Recycling of aluminium

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This paper on Recycling Aluminium focuses on the Aluminium Recycling Technologies, the market & the scrap sourcing issues related to Indian situation. The market projects growth of 16-20% in automobile industry in India. Recycling role is crucial in meeting the forecasted aluminium demand. This paper also gives glimpse of the scrap processing industry in Europe with environmental protection approach.

Aluminium consumption in India has been growing at the rate of 6-8% with Recycled metal content of 15-20%. Whereas the consumption of secondary metal in developed countries varies from 20 to as high as 45% in Holland. The consumption of secondary aluminium castings in India is estimated to 2 lakh TPA containing about 30% purer casting alloys, while 70% is the secondary alloy content. The recycling has following distinct advantages. To improve the India’s competitive edge in global market, we need to foster the Recycling in bigger way understanding these advantages.

• Green house gas reduction. One tonne of primary aluminum production generates 0.1 Kgs of fluorides, which are 650 Kgs equivalent of CO2 (green house gas), while the recycling generates 250 Kgs of GHG due to burning of fossil fuels per tonne of aluminium.

• Consumes less than 5% of electrical energy than required for primary aluminium production.

• Conserves bauxite reserves. If India increases the percentage of recycled metal from the existing of 15-20% to the world benchmark of 45% of Holland, India will conserve 8 Lakh tones of bauxite reserves every year.

• Less technology as well as capital intensive & quick set up time, with 30% of time & money requirement. The equipment can be procured in ready to use basis requiring minimum operative training & technology acquisition.

• Less than 10% melting loss hence ease of recycling.

• Impact on quality of the final product is differentiated only by the impurity content rather than any other parameters like inclusions, grain size or gas content, which are process dependant than raw material.

• Conservation of alloying elements if the suppliers properly segregate the scrap. In Europe the segregated scrap fetches 300-500 USD per tone extra over raw mixed scrap.

• Recycled metal cost largely depends on the skill of scrap sourcing & it’s processing.

Major issues in Recycling in India

• Absence of organized scrap collection, segregation & processing system consequently causing higher scrap prices.
• Limited aluminium usages in consumer durables & transport sector which has shorter life cycle. This causes limited availability from direct consumers.
• Poor pollution control systems.
• Imports with reduced invoiced values by unscrupulous manufacturers causing unhealthy competition.
• Unrealistic composition specifications by the users due to lack of technical know how. There is a need for technical validation of specifications.

Scrap Management – To improve the India’s competitive advantage in aluminium world market, one of the major factor is going to be scrap management. To give global scenerio & identify gaps in India, given below are the operations of two leading European scrap recyclers.

The Recycler under reference is the largest scrap recycler in Europe. It has 32 scrap collection depots in Europe, 10 shredding & segregation plants. Largest one of them is located near London with 250-cars/ hour shredding capacity. These plants segregated different metals with generation of aluminium scrap alone of 8000 TPM. The process includes shredding, separation, removal & incineration of coatings. While another scrap supplier with door-to-door collection system has more manual activities. The type of scrap collected is mainly of architectural extrusions, pipes, and beverage cans wires etc. The processes are as given below.

The shredded scrap has distinct advantages of freedom from non-aluminium content & less melt loss due to reduced VOC. However these advantages are to be weighed against the higher cost due to energy for shredding of about 45 units per tonne & higher cost of waste disposal in developed
The issues in the scrap industry are high capital cost for shredder & separation equipments, weight enhancement tactics by contamination by the suppliers, poor availability due to consumer ignorance.

**Melting Technology** - The melting process adapted for scrap melting & their efficiencies are as follows.

Important efficiencies for the melting processes are melt rate, metal quality & cost of production including the melt loss.

The crucible furnaces are the low capital intensive & effective for small batch sizes. However the fuel consumption is high due to losses & lack of mechanized stirring requiring higher melting temperatures that also leads to higher melt loss.

The rotary furnaces are the medium capital intensive & operate with good efficiencies. The size is limited to 5 T max. The fuel efficiency is further improved by charge preheating with flue gas. Charging is done manually limiting the melting rate. The charge is prepared in a salt bath containing sodium & potassium chlorides & fluorides. The rotary action ensures good homogeneity of temperature & composition, faster dissolution of alloying elements & submerged melting of the scrap.

Direct users mainly employ the induction furnaces to get good homogeneity. Furnaces operate with limited capacity (<2 T). The high cost of electricity prohibits its use on large scale. The melt loss is low due to recirculating action, which also improves the melting & dissolution rate for alloying elements.

Sidewell furnaces are the latest ones with capacities ranging from 10 to 100 T. The charging of the light scrap is done in the sidewell, while fuel-fired burners give the heat input in the mainwell. The metal pump circulates the hot metal from main well to sidewell & also allows gas injection. The scrap melting takes place metal circulation at lower temperatures. These gives better fuel efficiency, lower inclusion & gas contamination and lower melt loss. The alloying element dissolution also is faster. The gas injection helps in reducing magnesium & alkali metals.

Hindalco Taloja is employing this technology.

New technologies like vortex generator or electro-magnetic pump further improves the melting rate, reduce melt loss, improves alloy dissolution rate, reduce inclusion & gas contamination. Light scrap in the form of chips can be charged through a conveyor continuously in the vortex created.

Use of salts enables separation of oxides from metal & coagulation of metal particles. Salt consumption varies depending on the magnesium content & type of scrap. The inclusion & hydrogen content is improved by following methods.

- Reduction in metal turbulence in melting & casting.
- Applying degassing techniques like chemical tablet plunging, lance pipe degassing in furnace
- Use of coveral fluxes.
- Inline degassing.
- Transfer launder designing to avoid metal exposure & turbulence.

**Conclusions**

- Need for organized scrap processing in Indian industry.
- Need for improved understanding between recycler & consumer.
- Recycling industry needs to gear up to meet the projected growth in the automobile industry may be through increased capacity & adoption of newer technologies to improve quality.
- Increase awareness of safety & environmental damage.