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Research Paper

Solid Waste Generation and Utilization in Integrated Steel Plant Dolvi District Raigad (Maharashtra) India

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A B S T R A C T

Solid Waste generation and its utilization have become the most important factor in any integrated steel plant. In the current scenario Energy-efficient and sustainability era. Solid wastes are utilization to make various internal by-products Like Sinter, Pig iron, granulated Cement. In integrated steel Plant Slag (Electric Arc Furnace and Ladle Furnace) generated approx.3500 Mt/day & 1080 MT/day. Integrated steel industry other waste generated from Sinter Plant- like Electrostatic precipitator dust Blast furnace plant generate granulated slag and dry pit slag, Steel Melting Shop Generate Gas cleaning plant dust Sponge Iron Plant generate clarified sludge and classifier fines Coke Oven Plant Generated coal and coke breeze waste Pellet Plant-Generated ESP dust and lime calcination Plant Generated lime calcination plant dust. The Presence of total Fe content in EAF slag is 9.3-18.2% and in In LF slag sulfur content is 0.05 to 0.62%. The main purpose of this paper is generation waste from the integrated steel plant has utilization Potential per physico-chemical and mineralogical characterizes.

***Key words*:** Integrated steel plant, EAF & LF slag, Solid waste, Physico-chemical, Mineral characteristics

Integrated steel plant in India generated 3137 crude steel production (World steel association report 2019). Solid waste generated from the different metallurgical processes. Source of solid wastes generated in steel industries is thus coke oven by product plant, sinter plant, refractory materials plant, blast furnace, basic oxygen furnace, steel melting shop, rolling mill [1]. The process waste is gas cleaning plant dust, electric arc furnace dust, ladle furnace dust, granulated slag, and some dust generated from pollution control equipment like electrostatic precipitator dust, bag filter dust, cyclone, scrubber sludge ponds, wastewater treatment plant sludge, etc. [2]. This waste generation [3] depends upon the source of generation and quality of raw materials. In India, 90% of structural steel is produced the secondary sector where used mostly induction furnace. A lot of waste generated from the integrated steel plant, while generating pig iron, steel and end product [4]. One of the major concerns of world steel industry is the disposal of wastes generated at various stages of processing. Because of natural drive to be cost-effective, there is a growing trend of adopting such waste recovery technologies which convert wastes into wealth, thereby treating wastes as by-products. Steel plant generated waste mill scale [5], coke breeze dust, and coal and coke dust from the billet caster and bar mill and coke oven plants [6]. As per WAS (World Steel Association) recovered-product can be recycled. Therefore, reduce, reuse, recycle and recovery (4 RS) philosophy and efficient waste management needs to be adopted by the integrated steel industry.

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MATERIALS AND METHODS

The various dust and sludge analysis through XRF (X-ray fluorescence) in the Lab. in this XRF fluorescent X-rays emitted by the material sample are directed into a solid-state detector. The making small powder and detects through an XRF sample of the waste get analyzed parameters like Cao, MgO, Sio_2, Al_2O_3, Fe_2O_3, total FE, and sizes of sample. Normally, a waste sample taken as 10 grams with special binding agents like methyl cellulose 1.5 grams in cassette and run the programs except waste like LCP dust and EAF, LF slag not using binding agents in procedure of analysis solid waste. On XRF by following ways; 1) Heat the sample 105 degree for 5 minutes to make moisture free; 2) Place the sample in serial no like (1,2,3,……) and close the door. Open the WIN XRF software and go into analysis and enter the name of the sample in the ID against the corresponding position select the analytical programs (SIP sludge, flue dust). The result of chemical characteristics will be shown to software screen. In general, the integrated steel plant generates BF flue dust, LCP dust, SIP sludge, GCP dust, coal and coke breeze, mill scale, LF slag, and EAF slag. This waste is more recycling potential in the process. In the following table chemical composition of solid waste like Bf flue dust, LCP dust, SIP dust, GCP dust, mill scale, LF slag and EAF slag contains the [7] Cao, MgO, SiO_2, Al_2O_3 and TFE percentage (%). In general, total Fe (Iron) content high in SIP sludge all solid waste and sludge is used for preparation of cold briquettes and sinter making process. When the sinter process is finished it will go to blast furnace to produce a hot metal.

RESULTS AND DISCUSSION

In integrated steel plant solid waste shows minerolical characteristics i.e. Cao, Al_2O_3, TFE, MgO, SiO_2, it contains a high amount of various minerals. So, these mineralogical parameter shows waste can be utilized in sinter plant for making of sinter [8]. In blast furnace generate various waste, but specially flue dust from air pollution control system like dust catcher (it is from furnace side) on daily basis on an average 45 MT/day generation. Blast furnace added some flux, coke, sinter materials for generation of hot metals [9]. In LCP (Lime Calcination Plant) air pollution control system generated solid waste [10] like LCP dust in- plant generated 6.5 MT /day on an average. In general, integrated steel is manufactured from iron ore mostly using blast furnace (BF) and basic oxygen furnace (BOF) [11] and using the electric arc furnace in case of manufactured from scrap materials [12]. In the integrated steel plant generated two types of solid waste iron content waste and non-iron content waste it is called ferruginous and non-feruginious [13]. In ferrous waste like mill scale, BF flue dust, slag, SIP sludge and nonferrous is the refractory waste lime waste, bricks etc. the chemical composition of various types of solid waste are analyzed and are tabulated in (Table 1).

Table 1 Chemical characteristics of solid waste

Type of waste	Chemical composition ranges in percent
BF flue dust	CaO-4.3-5.81%, Mgo-0.97-1.66%, Sio2-7.37-13.4, Al_2O_3-2.24-4.22, TFe -35-45.2%
LCP dust	Cao-71-89%, MgO-1.7-3.2%, SiO_2-2.0-4.9%, Al_2O_3-0.89-2.2%
SIP sludge	Cao-1.5-2.26%, MgO-1-2.3%, SiO_2-2.46-4.29%, Al_2O_3-1.2-2.4%, TFe-70.22-73%
GCP dust	Cao-7-10%, MgO-1.3-2.9%, SiO_2-4.2-6.0%, Al_2O_3-2.5-3.1, TFe-52.33-57.52%
Mill scale	Cao-0.3-3%, MgO-0.1-1.5, SiO_2-2.0-5.0%, TFe-62-72.4%
LF slag	Cao-40.2-46.8%, MgO-5.2-5.9%, SiO_2-1.9-2.5%, Al_2O_3- 28-35.8%, S-0.05-0.62%
EAF slag	Cao-22-36.77%, MgO-4.23-6.98%, SiO_2-5.68-15.20%, Al_2O_3-4.32-4.67%, TFe-9.3-18.2%

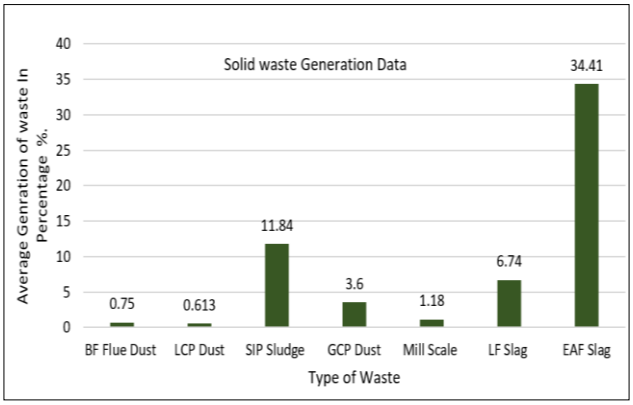

Fig 1 Chart showing generation of solid waste

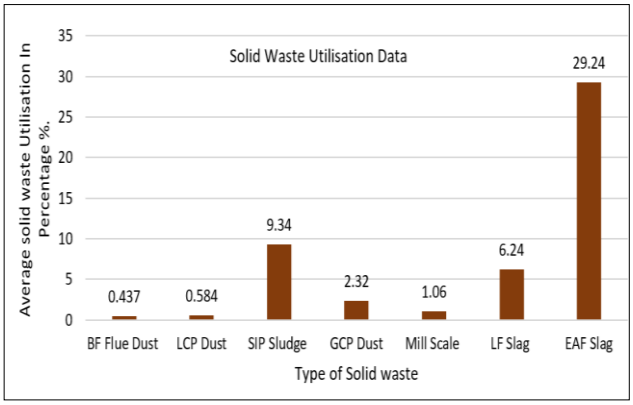

Fig 2 Chart showing utilization of solid waste

Table 2 Generation of solid waste

Type of waste	Source	Average generation of waste (Percentage)
BF Flue Dust	Blast Furnace	0.75
LCP Dust	Lime Calcination Plant	0.61
SIP Sludge	Sponge Iron Plant	11.84
GCP Dust	Steel Melt Shop	3.6
Mill Scale	Hot Strip mill	1.18
LF Slag	Steel Melt Shop	6.74
EAF Slag	Steel Melt Shop	34.41

Table 3 Utilization of solid waste

Type of waste	Utilization of waste	Average utilization of waste (Percentage)
BF Flue Dust	Sinter Plant	0.437
LCP Dust	Sinter Plant	0.584
SIP Sludge	Sinter Plant	9.34
GCP Dust	Sinter Plant	2.32
Mill Scale	Sinter Plant	1.06
LF Slag	Sinter Plant	6.24
EAF Slag	Sinter Plant	29.24

In the Integrated steel plant solid waste utilization is 100 percent. (Table 2-3) shows average generation and utilization of solid waste [14]. And the Pie chart shows solid waste utilization percentage. In the (Fig 3) the utilization percentage was calculated as per the average generation of waste divided by average utilization of waste multiply by 100 number.

Utilization potentials of steel plant solid waste

In steel plant various solid waste is generated so these wastes are BF slag, BF dust, EAF and LF slag. In the blast furnace generated BF slag this slag utilized in the cement plant. Slag used as fertilizer in agricultural sector [15]. As we know today growing environment awareness iron and steel slag is highly regarded as recycled materials that can reduce

the impact on environment due to its resource conservation (9). Mill scale is rejected as a waste that would be recycled for recovery of metallic iron [16]. One of the major factors hindering the utilization of industrial wastes has been the system for collection, handling and transportation of the wastes from the source plants and facilities for handling and storage at the user end [17]. The major advantages of recycling and utilization of wastes are as follows. 1) Economic advantages 2) Saving of raw materials 3) Conservation of resources 4) Better and cleaner environment 5) Reduced cost of disposal 6) Conservation of energy 7) Strengthen laws by the Government 8) Community relation/public image etc.

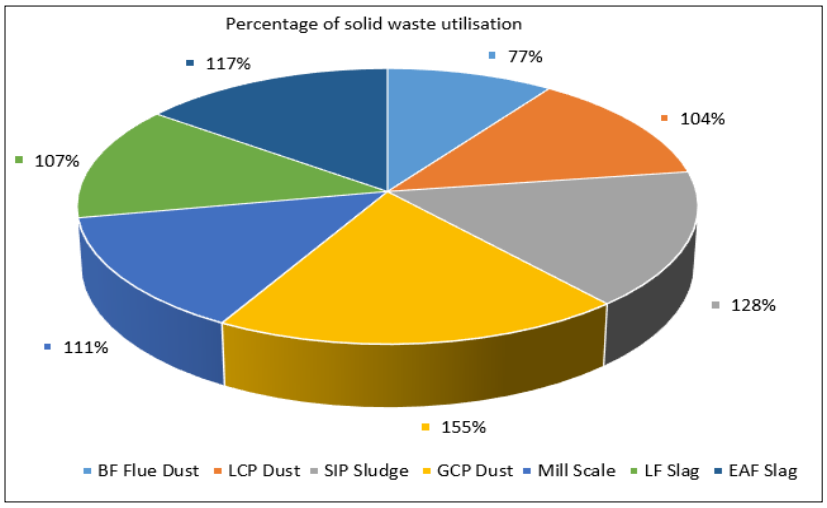

Fig 3 Pie chart showing percentage of solid waste utilization

CONCLUSIONS

As per the above result and discussion, it is clear that waste generated from the process is mostly reutilized in the sinter plant, blast furnace and cement plant as per chemical and mineralogical character tics. In EAF slag total Fe content ranges from 9.3-18.2% and LF slag. In other waste like Bf flue dust, SIP sludge, GCP dust and mill scale total Fe content is 35-45% ,70.22-73.0%, 53-57.0%, 62-72%. So Dolvi integrated steel plant process solid waste has utilization potential.

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