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Waste Management in Mining and Allied Industries

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Abstract - Waste management is the systematic assessment of potential hazards, disposal and proper utilization of waste in mining and allied industries. Due to waste there is a great environmental concern and resource constraint. These wastes can affect the environment through it intrinsic property. Proper planning is essential to manage the waste. Management indicates managing wastes in such a way that it would be beneficial in any way. In view of associated environmental hazards and their impacts on public health and safety, efforts must be made to minimize waste generation, systematic disposal practices must be followed, and sound waste management methodologies need to be adopted.

In mining and steel industry, wastes are generated in every stage of the operations and are required to handle properly. The types of waste generated from both the industries are solid, liquid and gaseous wastes. So, waste management involves solid, liquid and gaseous waste management. Therefore, the waste generated can be utilized or can be reused as raw material for other processes if not has to be disposed safely so that it will not affect the environment.

The objective of the waste management in mining and steel industry is to assess the waste disposal techniques used in both the industries as well as their waste management techniques. Field studies have been carried out on waste management in different industries, which include an open-cast limestone and dolomite quarry (BSL) mine, an opencast coal mine (Basundhara OCP) as well as an underground coal mine (Hirakhand Bundia) of Mahanadi Coalfields Limited (MCL) and Rourkela Steel Plant. In the BSL opencast mines that major waste problem is from the generation of the overburden and dust emission. In open cast coal mines due to high production and high mechanization the volumes of waste generated is more. The waste generated is managed by efficient methods. Solid wastes that are generated in the mines are being efficiently utilized for backfilling and the mine wastewater generated is used for fighting fire and used for dust suppression measures. In underground coal mines waste type generated is different, so technique of waste management differs. Depending on the types of various processes to produce steel, diverse number of wastes are generated in RSP as compared to waste generated from mining industry. In steel industry wastes contain some valuable resource in it, generally for solid waste. These solid wastes generated can be raw material for other process and in many cases can be reused. Water analysis for the R.S.P. and a mine was carried out to ascertain impact of waste generation by the two industries on the quality of the water that has been tested. Similarly soil samples from two different mines were analyzed and their characteristics have been reported.

Key Words: systematic, wastewater, heavy metals, and removal efficiency, mining.

2.INTRODUCTION

Waste generation is a major issue in every country, and waste quantities are generally growing. Total waste quantities continue to increase the problem in mining and allied industries. Unfortunately Waste is generated by activities in extraction of coal or ore from the mines and in steel industries by production of steel, which generates products which is generally regarded as an unavoidable by- product of economic activity waste generated from inefficient production processes, low durability of goods and unsustainable consumption patterns. The generation of waste reflects a loss of materials and energy and imposes economic and environmental costs on society for its collection, treatment and disposal. The impact of waste on the environment, resources and human health depends on its quantity and nature. The generation and of waste include emissions to air (including greenhouse gases), water and soil, all with potential impacts on human health and nature.

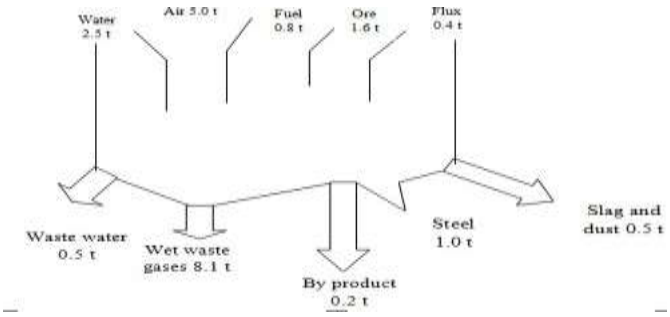

Figure 1 Schematic Diagram of Steel Making (Agarwal, 1999)

Year	Solid Waste	
	Generation (in million tonnes)	Utilization (%)
2005-06	7.841	70
2006-07	7.816	75
2007-08	8.029	79
2008-09	8.028	78.6

Table 1 Solid Waste Generation in SAIL (http://www.sail.co.in/),

3. Materials

3.1 WASTE MANAGEMENT IN THE BISRA STONE LIME COMPANY LIMITED

Introduction

Bisra Stone Lime Company Limited Mines is an opencast mine located at Birmitrapur District- Sundargarh Orissa on NH-23 and towards North of Rourkela at a distance of 30 KM and it is well connected by rail also. The lease hold area of mines is 1961.93 Acres or 793.966 Hectares

Location:-The geographical location of the mines falls

Latitude: 22°24'19.7 to 22°25'00

Longitude: 84o40'56.6 to 84°45'24

Figure 2 Location of BSL Mines

Limestone: The total reserve of Limestone to be around 400 Million Tonnes. During mining it has been found 60% is good stone (BF Grade) so total BF grade is about 240 Million Tonnes.

Ins	8.00 – 12.00
SiO2	5.00 – 9.00
Al2O3:	1.50 – 2.50
Fe2O3:	0.60 – 1.50
CaO	43.50 – 46.50
MgO	3.50 – 5.50

Table 2

Dolomite: The Dolomite reserve will be approx. 240 million tonnes. From the quality control in the mines it has been noticed that 70% is good stone (BF Grade). So based on the calculation.

Figure 3 Water stored in the Sump

As the water stored in the pit bottom is below the pollution norm. So water pollution is not a big problem in the mining area.

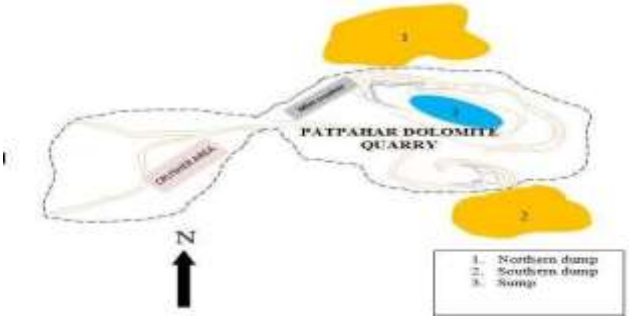

Figure 4 Layout of Patpahar Dolomite Quarry [14]

3.2 WASTE MANAGEMENT IN BASUNDHARA OPEN CAST MINE, MCL

Basundhara (West) OCP mine is located in north-central part of Ib Valley coalfield, which started operation during 2003-04. The project or mining lease covers an area of 401.10 ha.

Location

The project is located in the north-west of Basundhara East block and east of Chaturdhara block of Ib Valley coalfield in Sundargarh district of Orissa. It falls within: -

Latitude: - 22^{O} 03' 32" & 22^{O} 04' 11" (N) and

Longitude: - 83^{O} 42' 18" & 83^{O} 44' 08" (E).

Communication

The block under reference is well connected by road. It is accessible by an all-weather black topped road from district headquarter, Sundargarh, located about 48 km.

Topography

The topography of the block is generally flat. The general slope is towards south. The surface elevation of the block varies from 262 m to 288 m above MSL. Main drainage of the area is controlled by the perennial Basundhara River demarcating western and part of southern boundaries of the block and its feeder streams.

Geology

There are two coal seams (Ib seam & Rampur seam) which is in the process of extraction. The grade of coal is F (Avg.). The mineable reserve is 25.32 million tons (as on 01.03.2010).

Targeted output

The project has a production of 6.0 Million Tons/Year. The overall stripping ratio works out to be 0.81 cum/t.

Life of the mine

The life of the mine has been estimated to be 4 years from 01.04.2009.

Figure 5. Location of Basundhara Mines

The water which is obtained by the process is directly disposed in the nullah of the mine and it is never reused for any other purpose.

4. RESULTS AND DISCUSSION

Figure 3.4.11 Sitalpara Dump 1 of R.S.P

Figure 3.4.12 Sitalpara Dump 2 of R.S.P

Disposal Liquid Waste Disposal and Effluent Management

Waste water from the steel making process is being treated with best available physio-chemical methods as well as being recycled. Waste water from the coke plant is treated biologically where organic pollutants are oxidized and decomposed by microorganisms. Proper measures are taken at different units. The waste after usage is further treated and are released from the steel plant to natural water bodies, nearby to the plant. The liquid waste or wastewater is discharged through proper channels with the help of different outfalls.
Waste disposal of Hazardous Waste

The wastes which are falling under Schedule #1 and Schedule #2 of Hazardous Waste (Handling and Management) Rules, 1989 amended in May 2003 are termed as Hazardous Wastes. These wastes can only be disposed in scientifically designed hazardous pits as per the guidelines of Central Pollution Control Board. The steel plant has to obtain prior authorization for handling and management of these wastes under Hazardous Waste Rule, 1989. Rourkela Steel Plant constructed 3 no. of scientifically designed hazardous waste pits at SSM complex, near CCD area and SSD area. The list of the wastes management by RSP is given in Table4

Sl. No	Parameter	R.S.P. Water value	Permissible limit Standard100-1991)
1	pH Value	7.1	5.50-9.00
2	Odour	Unobjection-able	-
3	Total hardness (as CaCO3), mg/l	1256.1	600
4	Iron (as Fe), mg/l	0.8	1.0
5	Chloride (as Cl), mg/l	101.2	1000.00
7	Total alkalinity, mg/l	153	200

8	Calcium (as Ca), mg/l	47.4	200
9	Calcium (as CaCO3), mg/l	118.5	600
10	Magnesium (as Mg), mg/l	276.43	100
11	Ammonia, mg/l	4.8	1.2
12	Phosphate, mg/l	0.459	5
13	Sulphate, mg/l	Below 40	400
14	Chloride dioxide	Nil	1

Result

The result obtained from the analysis of the water was that the pH level of the water was appropriate as per norms. Similarly Iron (as Fe), Chloride (as Cl), total alkalinity, Calcium, Phosphate, Sulphate was found to be below tolerance limit. Magnesium, Ammonia and total hardness of the water was found to be excess and values of both the parameters are all above the norm.

Discussion

The above report of water analysis indicates that the water quality is not totally safe as some of the parameters like magnesium and total hardness is approximately thrice and twice than the normal permissible limit respectively. Other parameters found in the water were found below the permissible limit. Some of the parameter like the concentration of magnesium as well as the total hardness of the water is exceeding the norm. Presence of ammonia found to be above the limit, this makes the water little toxic. Overall, the water tested was found to be hard and little bit toxic.

WASTE MANAGEMENT IN R.S.P.

One of the major concerns of world steel industry is the disposal of wastes generated at various stages of processing. The global emphasis on stringent legislation for environmental protection

5. CONCLUSIONS

Waste management in mining and allied industries has presently assumed greater importance. It is a technique in managing wastes in such a way that it would be beneficial in any way. Waste management is the collection, transport, processing, recycling or disposal of waste material, usually one produced by human activities with an effort to reduce their effect on human health or local aesthetics or amenity. Waste management involves solid, liquid and gaseous waste management.

The types of waste generated by mining and allied industries can pollute the environment because of to its chemical (or physical) nature in particular media as water, soil, vegetation, and targets like the fauna and human. Waste management helps in reducing pollution by environmental friendly waste disposal system is possible due to the implementation of these processes. Disposal of mining and steel plant wastes demands due attention in planning and execution in order to achieve environmentally acceptable disposal practice so that environmental problems can be eliminated. Waste management helps in effective managing the waste generated and helps in better utilization of raw materials.

Field study was carried on waste management in the different mines and in Rourkela steel plant. The objective of the study was to know the status of waste management practices in the mining and steel industries, to know the sources of waste generation and whether the waste management practices followed was sound and benign.

From the field study of BSL mines it was concluded that major waste problem for the mine is the generation of the overburden and dust emission from mines and from the crusher area. These waste generated from the mines are not hazardous in nature. For the disposal of overburden they were using two waste dumps. The management of the solid waste generated i.e. overburden is disposed in the two dump of the mine, further this waste is used for paddy harvesting or in plantation. For the management of particulate matter water sprinklers were used in the mines for the dust suppression. Water sample of BSL mine was analyzed. In the result it was found that the concentration of magnesium and ammonia in the water sample was in excess. Soil sample of BSL mine was analyzed. BSL mines soil sample result shows that the soil lacks organic carbon and soil nitrogen.

Suggestions for improvement for waste management practices in the BSL mines are the overburden generated should be directly used for the landfilling or reclamation of the mines. More Number of water sprinklers should be used and there should be utilization of mine water.

In case of non-hazardous waste the major problem is by fly ash, SMS slag and sludge. These solid waste generated from the Steel Plant cannot be utilized due to various constraints and limitation. Due to their lack of utilization, their disposal is becoming a great concern. Among the three solid wastes fly ash disposal in RSP is a big problem. As fly ash rate of generation is very high as compared to the other two wastes and therefore the area required for the disposal of fly ash is very large. However the fly ash and SMS sludge generated are disposed in the fly ash pond and SMS sludge pond respectively. RSP presently, is unable to utilize 100% of SMS Slag and sludge. The percentage utilization of the SMS Slag and Sludge is below 50%. So various research works are going in the R&D unit of RSP to utilize these two wastes. Water sample of RSP was analyzed. For RSP water sample magnesium, ammonia and total hardness was found to be in excess.

The suggestions for improvement of waste management practices in RSP are that the fly ash can be utilized for brick manufacturing and can be supplied to the nearby mines and low-lying areas for backfilling. SMS slag can be used in rehabilitation of the land. So initiative should be taken to promote and utilize the SMS slag by supplying it to the areas that needs rehabilitation.

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