"Productivity and Production Increase by Optimum Utilization of Machines and Manpower Energy of Lead Recycling Plant"

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Abstract - *Productivity has often been cited as an important factor in industrial Management, and activation to increase it's said to improve profitability and the wage earn of employees. Improving productivity and production rate are seen as a important issue for survival and success in the very long term. This paper focuses on examining key factors of productivity enhancement, and investigating the causal relationships among those relative key factors to better communication, understanding and plan for productivity and production improvement. The results prove 5 key productivity factors, including „leadership quality ", „strategic quality planning", „trained people", „data and information", and „process report", selected model.*

Keywords: *- lead recycling process, man power, optimum utilization, production capacity, process management Chart and strategy quality planning Chart.*

1. INTRODUCTION

Productivity is the ratio between output and input. It is quantitative relationship between what we produce and what we have spent to produce.

70 Productivity is nothing but reduction in wastage of resources like men, material, machine, time, space, capital etc. It can be expressed as human efforts to produce more and more with less and less inputs of resources so that there will be maximum distribution of benefits among maximum number of people. Productivity denotes relationship between output and one or all associated inputs. European Productivity n Council states that „Productivity is an attitude of mind in as much as productivity is concerned in the development of any society, place or industry. We are all towing towards that direction of effective and efficient productivity. Productivity as the case may be is the effective use of all factors of production; or each factors of production which is defined as output to input (Oraee1998). Recent years have seen widespread discussion of productivity, and for good reason. It appears that labour productivity growth has improved sharply, perhaps approaching the pace of the "golden age" of the new millennium. To put the importance of this recent change in perspective, consider the direct impact of productivity in machine and human effort. If labor productivity were to grow at 2.5% (the average rate from 2013-2018) be output per hour will rise by 35% after 5 years. Clearly, the rate of productivity growth or the rate of productivity increase can have an enormous effect on real output and standard of living. The debate about the sources and sustainability of the recent productivity, difference between " labor productivity" and "total factor" productivity, and the relative importance of the factors like "capital deepening" " spillover" productivity of machine output and productivity of machine use etc. Many of these terms are not only similar wording, but intellectual differences between them and can also be quite suitable. This work aims to elucidate the key ideas and concept in the economic analysis of productivity and apply them to recent trends. We begin by describing the most commonly used measurement of the productivity, discussed the importance of productivity for several major economic variables, and also sketch some of the factors believe to determine productivity, and finally note several open research question, as it concern machine, manpower, and optimum utilization of the factors of productivity. Also some tables will be used in various sections to determine the production and productivity of each of the variable like machine and manpower energy as the case may be. The Organ gram of (Niger Mills} is also included in the section three of this work so as to have a clearer picture of the study

1.1 production improvement in recycling process

Recycling in its literal meaning, is the procedure of making used or unwanted products in into new remanufactured products.

The procedure of recycling is unique in the sense that the products are recycled in such a way that the materials that are left after the remanufacturing are considered essential. When educating one on the process of recycling it helps to remember that more type material can be recycled but certain products (i.e. cell phone and old computers etc.) provide more of a challenge to remanufacture. In this case, the re-making or the reusable materials become much inefficient.

Fig.1

On the other hand, products such as, paper, plastic, glass, tin and some other textiles are all relatively easy for processing and thus the recycling process becomes highly efficient.

Easily recyclable items share organic materials just as certain foods and plants do. The procedure that is used in the case of food and plants is known as the composting rather than the recycling.

1.2 The Recycling Process Benefits

The purpose for the recycling process is important for a number of reasons. One of the most obvious reasons lies in reducing the amount of natural resources that are consumed for every new product. Since recycling is conserving energy the process produces a smaller carbon footprint, thereby help the environment. The recycling process also prevents water as well as air pollution while forbidding the garbage build up accompanied by landfill proliferation. Since materials are brought to a recycling facility they do not wind up in areas that do not have a place for them.

Further, if the procedure of recycling happens to be a perfectly efficient process then one would be able to convert all old wasted products into similar amount of the same product. Though, there would be an energy expenditure this expenditure is used while processing recycled materials that can raise the cost of manufacturing of certain goods to a higher level.

1.4 Pure lead

Pure lead ingot is being produced from raw lead bullion/remelted and secondary lead ingots/lead scraps through Pyro-metallurgical process. Refining process producing pure lead ingots with a minimum purity level of 99.07% by weight but achieve purity level of 99.975% in most of cases.

Table 1(industry wise uses)

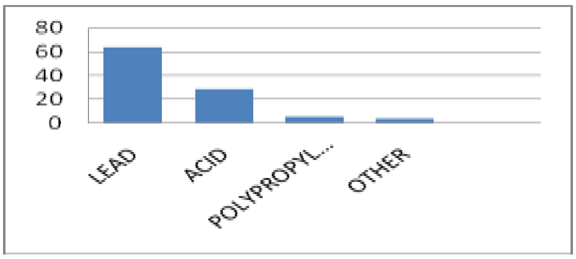


Table 2(Lead acid battery compositions)

Lead-acid batteries are most frequently used in automobiles, boats, and other vehicles. Each battery contains lead and corrosive sulfuric acid electrolyte solution. Smaller sealed lead-acid batteries have been used in computers and cellular telephones.

Fig. 2(lead recycling plant)

1.5 Lead Demand & Production

Lead demand during 2011-12 was 410,000 tonnes as per the Planning Commission, though industry estimates put the figure at much higher levels; this is because of the very large contribution coming from the lead recycling sector, whose number as well as lead imports is not precisely available. The only data that is accurately available pertains to primary lead, produced by Hindustan Zinc Ltd.

India's primary lead production during the last few years was as follows and demand next 3 years

Year	demand	Production (tones)
2012-13	600000	60323
2013-14	660000	64319
2014-15	730000	67294
2015-16	800000	85769
2016-17	880000	100245
2017-18	970000	109002

Table 3

1.6 Why lead recycling

Lead is a material which is very easy to recycle. It can be re-melted many times, and provided enough processes to remove impurities. The final product (termed as Secondary Lead) is indistinguishable in any way from primary Lead produced from the ore. The amount of Lead recycled as a proportion of total production is already fairly high worldwide. Over 50% of Lead consumed is derived from recycled or re-used material. Recycling rates of Lead are estimated to be much higher than for other materials

2.APPLICATION

Lead is used in applications where its low melting point, ductility and high density are advantageous. The low melting point makes casting of lead easy, and therefore small arms ammunition and shotgun pellets can be cast with minimal technical equipment. It is also inexpensive and denser than other common metals. Because of its high density and resistance to corrosion, lead is used for the ballets keel of sailboats. Its high density allows it to counterbalance the heeling effect of wind on the sails while at the same time occupying a small volume and thus offering the least underwater resistance. For the same reason it is used in scuba diving weight belts to counteract the diver's natural buoyancy and that of his equipment. It does not have the weight-to-volume ratio of many heavy metals, but its low cost increases its use in these and other applications

3. METHODOLOGY

We are there discuss about experimental equipment and to be performance of all stage in lead acid battery recycling plant and some implementation of equipment in plant by using Pyro-metallurgical method.

In 2001 the Ministry of Environment and Forests issued the Indian Battery Management and Handling Rules that require lead battery manufacturers to collect a minimum of 90% of the batteries they sell through dealers. The law established an extensive reporting system for dealers, manufacturers, importers, recyclers and others in the supply chain.

Recyclers are also required to be registered by state level pollution control boards. The extensive data collected for compliance with these provisions has never been evaluated or released to the public. Our goal is to evaluate compliance with this rule and its success in establishing large-scale collection of used batteries in India. In particular, we set out to establish if the largest lead battery producers are collecting a sufficient quantity of lead batteries to encourage additional investment and modernization of this highly fragmented industry..

3.1 Pyro-metallurgical method

Hydrometallurgy is a process through which ores and metals are heated to produce a finished product of workable compounds, purer metals and alloys. The process may be any of the following: drying, roasting, smelting, refining, and alloying, among others. By using high temperatures, one can cause chemical and exothermic reactions in materials. Various methods of heating can be performed, and these can all be referred to as hydrometallurgy. All processes use heat to change some aspect of the material being worked. The change may be as simple as heating water or other liquids to a gas state and then removing them. Or it could be as complex as chemically bonding metals, such as when copper and tin metal are combined to make bronze.

Pyro-metallurgical Refining is performed in liquid phase, which means that the crude Lead must be melted to temperatures from 327ºC (Lead fusion point) to 650ºC. As a general trend, the process is performed in batches of 20 to 100 tons, according to the refining plant capacity. The chemical concept behind the refining process is the addition of specific reagents to the molten Lead at proper temperatures. These reagents will then remove the unwanted metals in a specific order as they are added selectively

3.2 Lead acid battery recycling plant or working place

Lead recycling plant has been operating a secondary lead recycling plant in Niwari, tikamgarh Madhya Pradesh India since 2011 the technology in 1995 was based upon the use of a short body's blast furnace which produced approximately 16-20 tons per month of refined lead and lead in alloys.

I was visit in this plant and observed some problems in all the following process and design of plant and structure .so that some implementation in this plant and properly work out in present time regularly

3.3 Scrap or raw materials of lead acid battery

Lead acid batteries are made up of plates, lead and lead oxide with a 35% sulfuric acid and 65% water electrolyte solution. Lead acid batteries represent almost 60%of all batteries sold worldwide.

Fig. 3 Scrap of lead acid battery.

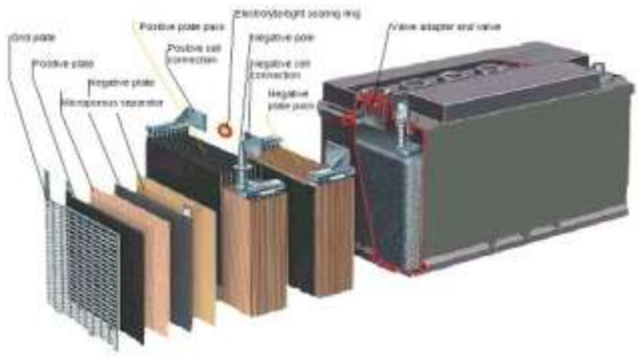


Fig. 4 Parts of lead acid battery

4. RESULTS AND ANALYSIS

4.1Collected parts of Battery braking stage-

Component	Grids	Battery plates	Separator	Battery case	Acid
Composition	Pb,sb, Ca,Sn	Pbo_2,$pbso_4$	Polyethylene glass fiber	polypropylene	H_2SO_4,Water
%of weight	25-29%	35-55%	3.5-8%	5-8%	11-28%

Table 4

4.2 Air lead pollution control system

This plant provide the full range of the service for air pollution control The most important aspect of Lead Smelting operation is treatment of effluent gases, which generates by reduction / smelting operation. These pollution control equipment's are designed and tested in house at various degree of operations on various atmospheric conditions. It consists of suitable size Dust collecting chamber (Settling Chamber), Cyclone Separator, Cooling Tower, Ducts, Spark Arrestor, Bag Filter House unit, Wet-Scrubber, Induced Draft Fan and Chimney through which flue gases finally forced out. These pollution control equipment's, are totally, controlled for any kind of over pressure and over temperature. At the inlet of Bag House, Spark Arrestor would be installed, which will catch the sparks coming in the bag house and prevent the burning of Filter Bags. Automatic temperature controlled system at the inlet of bag house is provided

4.3 Pollution control and waste management (Modification in Equipment)

- Dust Collector
- Cyclone
- Cooling Tower (Modification)*
- Spark Arrester
- Bag House (Modification)*
- Wet-Scrubber
- Water Tank(Fitted in the plant)*
- Chimney

4.3.1 Dust collector

It is a sort of Gravity Settling Chamber, the gravity-settling chamber consist of a chamber with baffles in which the gas velocity is reduced to enable dust to settle out by the action of gravity. Here normally the settling of particles larger 100 micron takes place. The velocity of flue gases entering into the dust collector will not be more than 2 m/sec and designed for minimum turbulence in chamber for easy settlement.

4.3.2 Cyclone

It is connected after Dust Collector where flue gas path involves a double vortex with the gas spiraling downward at the outside and upward at the inside. When the gas enters the cyclone, its velocity undergoes redistribution so that the tangential component of velocity increases with decreasing radius. The spiral velocity in a cyclone reaches a value several times the average inlet-gas velocity. These cyclones collect the dust up to the size of 50 Micron.

4.3.3 Cooling tower

It is connected after the Cyclone where the flue gases are allowed to cool down up to 12000^{0}C to 1300^{0}C to avoid burning of filter bags. This is properly designed as per the ambient air temperature and based on the heat transfer through conduction and convection. At the bottom of the cooling tower screw conveyor with Rotary air lock valves are provided to collect discharge dust in the bins. If we are modify this cooling process of flue gases, attach a flat plate of metal at the end of passage of flue gases inside the cooling tower some vapors of lead are collected or not delivered with the flue gases to the spark arrester.

After this modification, the lead collection is improved.

4.3.4 Spark Arrester

It is also installed after the cooling tower and just before to the bag house to avoid entering any spark into the bag house. Because of any spark, polyester filter bags may get burnt. To avoid such type of problem the spark arrester is designed and fitted before the bag house.

4.3.5 Bag house

Bag House Filtration is a necessary part of today's Industries. Bag house is a generic name for Air Pollution Control Equipment (APC) that is designed around the use of engineered fabric filter tubes, envelopes or cartridges in the dust capturing, separation or filtering process. It is present in series, after Spark Arrester and contains filter bags through which dust laden gases passes. Filter bags are made of 100% polyester non-woven fibers with Anti adhesive finish for water repellence and easy dust release with filter cloth and air permeability of 15 m^3/m^2/min. These filter bags are capable to filter 33000 CMH flue gases at temperature of 120^{0}C-130^{0}C in the presence of pulse jet cleaning system, which works at the air pressure of 6 kg./cm^2 . Screw Conveyor equipped with Rotary air lock valve is provided at the bottom discharge end for dust removal. In the bag house we have modified the filter bags such as filter bag thickness increase by 1 mm which improves the coal dust particle collection with lead and next in these bags reduce the orifices diameter (distance between the fibers).These modifications have reduced the pollution or emission in the environment and improve the lead collection.

4.3.6 Wet scrubber

It is one of the most essential equipment in the series for controlling pollution mainly removing gaseous pollutants. Counter Current vertically upward flow flue gas against water spray through the packed bad improve efficiency of removal of most unwanted gas from flue gas by water. Mist generated during wet scrubbing action is controlled by mist eliminators present in wet scrubber before flue gas outlet port. The circulating water absorbs Sulfur Di-Oxide gas and the acidic water formed which passes through Water Treatment Plant and gets neutralized. Neutralized water is re-circulated in the system.

4.3.7 Water Tank

Attach water tank between the wet scrubber and chimney the flue gases cool down and lead spread over the water after that it remove by manual process.
This modification improved the lead collection.

4.3.8 Chimney

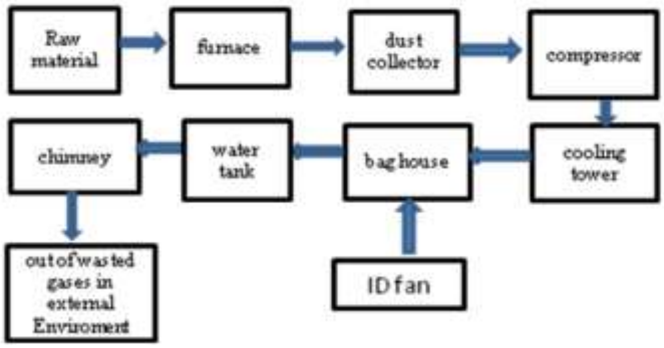
Chimney is provided for venting flue gases and dispenses pollutants at altitude helping to ease down its influence on surrounding over greater area reducing pollutants concentration in compliance with regulatory limits.

4.4 Analysis of experimental data (Production wise) which found from the lead recycling plant

4.4.1 These data collected of recycling plant or my working place before pre upgrading stage

- Overall per day based calculations-
  Maximum used raw material per day in this plant = 600 kg/day (working time 10 hours)
- Calculated After recycling process –
  Maximum output (pure lead) per day = 483kg/per day (working time 10 hours)
- Approximate recovery of lead around = 80.5%(lead recover after recycling process in percentage)
- Used fuel(coal)
- Using the fuel in every step = 57 kg (approximate)

4.4.2 Update/Modified lead recycling recycling plant



4.4.3 The Practical performance of data in the plant or actual production of lead before modification

Step -1 (Without water tank and any modification)
Used maximum raw material (lead acid batteries) = 600 kg/1 day (10 hour only)

- Calculated After recycling process

Collected actual pure lead after various process = 483.2 kg /1 day (10 hours)
- Approximate recovery of lead around = 80.53 %(lead recover after recycling process in percentage)
- Used fuel(coal)

Using the fuel in every step = 57 kg (approximate)

Step-2 (Without Water tank and modification)
Used maximum raw material (lead acid batteries) = 600 kg/per day (10 hour only)

- Calculated After recycling process

Collected actual lead end of various process = 483.5 kg /per day (10 hours only)
- Approximate recovery of lead around = 80.58%
  (Lead recovers after recycling process in percentage)
- Fuel (coal)
  Using the fuel in step = 57 kg (approximate)

Step-3 (without Water tank and modification)

- Practically justification

Used maximum raw material (lead acid batteries) = 600 kg/per day (9 hour only)
- Calculated After recycling process

Collected actual lead end of various process = 483.8kg /per day (10 hours only)
- Approximate recovery of lead around = 80.63 %
  (Lead recovers after recycling process in percentage)
- Fuel (coal)
  Using the fuel in step = 57 kg (approximate)

4.4.4 Practical performance data in the up gradation plant (with water tank and modification)

There is 3 days practical performance in modified plant.

Step -1

- Practically justification

Used maximum raw material (lead acid batteries) = 640 kg/per day

- Calculated After recycling process

Collected actual lead end of various process = 555.3 kg /per day (9 hours 30 minutes only)

- Approximate recovery of lead around = 86.76 %
  (Lead recovers after recycling process in percentage)

- Fuel (coal)
  Using the fuel in every step = 57kg (approximate)

Step-2

- Practically justification

Used maximum raw material (lead acid batteries) =640 kg/per day (10 hour only)

- Calculated After recycling process

Collected actual lead end of various process = 555.4 kg /per day (8 hours only)

- Approximate recovery of lead around = 86.78 %
  (Lead recovers after recycling process in percentage)
- Fuel (coal)
  Using the fuel in step = 57 kg (approximate)

Step-3

- Practically justification

Used maximum raw material (lead acid batteries) = 640 kg/per day (10 hour only)

- Calculated After recycling process

Collected actual lead end of various process = 556 kg /per day (10 hours only)

- Approximate recovery of lead around = 86.87 %
  (Lead recovers after recycling process in percentage)

- Fuel (coal)
  Using the fuel in step = 57 kg (approximate)

"These data collected of lead recycling plant or my working place after up gradation"

4.5 Profit-

4.5.1Total Profit privies stage -

Pure lead marketing cost in Indian - 112-118 Rs. /kg

- Before modified plant provided pure lead every day = 483 kg

Total production of every day **=** 483*112
= 54096 Rs.

Total cost (labor, raw material, maintenance)
= 49730 Rs.

Total actual profit per day basis = **4366 Rs.**

4.5.2Total Profit updated stage -

- After modified plant pure lead collected every day = 555 kg

Total production of every day **=** 555*112
= 62160 Rs.

Total cost (labor, raw material, maintenance)
= 53800 Rs.

Total actual profit per day basis = **8360 Rs.**

4.6 Capacity improvement

Pre upgrading plant capacity 600 kg/per day .But upgrading plant capacity increase 640 kg /per day

4.7 Advantages of modification plant

- Raw material saving
- Scrap losses decrease
- Increase no of working days
- Layout modification
- Process modification
- Time reduction
- Higher profits.
- Low labor costs.
- 99%+ Lead yield.
- Low energy costs.
- Environment Friendly.
- Reduced processing cost per ton.
- Simplified environmental compliance.
- Reduces the market demand supply Gap.

4.8 Analysis of Quality wise improvement

4.8.1 Pure lead (percentage of all included elements) in pre up gradation plant-

Element	Symbol	Composition in %
Antimony	Sb	0.001(max.)
Arsenic	As	0.001(max.)
Tin	Sn	0.001(max.)
Copper	Cu	0.001(max.)
Bismuth	Bi	0.025(max.)
Iron	Fe	0.001(max.)
Nickel	Ni	0.001(max.)
Silver	Ag	0.003(max.)

Zinc	Zn	0.001(max.)
Calcium	Ca	0.0005(max.)
Sulphur	S	0.0005(max.)
Aluminum	Al	0.0005(max.)
Selenium	Se	0.0005(max.)
Cadmium	Cd	0.0005(max.)
Tellurium	Te	0.0010(max.)
Lead	Pb	99.070(min.)

Table No. 5

4.8.2 Pure lead (percentage of all included elements) in modified plant

Element	Symbol	Composition in %
Antimony	Sb	0.001(max.)
Arsenic	As	0.001(max.)
Tin	Sn	0.001(max.)
Copper	Cu	0.001(max.)
Bismuth	Bi	0.025(max.)
Iron	Fe	0.001(max.)
Nickel	Ni	0.001(max.)
Silver	Ag	0.003(max.)
Zinc	Zn	0.001(max.)
Calcium	Ca	0.0005(max.)
Sulphur	S	0.0005(max.)
Aluminum	Al	0.0005(max.)
Selenium	Se	0.0005(max.)
Cadmium	Cd	0.0005(max.)
Tellurium	Te	0.0010(max.)
Lead	Pb	99.970(min.)

Table No.6

CONCLUSION

Lead-acid battery recycling could benefit both lead pollution control and resource recovery. Great efforts have been taken in India and some developing countries to improve lead recovery from waste lead-acid battery treatment.

After successful implementation of the method and modifications in the process by using a water tank, we able to increase the recycling percentage of lead up to 86-87% (previously it was in the range 80-83%). By this method we also increase the purity of lead as mentioned in the table - . The percentage of lead emitted through the chimney into the atmosphere is also reduced thus helping in pollution control. Overall capacity of the plant is also increased from 600 Kg/Day to 640 Kg/Day

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