

# Effective Utilization of Induction Furnace Slag by Extraction of Metal using Crushing System

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**Abstract** - Natural aggregates are becoming increasingly scarce and their production and shipment is becoming more difficult. Slag is currently used as aggregate in hot mix asphalt surface applications, but there is a need for some additional work to determine the metal contain in it. In technique of cast iron production helper unrefined material and mechanical wastes are molded. The most abundant waste beginning in the process is Furnace slag . Slag is a waste material (by-item) created in sanitizing metals, their throwing and alloying. Foundry slag of any sort have unsafe qualities however, by a wide margin, the most significant issues are made by slag that contain elevated amounts of iron oxide. The talk of the influence of slag on cast iron creation is generally an exchange of the destructive impacts made by iron oxide in slag. Ferrous slag are produced from the creation and castings of iron and steel. Slag are blends of oxides of metal & non metallic parts which outline blend blends and game plans with each other moreover contain little volume of metals, sulfides of metal and gasses. This slag is orchestrated off the plant floor on account of which land polluting happens which decrease productivity of soil. The paper presents examination of actuation warmer slag of ferrous foundry at Jadhao Steels and Alloys . From the results of the present study we can say that Induction Furnace Slag contain 12.5 percent of metal so that it minimize the adverse impact of disposal on the environment.

**IndexTerms** – Electric induction furnace, Metal, Slag, Steel

## I. INTRODUCTION

The Indian foundry creates around 6 million ton of castings yearly. The slag produced every year is around 1.8 million ton. The warmth vitality is diverted by slag is of enormous amount. However this slag is conventionally permitted to stream into melt dumping yard to cool commonly or by sprinkling with water and as indicated by present practice, there is no at all utilization of this colossal warmth vitality, which is accordingly squandered. The Indian steel industry has demonstrated a marvel development in the most recent couple of decades. Steel is a standout amongst the most fundamental materials needed for industrialization and assumes a basic part in the nation's financial advancement. India is fortunate since it is blessed with regular assets needed for a solid and enthusiastic iron and steel industry. India is at present delivering almost 17 million tons of saleable completed steel every annum. Improvement of steel industry has carried with it ecological debasement. Natural preservation has turned into an inexorably more essential part of our everyday lives. With the fast and broad industrialization and urbanization in numerous parts of India, there is an unfolding acknowledgment that extreme essential for man's survival could well be the conservation of environment. We live under horns of issue. Nonetheless, our desires and our view of what constitutes a base way of life have put expanding weight on both the general population and private industrialists to guarantee clean and solid environment. Therefore, it is essential to reuse this slag and separate metal from it.

### A) Causes of Induction furnace slag to environment

- Resource depletion
- Health hazard
- Dust emissions
- Potential accidents
- Land pollution
- Waste gases emissions,
- Emissions of heat into environmental water
- Noise

Foundry management is because characteristic unclean production, which cause different influences on people, atmosphere, water, soil, vegetal and animal world in constant contact with ecological experts and make every effort to minimized those influences.

## II. OBJECTIVES

- 1) Study existing system of slag utilization at Jadhao Steel Alloys
- 2) Collect industrial data for slag utilization in steel industries
- 3) To separate metal from slag of induction furnace to increase the productivity

- 4) Analysis of metal contain in slag to decrease cost require for raw material
- 5) Estimate cost of metal to overcome losses

### III. METHODOLOGY

#### A) Electric Induction Furnace

In Jadhao steels & mixes electric activation warmer is used for cast iron/bendable iron era. The electric affectation warmer is a kind of melting radiator that uses electric streams to mellow metal. Instigation warmers are most suitable for softening and alloying a wide variety of metals with slightest relax adversities. An electric impelling warmer requires an electric twist to convey the charge. This warming circle is finally supplanted. The pot in which the metal is situated is made of stronger materials that can restrict the glow, and the electric circle itself cooled by a water system so it doesn't overheat or melt. The upside of the induction warmer is an essentialness viable, clean and well-controllable condensing method diverged from most distinctive technique for metal softening. Foundries use this sort of radiator and now moreover more iron foundries are supplanting vaults with prompting radiators to relax cast iron, as the past release heaps of dust and diverse toxins.

Capacity : 500Kg

Power : 250KW

Voltage : 1600-1700V



Fig. 1. Electric Induction Furnace

#### B) Slag

Amid the operation of electric affectation liquefying heaters, non metallic are created from the different sources, for example, scrap, soil of runner & riser and so forth. Contingent upon the particular procedure being utilized and the sort of iron or steel being liquefied the arrangement of slag will differ. The piece of heater & scoop slag is frequently exceptionally complex. The slag that frame in electrical heater dissolving are the aftereffects of complex responses between silica, iron oxide from steel scrap, other oxidation by items from liquefying, and responses with stubborn linings. The subsequent slag will comprises of complex fluid stage. Slag contain  $Al_2O_3$ ,  $MgO$ ,  $SiO_2$ ,  $Fe_2O_3$ ,  $CaO$  &  $MnO$ .



Figure 2. Induction furnace slag

Table 1. Production of Slag

No. of heat	Weight of CI (kg)	Slag produced (kg)
1	650	12.5
12 per day	7800	144.6
312 per month	16900	3133

Induction furnace slag contain metal due to

- 1) Smelting i.e. process in which slag forms a layer above molten metal so that some particles in molten metal stuck to the slag.
- 2) Breakage of pouring ladle due to use of same ladle again and again.
- 3) Human error at the time of pouring molten metal from furnace to ladle.

*C) Process of Crushing and Separation using crusher*

- 1) Slag of prompting heater is pounded in crusher. These crusher is for the most part used to make powder of solidified sand mold.
- 2) Crushing is finished by method for mallet mounted on roller.
- 3) Metal is divided by utilization of plate sort attractive separator. Utilized for lifting & treatment of ferromagnetic particles. Solid attractive field to lift extensive amount particles. Particles are confined by dividing lower plate from upper attractive body.



Figure 3. Crusher



Figure 4. Crushed slag

*D) Separator*

Magnetic separation is a process in which magnetically susceptible material is extracted from a mixture using a magnetic force. By combining the different forces of magnets with gravitational or frictional forces a separation of mineral particle is possible. Two or more products are obtained depending on their commercial value, these products are concentrates, middling's, or tailings.



Figure-5: Plate type Magnetic Separator



Figure – 6: Metal contain in slag

#### IV. RESULTS AND DISCUSSION

Table-2 Amount of metal contain in slag

SN	Slag (kg)	Metal (kg)
1.	10.1	0.75
2.	9.85	0.85
3.	8.5	0.75
4.	11.9	0.75
5.	8.95	0.9
	Total= 49.3	3.9

##### A) Cost Analysis

###### 1) Metal Cost

% of metal =  $49.3 / 3.9 = 12.64$

Annually slag produced = 3.1 ton

Therefore , amount of metal contain in slag annually = 0.395 ton

1kg of metal cost = Rs 30

0.395 ton metal cost = Rs 11,850/-

###### 2) Electricity cost

Production of slag per day= 144Kg

Motor= 5HP

$5 * 746 = 3.7KW$

Time= 2.30Hr

$2.3 * 3.7 = 8.51KWhr$

Cost per unit= Rs 9.79

$8.51 * 9.79 = Rs 83.31$  per day

$Rs. 83.31 * 26 = Rs 2166.06$  per month

###### 3 ) Manpower cost

Time required for crushing = 2.3 hr

Time required for separation = 1 hr

Wages per 8 hr = Rs.150

1hr = Rs. 18.75

$3.3hr * 18.75 = Rs. 61.87$  per day

$61.87 * 26 = Rs. 1608.7$  per month

###### 4) Net Profit

Electricity cost +Manpower cost = Total cost

$Rs.2166.06 + Rs.1608.7 = Rs. 3774.76$

Cost of metal – Total cost = Net profit

Rs. 11850 – Rs.3774 = Rs. 8075.24

## V. CONCLUSIONS

From the outcomes acquired it is observed that the creation of incitement heater slag is 3.133 tons/year and metal contain in that slag is 0.395 tons/year which is costing around Rs. 11,850. Thereby ascertain power and labor cost for pounding the slag and detachment of metal from it and it is realized net benefit per month of Rs. 8075.24. We utilize remaining slag in red earth blocks fabricating. The additional advantages of executing this system in various foundry users are Reducing waste through productive utilization of vitality and crude materials, enhancing efficiency and expanding item yield through more prominent effectiveness. increasing productivity and nature of items, reducing the dangers of natural mishaps and keeping away from administrative consistence expenses prompting protection sparing and minimizing undesirable pollution on the earth.

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