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Sustainable Waste Management in Integrated Steel Plant

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Abstract

'Wealth from Waste' is a known phenomenon for integrated steel plants of the world. For the sake economic sustainability, the thumb rule of 'reduce, reuse, recycle and restore' appears to be most suitable for the various steel industries (Sarkar and Muzumder, 2015). For this purpose, while making value addition in the process of steel making various mitigation measures are adopted to control the pollution of air, water, soil, etc. The processing of raw materials in integrated steel mill plants is brought about with the help of processes such as direct reduction, blasting furnace, electric arc furnace (steel melt shop), mill sintering, coking oven & palletisation, etc. The by-products of integrated steel mill are coke fines, coal-fines, mill-scale, sinter-fines, SMS slag, BF Slag, coal tar, sulphur, granules & GCP dust. During sustainable waste management, these are reutilised to enhance production quality. The smart use of energy and water consumption also is an added responsibility. The entire waste utilization within the plant demands proper disposal and environmental safety.

The present study it is observed that integrated steel plant waste Generation, Utilisation & Restore for Utilisation from Year 2014 to 2022 the utilisation of solid waste was almost 85% & Remaining 15% was stored for further use for improved plant performance and Sustainable of waste Management.

Keywords: Integrated steel plant, BF Slag, Sustainability, coke oven EAF & EF slag.

Introduction:

The world steel industry produces about 780 Mt of crude steel and simultaneously more than 300 Mt of solid waste products are also produced. Thus, on an average, about 400 kg of solid by-products are generated in the steel industry per tonne of crude steel. Major share of this (70-80%) consists of Blast Furnace Slag and basic Oxygen Furnace Slag (1, 10).These wastes are an ecological hazard. The total steel production in India is about 25 million tones and the waste generated annually is around 8 million tonnes (considerably higher than the world average). Though the present study highlights associated ecological problems and based on available data, few remedial measures have been suggested, the main purpose of this study is to highlight the business opportunities available during conversion of the generated waste into commercial products. Technologies have been developed in most the developed nations of the world for such utilization of the generated wastes. There are nations which have technologies for complete utilization of the waste (9).

Environmental concerns have been given prime importance after the Kyoto Summit and that has severely affected the steel industry. As a result, Ministry of Steel, Government of India has set up a target of 100% utilisation of solid waste (National Steel Policy - 2011). Under Charter on Corporate Responsibility for Environment Protection (CREP),

steel plants are required to set mutually agreed targets with the purpose of making due compliance of regulatory norms for waste utilisation. The most fundamental changes are those of public attitude, awareness and acceptability with respect to generated waste. These changes are increasingly applying pressure to minimise waste, encourage waste recycling and demanding waste disposal, with all probability, landfilling as the last option (2).

The study Area:

Located at the Dolvi (New Mumbai, Maharashtra), the JSW Steel is one of India's leading integrated steel manufacturing company, with a capacity of 5 MTPA. As a part of Jindal group, it is one of the fastest growing companies in India. It has its footprints in more than 140 countries. After it took over ISPAT steel, it has become India's second largest private sector steel company. Its current installed capacity is 10 MTPA. Being a $11 billion conglomerate, its presence is felt all across India and also in USA, South America & Africa. The JSW Group has its strong reputation within core economic sectors, namely, steel, energy, infrastructure, cement, and also specific ventures and sports.

In this integrated steel plant, raw materials like iron ore oxide, (lumps & pellets) coal, limestone & dolomite are used. After processing, direct reduction of sponge iron takes place and then, it is used in blast furnace or directly in hot strip mill plant (12, 13, and 14).

In blast furnace hot metal formation takes place along with granulated slag & dry pit slag. The hot metal is converted into slab caster & finally, hot roll coil is produced in hot strip mill Plant. It also generates hot strip mill slag, mill scale and gas cleaning plant dust. The waste materials from sponge iron plant, blast furnace, and hot strip mill plant are used for manufacturing of sinter in sinter plant (2, 3).

The objective of this study is to bring forth the status of the Indian steel industry with respect to generation of wastes and their management, in terms of extent of recycling, reuse (including sale to the outside parties) and disposal (dumping). A comparison will have to be made with the corresponding figures in the developed world and then to identify measures to minimise generation of wastes. An eye on the maximisation of utilisation of generated wastes and to achieve ‘zero waste’ status will also help Indian economy (4).

Methodology:

During the initial stages of this study, the collection of data was carried out for identification of various types of wastes generated in steel plants, along with the extent of generation of these wastes and their distribution in terms of recycling, reuse and Restore (10,11). Hence, during systematic analysis of the data, information regarding generation of waste & utilization of materials, was given priority. Subsequently, qualitative evaluation of the technological options for by-product management was undertaken and recommendations have been put forward for achieving the goal of ‘zero waste’ (5,6,7).

Categorisation of Generated wastes:

The generation of various types of waste materials and their quantity differs from one steel plant to another depending upon the adoption of various types of steel making processes and pollution control equipment installed. The generation and utilization of major wastes from such process units and pollution control equipment are as follows:

1) Electric arc furnace & ladle furnace slag, 2) Clarifier Sludge, 3) Classifier fines, 4) Gas cleaning plant dust, 5) Blast furnace slag, 6) Dust, 7) Coke Fines, 8) Oxide Fines, 9) Sinter Fines, 10) Electrostatic precipitator dust, 11) Coke Breeze, 12) Coal & Coke dust, 13) BF Waste Gas, 14) Coke oven waste gas, 15) Sulphur Paste, 16) Waste

water generated from sponge iron plant, 17) used oil, 18) E waste, 19) Oil sock cotton, 20) Coal tar, 21) Wet quenching waste water, etc., (15,16,17.).

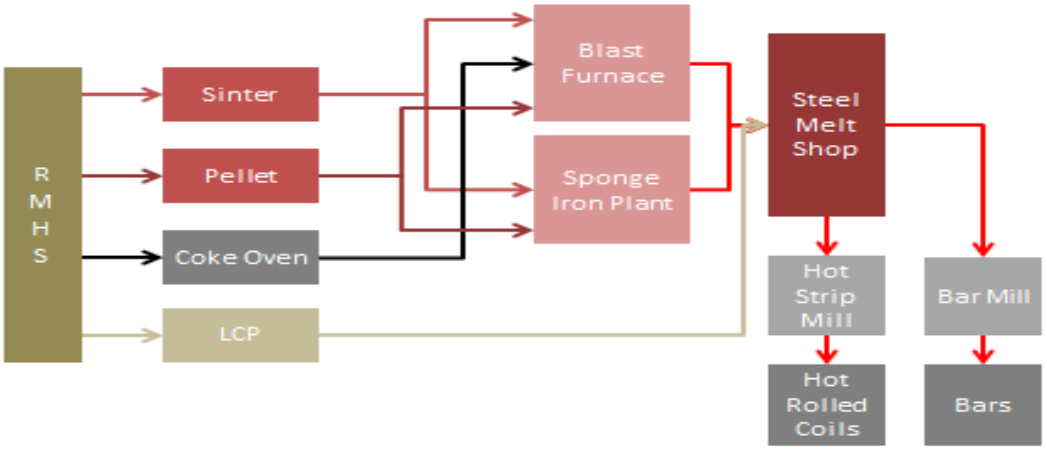


Fig. 1 Flow Sheet of Integrated Steel Plant (6)

RESULT AND DISCUSSION:

Integrated steel plants consume very large quantity of raw materials and energy for producing steel. During the conversion process, there are various solids, liquids & gaseous wastes that are produced, as shown in tables given below. (Tables 1,).

Table -1:- Data for Generation and Utilization of various wastes in Integrated Steel Plant.

Sr.No.	Name of Plant	Tentative Generation of waste (MT/M)	Tentative Utilization of waste (MT/M)	Type of solid waste	Disposal/Reused.
1)	Sponge Iron plant	38486.1	38486.1	Clarifier Sludge & Classifier fines, High-rate thickener sludge and Sludge pond sludge, used oil	Used In Sinter Plant for sinter making, and sold to authorised recycler.
2)	Hot Strip mill	1,08886.0	1,08886.0	EAF & LF Slag, GCP dust, & Sludge. Mill scale, Oil soak cotton, used oil.	Used In Sinter Plant & Pellet Plant & Remaining waste stored in designated place for reuse, sold to authorised recycler.

					Oil sock cotton is used as fuel in furnace.
3)	Blast Furnace	1,35672.0	1,35672.0	Bf-slag, Dust catcher, Coke fines, Oxide fines, Bf gas.	Used In sinter plant & remaining waste stored in designated place for reuse. BF gas is reused in captive power plant for generating Power.
4)	Sinter Plant	45654.0	45654.0	Sinter Fines & ESP Dust.	Reused In sinter plant.
5)	Pellet Plant	21321	21321	ESP Dust	Reused In pellet plant.
6)	Coke Oven Plant	11322	11322	Coke breeze, Coke & coal dust. Sulphur paste. Coal tar	Used In sinter plant & mixed with coal blend. Coke Oven gas is used as fuel in sponge iron plant, hot strip mill Plant, sinter plant, etc.
7)	Billet Caster & Bar Mill	639.35	639.5	Mill Scale	Used In Sinter Plants.

In Below Graphical representation of Waste Generation, Utilisation & Storage for Reuse from the FY -2014 to 2022.

Fig. 1 Graphical Representation of Waste Management (2014 -15)

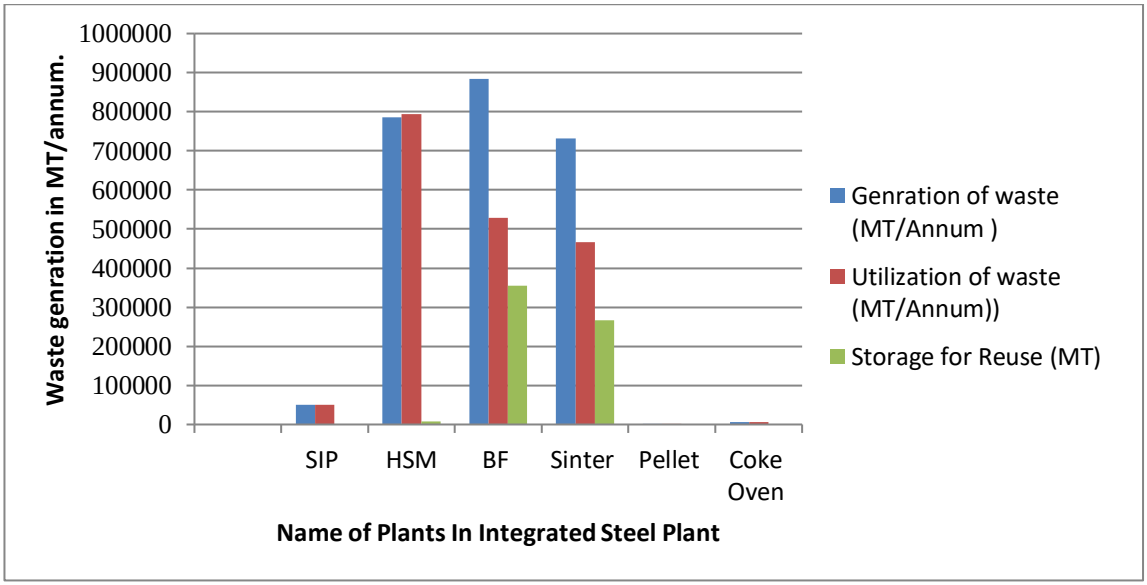


Fig. 2 Graphical Representation of Waste Management (2015-16)

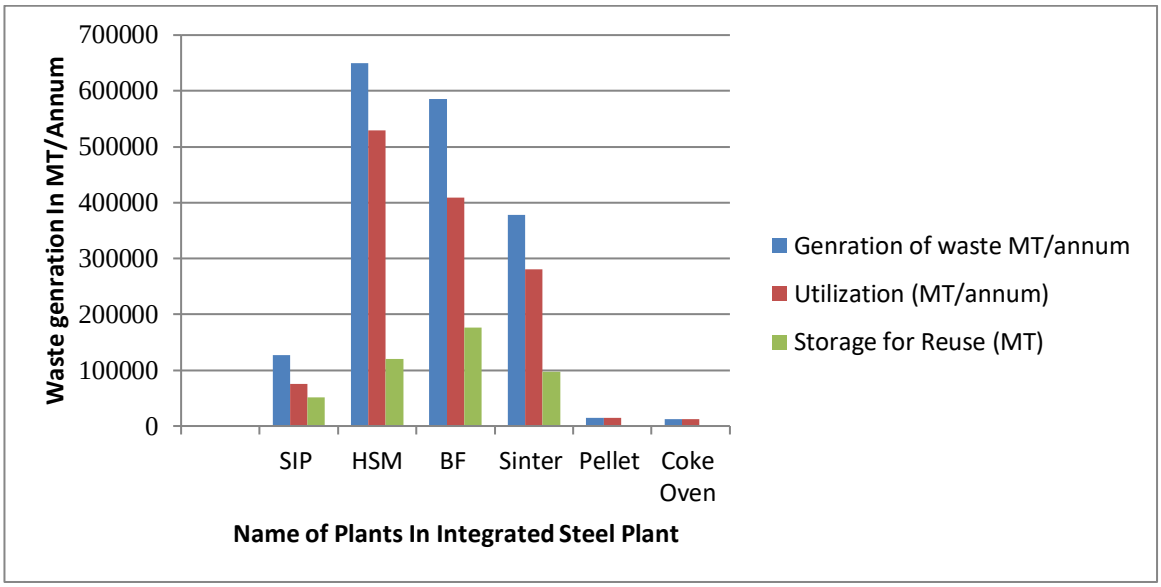


Fig: - 3 Graphical Representation of Waste Management (2016-17).

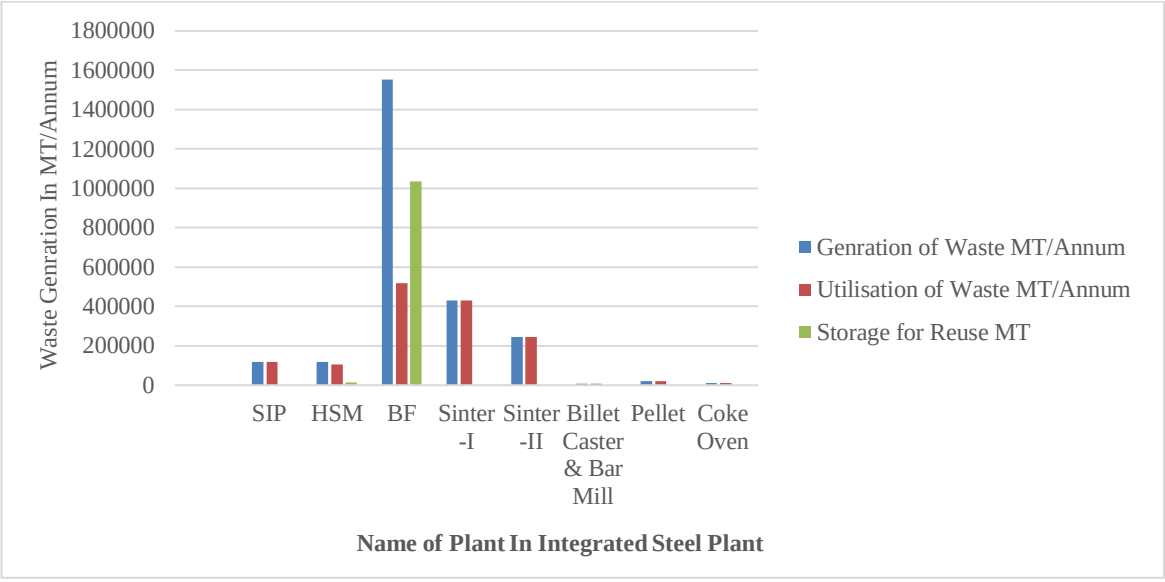


Fig- 4 Graphical Representation of Waste Management (2017-18).

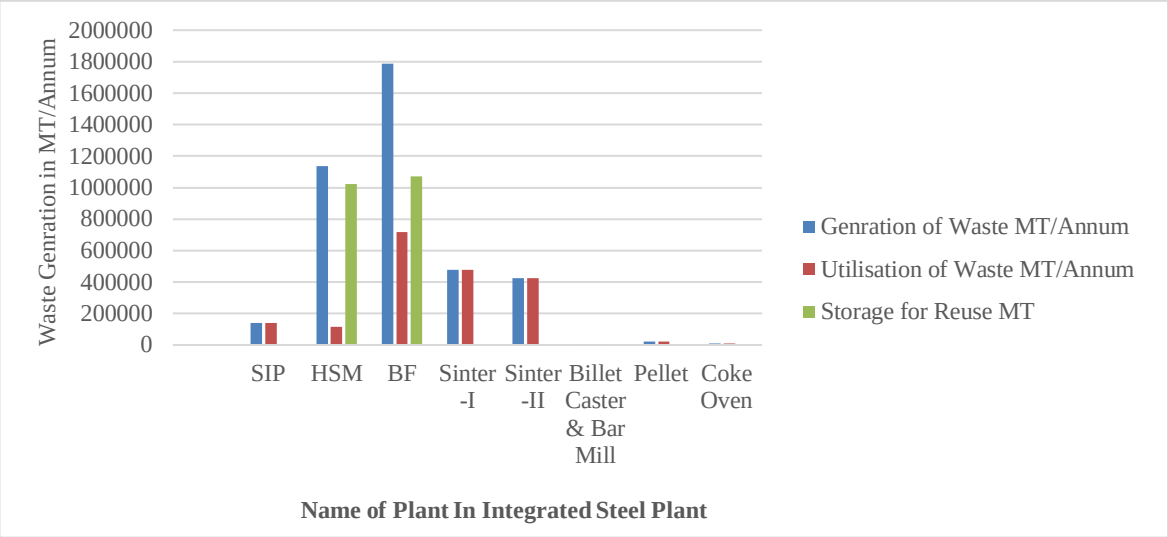


Fig: - 5 Graphical Representation of Waste Management (2018-19).

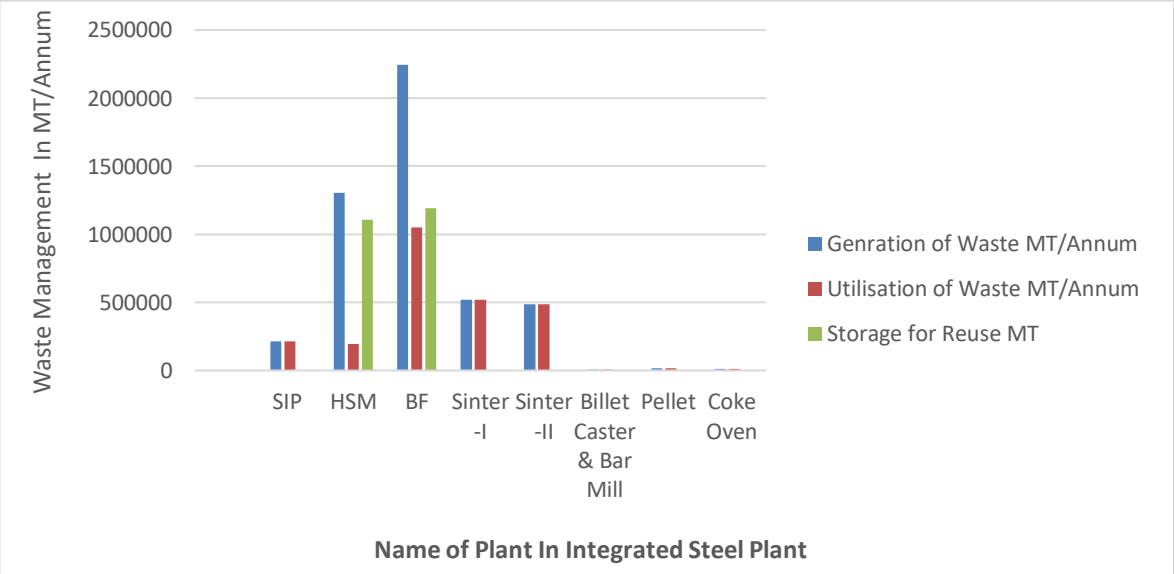


Fig: - 6 Graphical Representation of Waste Management (2019-20).

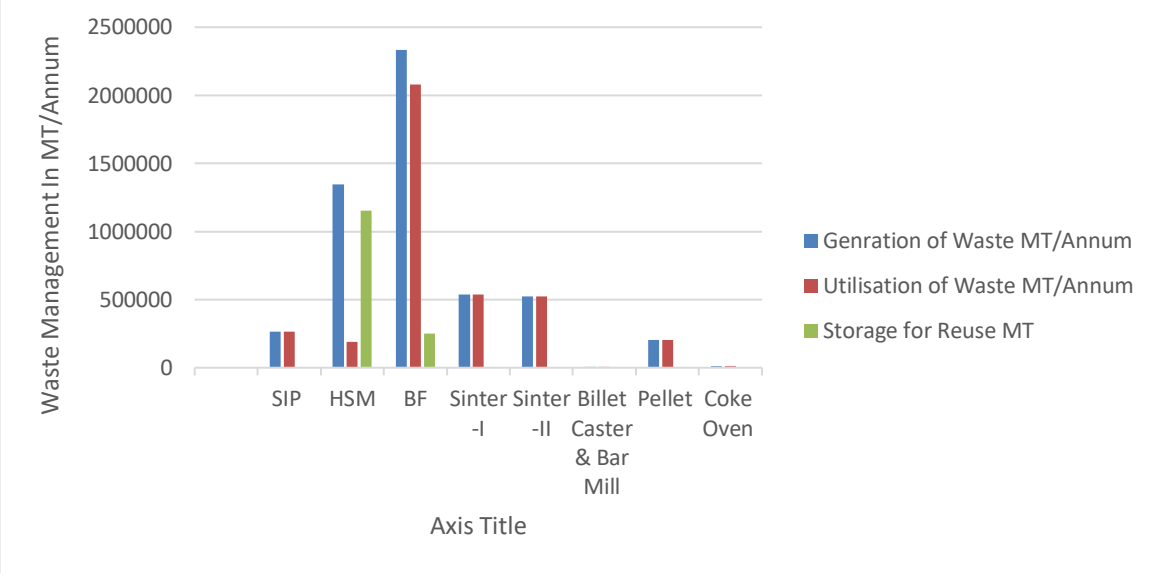


Fig: - 7. Graphical Representation of Waste Management (2020-21).

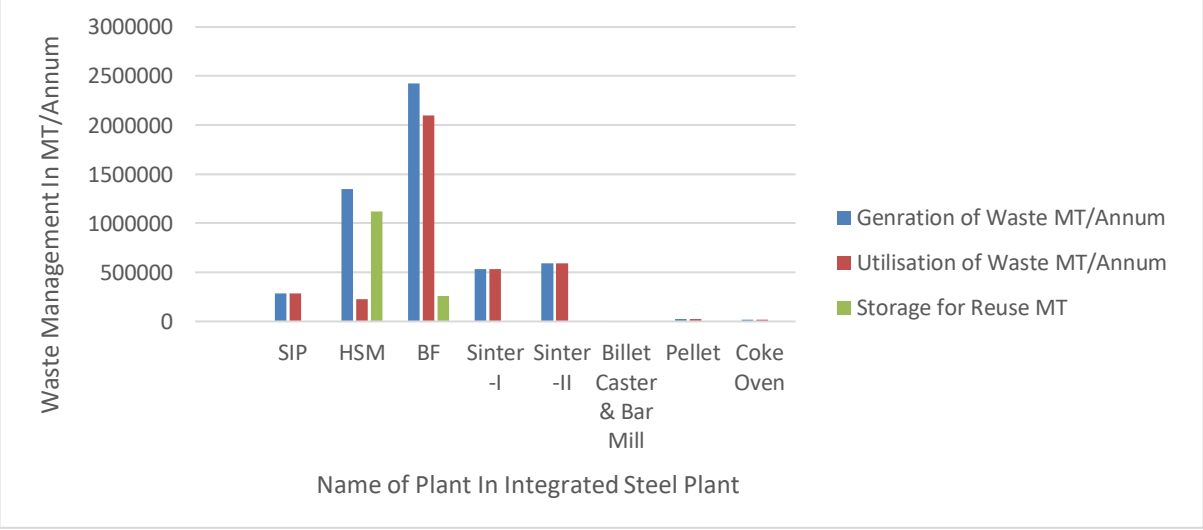


Fig: - 8 Graphical Representation of Waste Management (2021-22.)

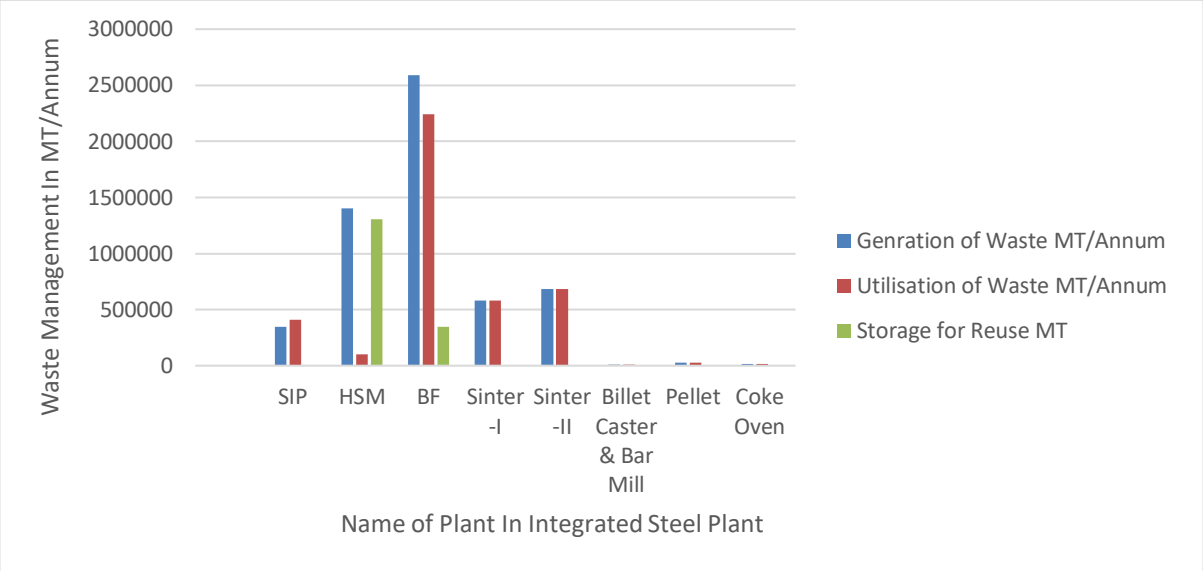


Fig. 1:- Pie Chart representation of Waste utilisation for the (2014-15).

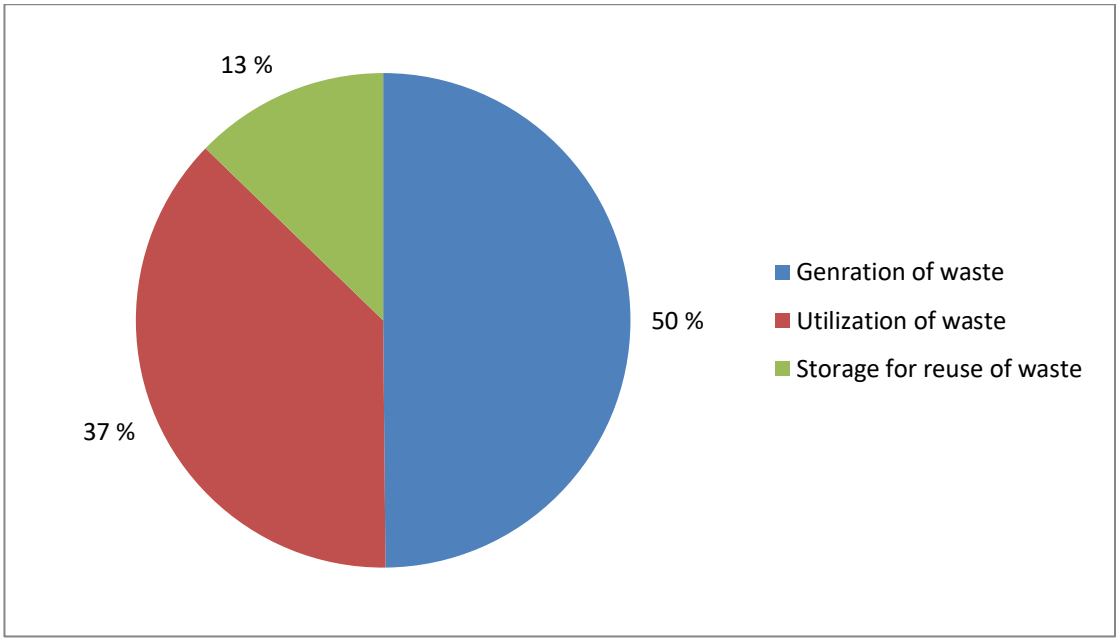


Fig. 2:- Pie Chart representation of Waste utilisation for the (-2015-16)

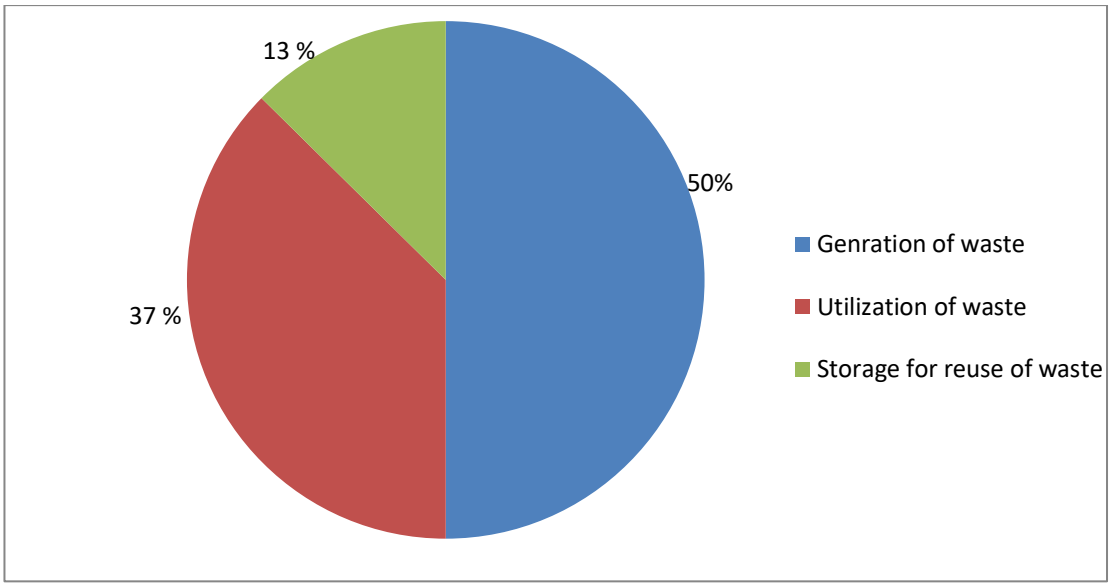


Fig. 3:- Pie Chart representation of Waste utilisation for the (2016-17).

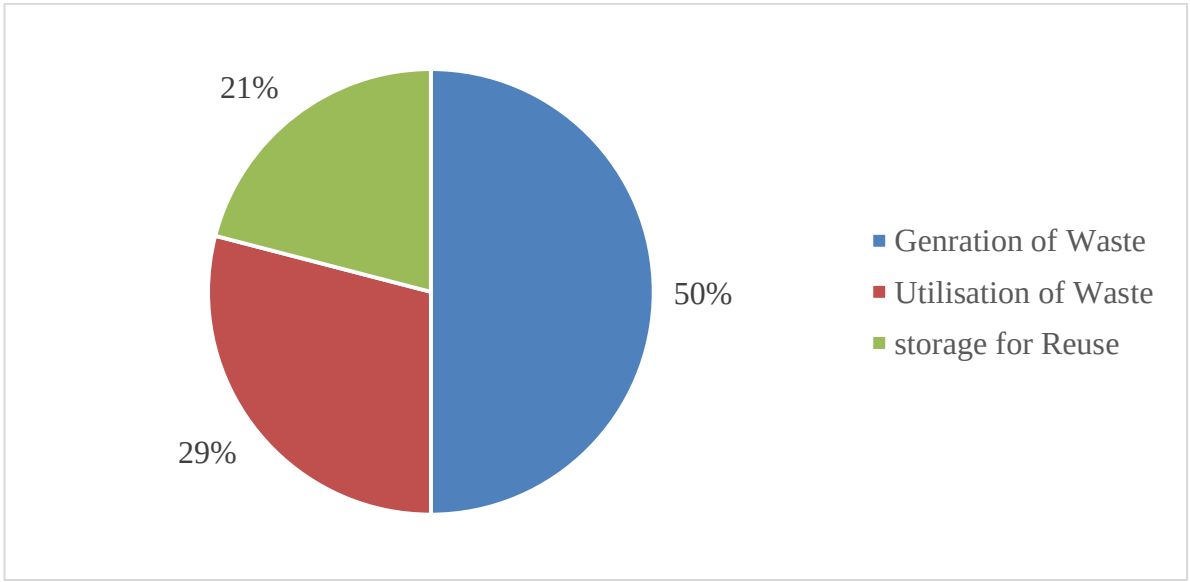


Fig. 4:- Pie Chart representation of Waste utilisation for the (2017-18)

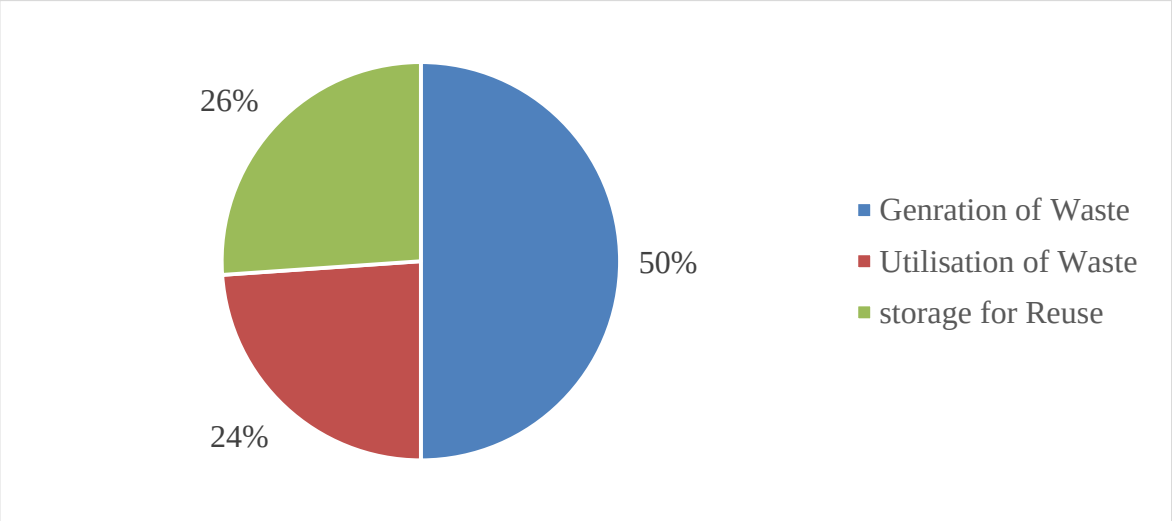


Fig:-5:- Pie Chart representation of Waste utilisation (2018-19)

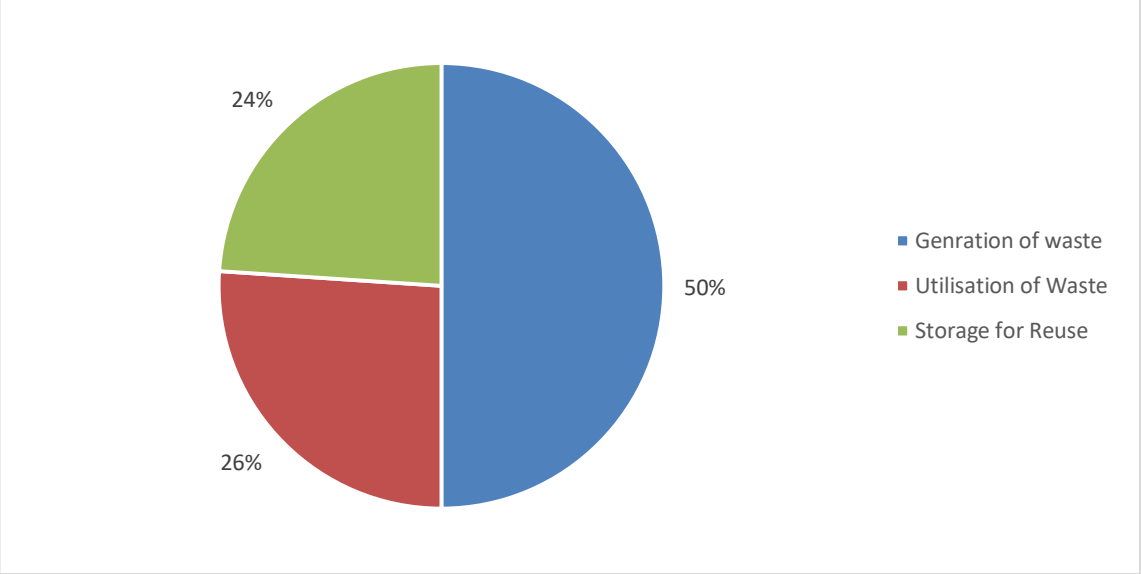


Fig:-6:- Pie Chart representation of Waste utilisation (2019- 20).

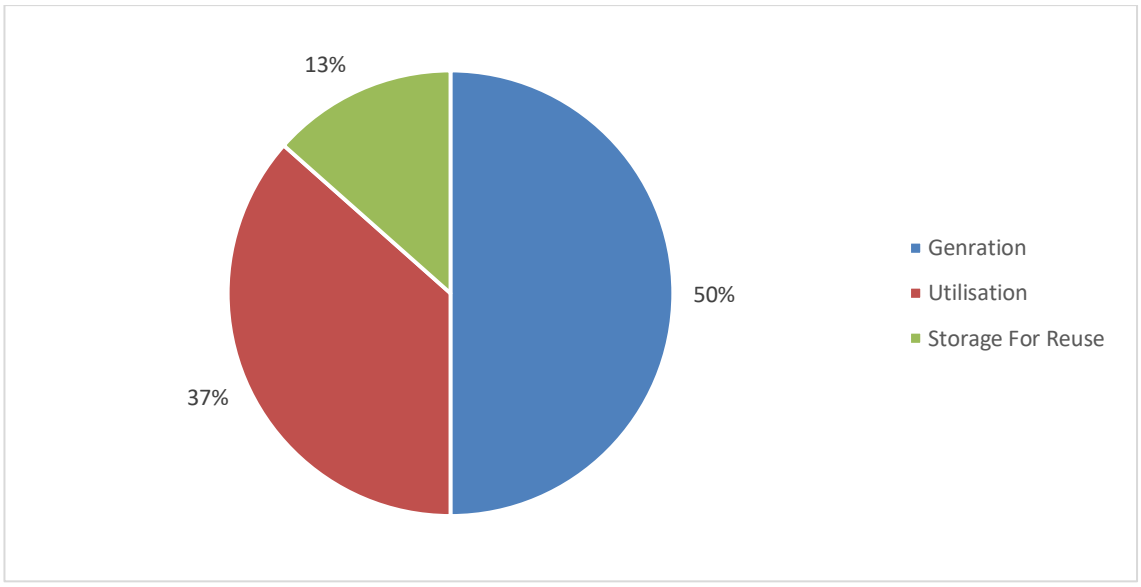


Fig:-7:- Pie Chart Representation of Waste utilisation (2020- 21).

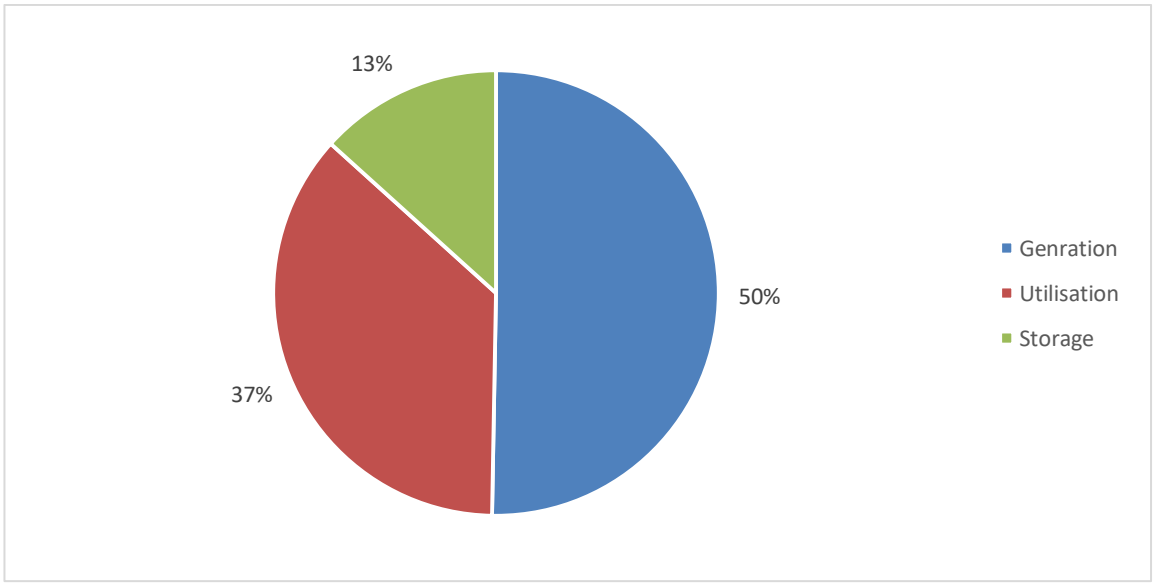
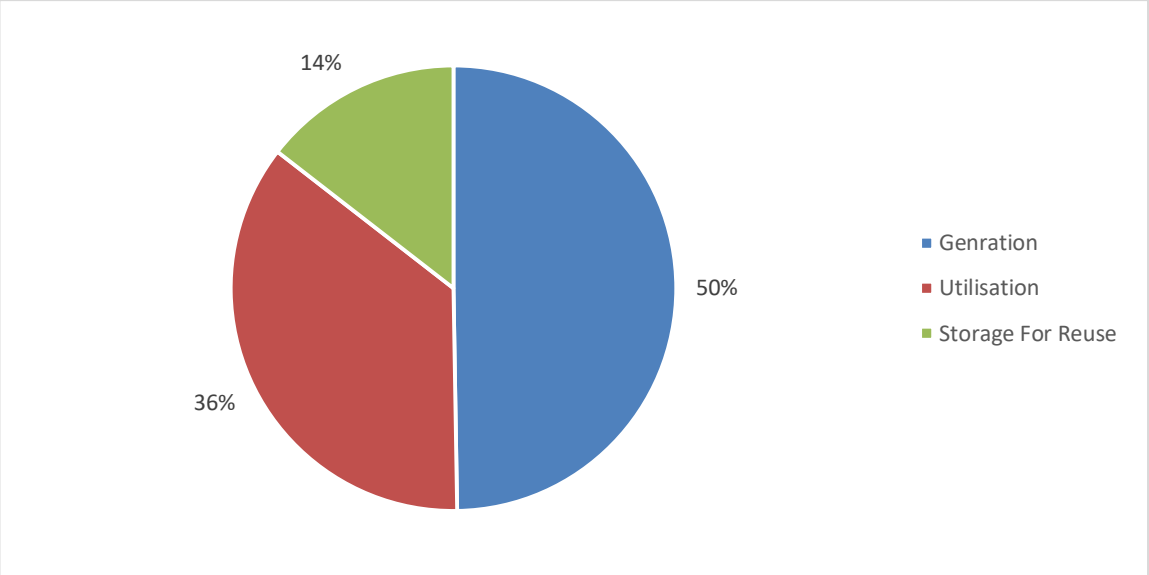


Fig 8:- Pie Chart Representation of Waste Utilisation (2021-22)



Result & Discussion:-

As shown in Table.1, And Graphical Representation fig No.1 to 8 most of the solid wastes, generated by the integrated steel plant are reutilised in sinter plant for making sinter. As shown in Pie Chart waste utilisation data Fig No.1 to 8 **(FY-2014 to 2022),** shows that the utilisation of solid waste was almost 85% & Remaining 15% was stored for further use.

In JSW steel plant, maximum waste gases are reutilised for fuel as a source of energy in captive's power plant and in different plants for energy source. All waste is utilised in the plant & also stored for future waste management and utilisation.

Conclusion:

In integrated steel plants, the generated waste is further converted into profitable products by utilization of eco-friendly advanced technology to reduce, reuse and recycle the waste. Natural resources like water, air and soil are adequately used to mitigate the load of pollutants within natural environment. The sponge iron plant produces classifier and Clarifier fines which are reused in the sinter. The Hot strip mill plant generates electric arc furnace and ladle furnace slag. The Gas cleaning plant dust and mill scale are utilised in sinter plant and pellet plant. The Blast furnace generates granulated slag which is utilised for making cement in the cement industry. Blast furnace slag and waste water plant sludge is also utilised in sinter plant. The dust catcher dust, coke fine dust & oxide fines are also reused in the sinter plant. In sinter plant, electrostatic precipitator dust & Sinter fines are reused in sinter plant. In the pellet plant, the electrostatic dust is reused in induration process. Coke oven plant generates coke breeze & ground dedusting dust which is reused in coal mixing for preparation of stamping coal. In most of the plants like sponge iron plant, blast furnace and hot strip mill, the waste is reused in the sinter plant.

Maximum recycling of waste water generation, all solid waste and gases to be utilised for energy conservation like BF gas, coke oven gas to produce to power. Sponge iron waste water is 100 % reused in hot strip mill plant for

cooling of slag. The coal tar, which is generated as a by-product, within coke oven plants are utilized for making of cosmetics, road, organic solvent, etc. The sulphur paste generated in the Coke oven plant is utilized for tannery Industry. Overall integrated steel mill complex process uses oils to recycle into authorised processors. Integrated steel plant produces empty paints drums while oil soak cottons are used in electric arc furnace. Thus, it shows that the waste management is very much crucial and while complying with statutory norms and zero waste generation, demands remedial measures from the steel industry.

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