QUALITY AND PROFITABILITY IMPROVEMENT BY TECHNICAL AUDIT

*Dr. Mishra R. C.
Head – Mechanical Engineering,
Northern India Engineering College, Lucknow.

**Prof. Srivastava S. B.
Head – Mechanical Engineering
Naraina College of Engineering & Technology,
Kanpur

Abstract: This paper is aimed for finding the Quality and Profitability Improvement by Technical Audit, through a case study and further establishing the relationship between the product quality, profitability and technical audit. Quality audit generates the report of non conformance which basically represents the deviation from committed quality of products, or in short, it may be called as postmortem of product quality. By virtue of quality audit, the commitment, implementation and follow up for product quality are aligned. This delivers a good quality of product to the customers and thus the customer is benefited. In industries, Quality Inspectors are giving their decision for quality of product in two categories, "ACCEPTED" or "REJECTED". The accepted products are coming to the customers and the rejected products become the burden / problem to the manufacturers.

If accepted product quantity is within the "NORMS", no one cares regarding the rejected product quantities, what so ever.

When the rejected product quantity increases beyond the "NORMS", the analysis process starts to find out the reasons of rejections. Sometimes, it becomes too late to search out the reasons of rejections and survival of the industry becomes a problem. By technical audit and audit report implementation such type of conditions can be avoided and controlled.

Basically, Quality is the function of Man, Machine, Materials, Methods, Movement, Manufacturing Processes, Monitoring and Management (8 M's). If the technicality of 8 M's is corrected by Technical Audit, the product quality will improve automatically and the profitability of the organization will improve. In short it can be solicited that if 8 M's are all right, the product quality and profitability will automatically be set right. This may become an important aspect in the scenario of Indian Industries. The findings are supported by a case study of a Process Plant (Slag Dryer) of a reputed Indian Industry.

Keywords: i) Technical Audit, ii) Product Quality, iii) Profitability, iv) 8M's, v) Technicality, vi) TAS (Technical Audit System), vii) Slag Dryer

I. INTRODUCTION:

Quality is an important and essential ingredient for the survival of an industrial organization. It was recognized by Japan over four decades earlier and latter its conce b v pt percolated down to U.S. and other western countries. The importance of Quality was recognized by Indian Industries recently with the introduction of various Liberalization and Globalization policies and processes. Today the wealth of any Nation depends more on its people, management and governance rather than on its Natural Resources. The knowledge and skill of the Engineers who are working in various Organizations can be harnessed fully by adopting the Culture of "TOTAL QUALITY CONCEPT" in the organizations.

Quality has become the fundamental strategic objective for competitiveness and earning the profit in any Organization. Principally all the Businessmen agree that Quality Leadership is the Key to business success. Now more or less the Quality has gone Global due to global compositeness. The Quality and Profitability are the most important parameter which determines the success of any organization. The ROI (return on investment), a gain from strong and effective Quality Program is giving excellent profitability result in organizations with effective Quality and profitability strategies. This demonstrated the substantial increase in market penetration. To maintain the quality, most of organizations are having their set of rules and regulations in well documented form which are to be adopted in their organizations, but with passage of time, these rules and ordinances are diluted due to change of work force or management or due to other reasons. Quality audit is arranged from time to time (generally once in six months), to ensure the implementation of these rules and regulations for achieving the desired product quality. Latter on, a non conformance report is prepared for implementation, as such, to maintain the product quality standards. But occasionally, the quality audit is also not giving the fruitful result and rejected products quantity are increasing day by day with a sweat poisoning rate. This results that a time comes when the manufacturers become unable to bear the cost of rejected products. In such a situation the Technical Audit is an important aspect to benefit the organization. The approach of technical audit is to correct the deviation in "Technicalities" to maintain the Quality and Profitability.

II. REVIEW OF LITERATURE:

Survey of the research literature indicates that either the research have been directed out on General Auditing Principles or procedures and not on the Effectiveness of Quality Audit itself. This has also been confirmed by Beckmerhagen et al. (2002) and Rajendran and Devadasan (2005). The only exception is Health and Milne (2002) and Franka Piskar (2006) who have given some contribution to Value Added Quality Audit.

The contribution of Zutshi and Sohal, (2002) represent the practical experience of eight prominent auditors with respect to adoption of EMS/ISO 14001 (a quality system) by Australian Organizations. The issues and benefits relating to the quality auditing processes are discussed. The aims of research by Terziovski et al (2002) were to examine the role of non financial auditors and the audit process with respect to the existing ISO 9000 Quality Standards. They concluded that conformance auditing has a role in the early stage of quality system implementation.

However, the effectiveness diminishes as the quality system matures. It has been observed by research results that 89% of the organizations firmly follow implementation of audit recommendations. Audit results, showing thrust on quality audit are recognized [Beecroft, (1996); Pivka and Ursi, (1999); Seddon, (2001); Heras et al., (2002); Magd and Curry, (2003); Fuentes et al., (2003); Pan, (2003); Piskar, (2003); Pivika, (2004); Marki, (2005)] for their theoretical and empirical work. Bhatt et al. (2004) worked on quality and cost improvements in neonatal prescribing through clinical audit. By completing the audit cycle, improved therapeutic care has been achieved with more accurate drug monitoring target and reduced the drug cost. Similar findings have also been reported by Wickramasinghe and sharma (2005), Smith and Manna (2005), and Souillard et al. (2005). Oliverio Mary Ellen (2007) has given thrust to Audit Quality in U.K. Financial Report Counsel in Feb. 2007. S. Nagata et al, (2008), has given valuable information for improving Product quality through Audit System in April 2008.

The present work aims at giving more value to the Quality Audit Effectiveness which will result in the profitability of the organizations by technical audit e.g. audit of equipment effectiveness, system effectiveness, process effectiveness, method audit etc for reaching a step forward towards Zero defect in product quality. A case study of a Slag Dryer Plant is presented below for the same purpose.

Description of Slag Dryer Plant:

The slag dryer is low temperature, circular rotary furnace where from one side the hot air is flowing and from the other side, the slag is moving. Thus the wet slag is coming into contact with hot air, so the drying of wet slag takes place. On furnace shell two numbers of tyres and one number Girth Gear are mounted (Fig.-1). The dryer is rotated on rollers which support the tyres. For rotating the dryer, motor, gear box, pinion and girth gear arrangement are also shown in Fig.-1.

The entry point of hot gasses is at the discharge point of the dry slag which is handled by a heat resistant conveyor belt. The slag is discharged into the dry slag storage bin. The entry point of wet slag is the exit point of flue gasses. Flue gasses are handled by Exhaust fans through multi cyclone dust collectors where dusty particles of slag are collected. The dust free flew gasses are then discharged into the atmosphere through chimney stack. Dryer is fitted with lifter arrangement throughout the length except at discharge end. At feeding end, three layers of hanging chains are fitted.

Specification of Slag Dryer Plant:

To analyze the problem of slag dryer, it is important to study the specification of slag dryer plant. The major specifications of slag dryer plant are listed bellow.

- Length of slag dryer: 30 meter
- Inside shell diameter: 3.05 meter
- Dryer shell inclination: 12.7 mm per 305 mm or 2.386°
- Dryer shell thickness: 28 mm to 40 mm
    a. Shell thickness under Rider Ring or tyre: 40 mm
    b. Shell thickness under Girth Gear: 32 mm
    c. Shell thickness at other places: 28 mm
- Tyre or Rider Ring
    a. Outside diameter of Rider Ring: 3600 mm
    b. Rider Ring width: 450 mm
    c. Material of Rider Ring: Cast Steel (CS)
    d. Nos. of Rider Ring: Two
- Rider Ring Supporting Rollers
    a. Outside diameter: 1200 mm
    b. Width of rollers: 550 mm
    c. Material of supporting rollers: Cast Steel (CS)
    d. Bearing of supporting rollers: made of Gun metal, bush type bearing, 360 mm diameter and 516 mm width
    e. Numbers of supporting rollers: 4
- Drive Arrangement:
    a. Pinion: Made of forged steel

b. Pitch circle diameter (PCD) of pinion: 690 mm

c. Width of pinion: 300 mm

d. Numbers of teeth on pinion: 23

e. Numbers of teeth on Girth Gear: 156

f. Modulii of gear 30

g. Gear Box: Elecon make, S. No. HG.28.328B, Type GS.30.153.AO, speed ratio 28:1, Input RPM 742, Input Power 270 HP

- Capacity of Slag Dryer: 70 TPH assuming the ideal condition i. e. initial moister content is 10% and final moisture content is 1%.
- Existing Flow Condition: Counter Current
- Rotational speed of slag dryer: 4 RPM
- Weight of slag dryer without loading: 210 MT
- Lifter: M.S. lifter angle type (120°), HRC-1 lifter, 20 mm thick screwed to M.S. Plate in brick lining zone and M.S. lifter, 10 mm thick, welded to M.S. liner in other part of dryer
- Exhaust Fan: Centrifugal type, size 1759 mm, coupling drive, air handling capacity-50000 cubic meter per hour, supplied by M/s Andrew Yule and Company, driven by 160 Kw / 220 HP Constant speed motor, Fan RPM 740, Weight 3.5 MT
- Recommended Lump Size of Slag 4-6 mm (Maximum)

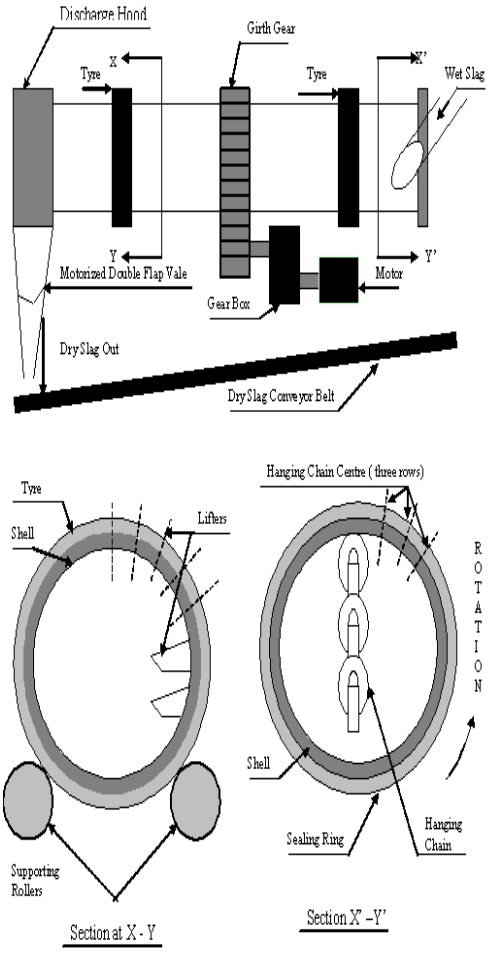

Figure 1. Sketch of General Arrangement of Slag Dryer Plant

Why Technical Audit?

When it is solicited for Technical Audit, most of the Organization are opposing it saying that our Quality Control System is all right and our people working in concerned area are well knowledgeable. There is no need of Technical Audit in our Organization. Some Organizations are afraid that Technical Auditors may leak the Technical Confidential matters of their organization to others which may result in the increase of competitiveness for them. But here are some simple questions to understand.

- Due to flushing of muddy water by a crossing vehicle, a bad spot has come on your back portion of shirt; can you see that how it appears and affects to your personality?
- Have you ever counted the steps of you stairs?

- The vehicle is having some less pressure in tyres; can you recognize the same while driving, without measuring it?
- The front light of your motor bike is unnecessarily "ON" in day time and you are driving the bike but you are not noticing the same.
- If anyone's armpit, mouth, sweat etc. are giving a bad smell, it is difficult for him to notice the same easily.
- If anyone's some teeth are broken, he himself becomes habituated to eat the foods without any problems. The problem of broken tooth is no more important for him.
- The stairs going to your flat are broken in small portion at some places but there is no problem to reach at the flat due to habit modification.
- If anyone's socks are giving bad smell, it is difficult for him to notice the same. Any how, if he notices the same but still, he is unable to realize the problem of bad smell which his companions are feeling.

Certainly all the above problems are difficult to come in notice because the concerned person is habituated to remain with his problems till major harm occurs. Similar is the condition of industries / Organizations. These problems are necessitating the requirement of technically knowledgeable persons for Technical Audit. Still in most of the Organizations, there are some reports which are generated without any present relevancy though there is cost involved either in terms of money or manpower, but no one dares to say to stop this report because the report was asked to generate long ago by a knowledgeable senior executive.

Research Problems and Objectives:

The implementation of Technical Audit System (TAS) depends on many factors which are listed as under:

- The commitment of the top management..
- Involvement of employees at all level.
- Proper communication between the Managers and Workers.
- Existing data availability (regarding the technicality of 8 M's).
- Actual data searching and details of any change, modifications, developments, deviations etc.
- Data analysis and establishing the deviations.
- Inadequate knowledge of Technical Audit to the Team members.
- Lack of clarity between Existing and Actual data.

Duly considering the above problems, a case study of a Slag dryer (one of the major equipment of Cement Plant where Blast Furnace Slag is used as additives in Cement Manufacturing) was initiated to achieve the following objectives.

- To maintain the Quality Consistency (dryness) of slag used to mix with Cement Grinding.
- To optimize the Energy consumption (Pulverized Coal and Power).
- To optimize the Utilization of Resources.
- To increase the Plant Profitability.
- To sort out the problems in the way of smooth running of plant.

Problems of Slag Dryer Plant:

It has been observed that most of the organizations are facing with some of the problems with Slag Dryer where ever it is used for drying the wet slag. The problems should be solved carefully whether it is big or small problem. Sometime even a small problem is gives a significant loss to the organizations and a major problem gives an insignificant effect in the functioning of the organization. The major problems of Slag Dryer Plant are listed below:

- Problem in maintaining the consistency of the Quality of Dry Slag (i.e. the moisture content in dry slag should be less than 1%).
- The problem of high fuel consumption and power consumption.
- Frequent breaking of Slag Handling conveyor belt.
- Frequent failure of Refractory Lining.
- Frequent stoppage of plant.

Technical Observations:

Here, the technical observations have been mainly concentrated on the technicalities of Man, Machine, Materials, Methods, Movement, Manufacturing Processes, Monitoring and Management (8 M's). Point wise observations are listed below:

Manpower-

It has been observed that most of Sr. Dryer Operators are the Ex trainees of Kiln (Direct fired furnace) operation. Not even a single Dryer Operator is having the experience of Indirect Fired Furnaces whereas the Slag Dryer is an indirect fired furnace.

Since there is major difference between direct and indirect fired furnaces and the control parameters are also different, so in such a condition, the chances of damaging effect are more with

respect to situation control effect. It has been learnt from some of the reliable source that a dryer operator was burnt due to his own negligence and was hospitalized for a long time.

Machine:-

It has been observed that one of the Bearings of Motorized Double leaf Flap Valve fitted at Discharge point of slag dryer failed. On the inquiry, it was found that the life of bearing was only one month.

It has also been noticed that the material diverter plate above the slag table feeder was having an abnormal wear from bottom side and it was not scooping the material completely. The existing profile of this plate cut is shown in Fig.-2.

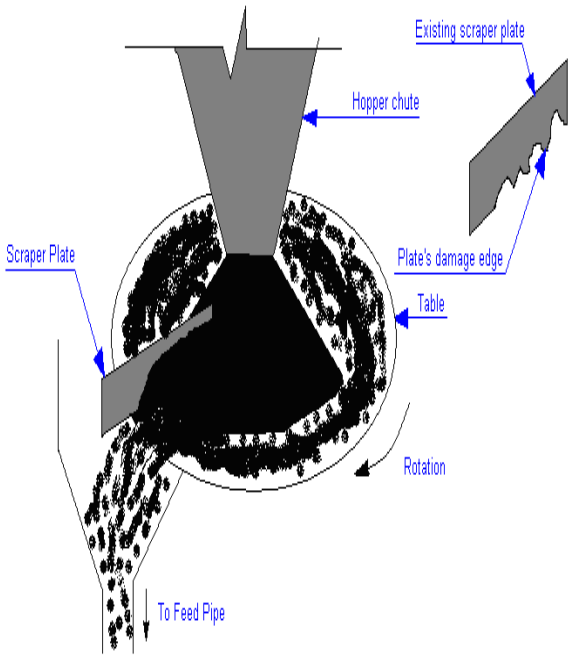

Figure 2.

Materials:-

The raw material for slag dryer plant is Wet Blast Furnace Slag. The average initial moisture content and final Moisture content of the slag has been observed as shown in Table-1, as under:

S. No.	Months	Wet slag Moisture, (%)	Dry Slag Moisture, (%)
1	January	12.5	1.5
2	Feb.	12.3	1.5
3	March	09.8	1.3
4	April	09.3	1.1
5	May	09.2	1.0
6	June	11.7	1.8
7	July	16.4	2.6
8	August	16.0	2.5
9	Sept.	14.1	2.3
10	Oct.	13.3	2.2
11	Nov.	12.4	2.0
12	Dec.	12.3	1.7

TABLE I. OBSERVED VALUES OF MOISTURE CONTENT OF DRY AND WET SLAG FOR DIFFERENT MONTHS BEFORE TECHNICAL AUDIT

Above data are the average data of the month. It is clear from above data that moisture content in wet slag and dry slag is varying from 9.2 % to 16.4 % and from 1.0 % to 2.6 % respectively. The Quality of dry slag is monitored with its Moisture Content. The required Quality of dry slag should be such that there should not be Moisture Content more than 1.0 %. Above table shows that dry slag Quality is not as per the "NORMS". It is according to the "NORMS" only in the month of April and May only and in all the other months it is out of "NORMS".

It is also observed that sometimes, iron pieces of uneven size and shape, weighing from 2 to 3 kilogram are coming mixed with wet slag which is damaging the toggle of the Jaw crusher, refractory lining inside the slag dryer and the conveyor belt.

Method:

Wet slag is taken into wet slag bunker. The furnace is then fired to maintain the required temperature. Once the required temperature is maintained, the slag dryer is started. Latter on slag feeding is done into slag dryer through Slag Table Feeder. It is also observed that sometimes, due to abnormal delay in slag dryer starting (due to control problem), retention of wet slag in wet slag bunkers occur for abnormal periods, resulting in the jamming of wet slag bunker. It results the irregular flow of slag through the dryer. Due to this problem, sometimes, the slag out put Quality is over dried slag (roasted slag) and sometimes, it is under dried (contains moister more than 1 %).

Manufacturing Process:

The slag drying process is a counter currant flow process where from one side (one end of dryer), the material (wet slag) moves and from the other end (slag discharge end), the hot air flows and slag drying is being done throughout the length of the dryer. The dried slag is handled by heat resistant conveyer belt which carries the slag above the dry slag storage bin. Flue gases from dryer pass through cyclone type dust collector and latter on discharge into atmosphere through chimney stack. It has also been observed that the hanging chains at dryer inlet are having very thin diameter, about 8 mm diameter at tip and 18 mm diameter at fastening end. There is a provision to hang the chains in three rows but the chains were available in two rows only.

Monitoring:-

Monitoring is one of the most important parameter to reach at perfection. Here, it was

observed that dry slag sample was collected twice in the shift, every after of 4 hours, 280 MT slag (as the capacity was 70 MT / hour), was fed to the dry slag storage bin. If, 50% of this quantity is stored in dry slag storage silo with 2 to 4% moisture, it is possible that the storage silos may get jam. During the observation it was also found that one bin was badly jammed with wet slag. The cleaning of slag bin was going on.

Movement:-

The movement of slag inside the slag dryer was viewed through safety view glasses. It was found that the flow of the material was just like the flow in a gutter. There was very little agitating action in the materials. Its flow nature was found rolling type. It was also found that inside the dryer there was uneven lumps formation and these lumps stuck to the shell of the dryer.

Management:

It has been seen that management always tries to catch big fishes first. The same was the problem with factory management for slag dryer section. It was always concentrating all its efforts to the final Product Manufacturing, Packaging & Dispatch of finished goods etc.

Management seldom cared to find time to see the problems of slag dryer section. With the result, this section of the industry was more or less neglected. When, it come in the notice of management that one of dry slag storage bin has badly jammed, the management started to arrange its cleaning but it was least interested to analyze the reasons for the jamming of the dry slag storage bin.

Analysis of Technical Observations:

- It is true that the work taken from untrained workers results in the destruction of the work itself and sometimes the workers also harm themselves. Semi skilled workers are also less productive. Until the workers are not having the knowledge and experience of work to the required degree, the product quality will not improve.
- It is analyzed that the moisture in wet slag varies from season to season. So it is difficult to fix the exact operating parameter to maintain the product quality. To maintain the Final Product Quality i.e. the Quality of Dry Slag (Less than 1% moisture), feed control of wet slag is required according to initial moisture content in wet slag which varies from 9.2% to 16.4%.
- The damage of Crusher Toggle Bolt, upper layer of conveyor belt and refractory lining is due to Iron pieces mixed with wet slag.
- The method of Slag Dryer Operation requires some rectification so as to get the uniform feed rate of wet slag at dryer inlet.
- Due to breaking of bearing of motorized flap valve, it is not closing properly, so flap valve is not air tight. This permits air entry from dryer discharge side which is not desirable at all because atmospheric air is reducing the dryer temperature.
- When the dryer was stopped and cooled down, it was found that the lifters are badly jammed. The cavities made in lifter plates are filled with Iron like hard cakes as shown in Fig.-3.

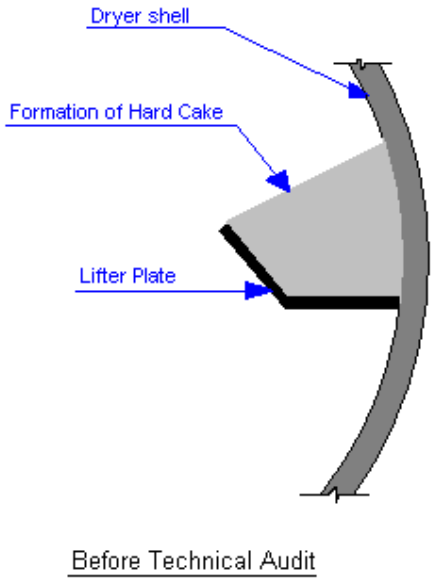

Figure 3. Hard cake formation

Since the lifters are not functioning at all, for what they are meant, so the nature of material movement inside the dryer is of rolling nature instead of rising and falling. Rolling material will take more time and more fuel in drying where as the lifting and falling material will dry faster with less fuel consumption. Due to rolling action the movement of material will not be faster w. r. t. lifting and falling material. Also the loading on dryer will increase due to rolling of material for the same output.

- Hanging Chains at inlet of slag dryer are working as heat curtain i. e. maximum heat is utilized for drying work. Their presence is of quite importance. Due to abnormal weir of Hanging Chains the Heat curtain will become weaker and flue gasses leaving to chimney stack will have higher temperature than the “NORMS”.
- The Dry Slag Quality Monitoring frequency is low. This may allow substandard quality of dry slag to pass to the slag storage bin.
- Most important aspect is the management attention to all the sections equally.

- The function of the management should be just like the function of the mouth which inhales all type of food himself but not for the nursing of him only. The food taken by mouth nurses all parts of the body as per requirement with out any partiality. Here in this case the problem of dryer should be taken earlier by management.

Technical Audit Recommendation:

After considering most of the technical aspects of 8M"s, the recommendation of Technical Audit to increase the product quality and profitability of Slag Dryer Plant is as under-

- Proper training at site should be given to Slag Dryer workers and operators by suitable expert of any well running Slag Dryer Plant. The expert may be hired from market for short tenure.
- Cast Iron Bearing should be fitted in motorized flap valve instead of bearing made of bearing metal because the reason of bearing failure is due to high temperature.
- Cleaning of lifter bucket should be done, so that the shape of lifter buckets may become as per original drying bucket shape in Fig.-4.

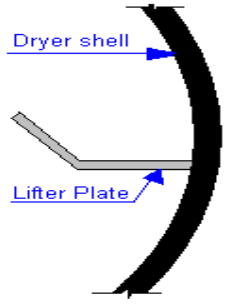

Figure 4.

- An automatic magnetic separator (Catcher of iron pieces) should be installed above the Feed conveyor Belt to vibrating screen as shown in Fig.-5 and hourly hand picking of iron pieces should be insured from the magnet.
- Care should be taken during the picking of iron pieces during running condition of conveyor belt.

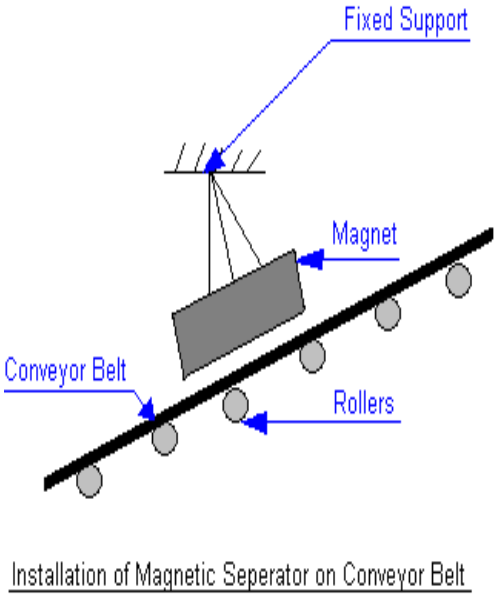

Figure 5. Conveyer Belt

- Before feeding the slag into the slag dryer, the dryer should be uniformly heated to maintain the temperature of 80°C to 90°C, so that the wet slag may not stick again to the lifters to form the hard cake. When the lifter will remain clean, the rolling action of the material will be minimized and drying efficiency will improve.
- The scrapper (material diverter installed above the slag table feeder should be replaced as it wears out abnormally.
- The sample of wet and dry slag should be taken on hourly basis to monitor the input and out put product quality (i.e. moisture content)
- Management may pay proper attention for streamlining the operation and maintenance system of slag dryer section.
- Dryer should always be stopped after emptying.

Improvement after implementation of the Technical Audit Report:

On implementing the Technical Audit Report, following improvement were observed in the plant.

- The operation of the slag dryer plant has become smooth and workers felt a little bit relaxed.
- The breaking of toggle bolt of Jaw Crusher stopped.
- Jamming problem of lifter plate vanished.
- Material flow inside the dryer became uniform through out the length.

- The reliability of the plant has increased. And the quality of the dry slag has increased.
- The product quality (%dryness of slag) improved. Now the data of product quality is shown in Table-2.

TABLE II. OBSERVED VALUES OF MOISTURE CONTENT OF DRY AND WET SLAG FOR DIFFERENT MONTHS AFTER IMPLEMENTATION OF THE TECHNICAL AUDIT REPORT.

S. No.	Months	Wet slag Moisture, (%)	Dry Slag Moisture, (%)
1	January	12.5	0.90
2	Feb.	12.3	0.87
3	March	09.8	0.85
4	April	09.3	0.80
5	May	09.2	0.88
6	June	11.7	0.91
7	July	16.4	1.00
8	August	16.0	0.98
9	Sept.	14.1	0.96
10	Oct.	13.3	0.95
11	Nov.	12.4	0.92
12	Dec.	12.3	0.93

Table: II Moisture content after implementing audit report

- The failure of refractory linings inside the dryer stopped.
- The operation of double flap valve became smooth and there was no false air entry. The bearing life has increased.
- The break down of dry slag handling conveyor belt minimized.
- The details of main energy resources consumption (Electricity and Coal) in major areas are as under in table No.3

S. No.	Descriptions	Before Audit	After Audit
01	*Coal consumption (Kg / Ton of dry slag)	31.38	27.4
02	Dryer Power consumption (% loading of motor)	82.3	78.1
02	Table Feeder Power consumption (% loading of motor)	81.2	62.3

TABLE III. ENERGY CONSUMPTION

*Coal quality - The coal quality was same before and after Technical Audit.

Calculation of Savings: - After implementing the Technical Audit Report, the following savings have been observed.

a. Savings in coal consumption-

Saving of coal per ton of dry slag = 31.38 – 27.4 = 3.98 Kg.

Production of dry slag in one year (considering 330days in one year

And two shift working basis) = 330 x 16 x 70 = 36900 MT.

Net quantity of coal saving = 369600 x 3.98 =1471008 Kg.

= say 1471 MT.

Considering the cost of coal Rs. 2000/ MT., the net cost savings

= 1471 x 2000 = 2942000

The potential of net savings is **Rs. 29.42 lacs**.

a) **Savings in Power consumption-**

- **In case of Slag Dryer**

Change in Motor Loading of Slag Dryer = 82.3 – 78.1 = 4.2%

Hence Power Savings = 195 x 330 x 16 x 0.042 x 0.8 = 34594 Kw

Cost saving in Power = 34594 x 3.5 = Rs. 1.21 lacs

- **In case of Slag Table Feeder**

Change in Motor Loading = 81.2 – 62.3 = 8.9%

Hence Power Savings = 4.3 x 330 x 16 x 0.089 x 0.8 = 1616 Kw

Cost Savings in Power= 1616 x 3.5 = Rs. 0.056 lacs

Total cost on Power Savings

= **Rs. 1.26 lacs**

Total Potential of Cost Savings

= 31 Lacs per Annum

Note: - The rate of power and coal taken as per market value. The Power Factor has taken as 0.8. The cost savings in coal grinding are not considered.

Research Findings:

It is clear from this case study that quality and profitability is the product of 8M's (Man, Machine, Materials, Methods, Movement, Manufacturing Processes, Monitoring and Management). With the passage of time, the variation in technicality is quite possible either due to habituality or due to

detraction of healthy practices. The technical audit is one of the tools for correcting the technicality of 8 M's. The findings are very well illustrated by Fig.-6.

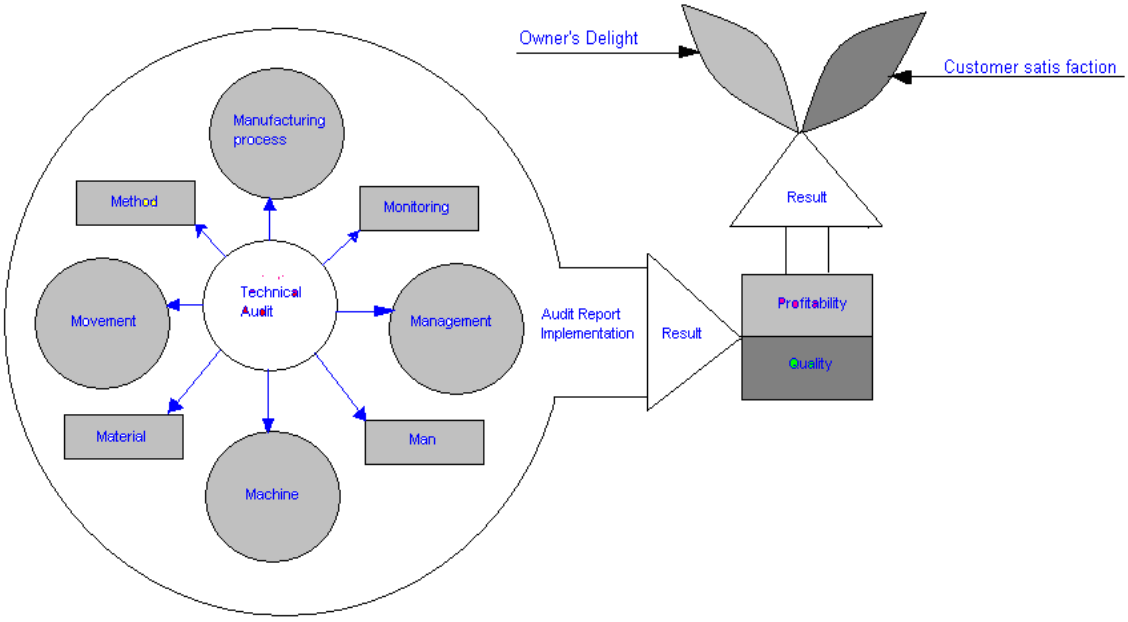

Figure 6. Output of Tech. Audit

Technical audit is not the postmortem of product quality, like the Quality audit report but it is the finding of Actual technicality of quality. In this case study, it has been found that after implementing the audit report, the profitability increased by Rs. 31 lacs per annum and product quality improved from 16.67% to 83%. The reliability on the product quality has increased in many folds by Technical Audit Report implementation.

If the Technicality of any parameter of 8 M's is deviating, there will be significant impact on quality and profitability of the organization. The deviation will also affect the Customer as well as the Owner, as the poor quality will not be accepted by customers. It will also be difficult for the producer or owner to sell the product in the market and earn the desired profit.

This research reveals that better quality and profit can be obtained if, the industrialist plans for Technical Audit for their establishment periodically by technical experts of the respective fields (at least once in a year). Technical Audit is not a work of postmortem type like Quality Audit but it is in depth study regarding the Product Quality. The result of the technical audit report implementation will fetch not only the product quality but will also increase the profit to the company.

Thus it can be solicited that Technical Audit is one of the important Tool to "DELIGHT" the customer and manufacturers.

III. CONCLUSION:-

In is concluded that the Technical Audit will increase to the Customer and Owner's DELIGHT and gives a NEW thrust to the organization. The success of Technical Audit depends up on the implementation of audit report and management's ability to adopt it. The Technical Audit assures the increased knowledge about the Product Quality and Profitability. The point wise conclusions are as under:

- The study clearly shows that the Technical Audit helps to improve the product quality and profitability of the organizations.
- The Technical Audit gives a thrust on 8 M's by considering one parameter at a time.
- It also compares the existing parameters with the best possible parameters or with the ideal parameters (If required the comparisons are also made with the recently developed parameters).
- The outcome of Technical Audit findings provides some suitable and favorable changes in the organization's workings which result in the improved product quality and profitability.
- Timely adoption of Technical Audit will benefit both, the customer and the producer.

- The effectiveness of the organization improves.
- Technical skill of people will increase.
- The reliability of the product quality will increase.
- The profitability of organization will increase.
- The work environment will improve due to reduction of failures.

IV. BIBLIOGRAPHY:

[1] Beroft, B.D, 1996, Internal Quality Audits, The TQM Magazine, Vol. 16, No. 1, pp.14 – 25.

[2] Bhatt, J., Nye, C. and K Kirkbride, V, 2004, Quality and Cost Improvement in Neonatal Prescribing through Clinical Audit, Training for quality, Vol. 4. No. 3, pp. 14 - 25

[3] ANON Commission's Decision, 2004, adopting the work plan for 2004, in the field of Public Health (2003 to 2008), Int. J. for Electronic Health Care, Vol. 1, No. 2, pp. 149 – 164

[4] Franka Piskar, 2006, Quality Audits and their Value Added, Int. J. Services and Standards, Vol. 2, No.1, pp. 69 – 83

[5] Fuentes et al, 2003, ISO 9000 Based Quality Assurance Approaches and their Relationship with Strategic Analysis, Int. J. of Technology Management, Vol. 14, No. 2 / 4, pp. 277 – 286

[6] Heath, P. and Milne, D. 2002, Making Quality Everyone's Business: A Case Study of Partnership in Primary Care, Int. J. of Service and Standards, Vol. 1, No. 2, pp. 193 – 205.

[7] Heras, I., et. al, 2002, ISO 9000 Certification and Bottom Line; A Comparative Study of Profitability of Basque, Region Company, Int. J. of Service and Standards, Vol. 1, No. 3, pp. 358 – 378.

[8] How to asses Technological Standards of a Company, Nov. 1991 Published in International Journal of Production Economics, by Elseveir Science BV, pp 41-47.

[9] Marki, M, 2005, Innovation Process and Quality Development, Managerial Auditing Journal, Vol. 18, No. 4, pp. 313 – 322.

[10] Magd, H., and Curry, A., 2003, ISO 9000 and TQM; Are they complimentary or Contrary to Each Other. Int. J. of Innovation and Learning, Vol. 1, No. 1, pp. 36 – 44.

[11] Magd, H. et al, 2003, ISO 9000 Implementation: A Study of Manufacturing Companies in Saudi Arabia, Int. J. of Electronic Health Care, Vol. 1, No. 4, pp. 442 – 452.

[12] Mohanthy, RP, and Yadava, O.P., 1997, Understanding the Fundamentals for Managing Change, Industrial Engineering Journal, Vol. 26, No. 1 pp. 25 – 30.

[13] Mills, C, 1989, Quality Audit Management Evaluation Tool, http://:www.mc2consultingcom/csaart/htm. visited on 18th. May 2008

[14] Oliverio, Mary Ellen, 2007, Promoting Audit Quality, U. K. Financial Report Counsel Discussion Papers, CPA Journal Feb. 2007

[15] Pivika, M, 2004, ISO 9000 Value Added Auditing, Int. J. of Technology Management, Vol. 14,No. 2 / 4, pp. 277 – 286.

[16] Piskar, F.,2003, The Influence of Quality Certification on Slovenian Companies and their Continuing Efforts in this Field, Industrial management and data system, Vol. 104, No. 7, pp. 558 – 566

[17] Pun. K.F. and Lau, C.W, 2003, Integration of Total Quality Management in Government Department; An Empirical Study in Hong Kong, Industrial Management and Data System, Vol. 104, No. 7, pp. 558 – 566

[18] Pan, J.N., 2003, A Comparative Study on Motivation and Experience with ISO 9000 and ISO 14000, New York, NY: McGraw – Hill.

[19] Piviki, M, and Ursi, D., 1999, Slovenian Experience in ISO 9000 Certification Process, The Quality Management And Business Excellence, Vol. 15, No. 3, pp. 345 – 355.

[20] Rajendran, M. & Devadasan, S.R., 2005, Quality Audits; Their Status, Pprowess, and Future Focus, Quality Audits; Their Status, Prowess, and Future Focus.

[21] Russell, J.P., 2000, Quality Audit Related Information, Managerial Auditing Journal, Vol. 20, No. 4, pp. 364 – 382.

[22] Russell, J.P. and Regel, TL, 2000, Management Audits, Milwankee, WI, Quality Press. The Quality Hand Book 2nd. Edition.

[23] Smith, A. D. and Manna, D.R, 2005, E – Recruitment of Patients for Clinical Trials, Int. J. of Educational Management, Vol. 18, No.4, pp. 266 – 279.

[24] Souillard, M. et. Al, 2005, A Flexible Framework for Managing temporal Clinical Trial Data. Int. J. of Electronic Health Care, Vol. 1, No.4, pp. 413 – 426.

[25] Seddon, J., 2001, Quality Audit, After the Quality Audit, 2 nd. Edition, Milwaukee, WI, ASQ Quality Press.

[26] Sayle, 1985, Management Audits, After the Quality Audit, 2nd. Edition, Milwaukee, WI., ASQ Quality Press.

[27] S. Nagata, et al, 2008(April), Improving Product quality through Audit System, visited on July 3, 2008 at site, http://:www.fujitsu.com/domloads/MAG/vol44-2/papers10pdf.

[28] Terziovski, M. et al, 2002, From Conformance to Performance and Continuous Improvement Using ISO 9000 Quality System Standards.

[29] Venkoba Rao, TS, 1996, Must Change but How, The TQM Magazine, Vol. 16, No. 1 pp.14 – 25.

[30] Wickramsinghe, N. & Sharma, S. K., 2005, Key Consideration for Ensuring High Quality, J. Management and Enterprise Development, Vol. 1, No. 3, pp. 208 – 217.

[31] Zutsi, A. and Sohal, A.S., 2002, Environmental Management System Auditing: Auditors Experience in Australia, Int. J of management and Enterprise Development, Vol. 1, Nos. 3/4 pp. 441-457.