automobiles it contains up to 0.5 wt. % residuals. At the same time, current exposed automotive sheet steel requires less than 0.1 wt.% residuals. This disconnect is a concern. A Japanese study (Nakamura) indicates that only about 7 – 8 % of automotive scrap is recycled back into automobiles. North American and European studies indicate a higher rate at 20 – 25 %. Regardless, it is apparent that steel scrap tends to be down-graded and is used to produce lower quality products when it is recycled. AISI analysis indicates that 99 % of automotive steel is recycled. Thus, shredded automotive scrap may be used to produce SBQ bar and rod or merchant bar products. Most automotive steel scrap is used to produce steel for construction – buildings and infrastructure.