A STUDY OF MAINTENANCE MANAGEMENT IN SAKTHI AUTO COMPONENT LIMITED WITH SPECIAL REFERENCE TO DISAMATIC MOULDING LINE ERODE

by

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A PROJECT REPORT

submitted

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of

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BONAFIDE CERTIFICATE

Certified that this project report titled **"A Study of Maintenance Management in Sakthi Auto Component Limited with Special Reference to Disamatic Moulding Line"** is the bonafide work of **Mr.Vivek R,Reg no: 1120400106** who carried out the project under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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DECLARATION

I affirm that the project work titled **"A Study of Maintenance Management in Sakthi Auto Component Limited with Special Reference to Disamatic Moulding Line"** being submitted in partial fulfillment for the award of Master of Business Administration is the original work carried out by me. It has not found the party other project work submitted for award of any degree or diploma, either in this or any other university.

Signature of the Candidate

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I certify that the declaration made above by the candidate is true.

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SYNOPSIS

Sakthi Auto Component Limited is one among the multi faceted Sakthi Group established in the year 1983. Presently the Sakthi Auto has a capacity to produce 24000 Tonnes / annum of S.G.IRON Castings. Sakthi Auto is one of the major producers of S.G.Iron Castings, meeting the needs of most of the automotive and other general engineering industries.

The main purpose of regular maintenance is to ensure that all equipment required for production is operating at 100% efficiency at all times. A good maintenance program requires company-wide participation and support by everyone ranging from the top executive to the shop floor personnel.

This study is undertaken to know the maintenance management program followed at Disamatic moulding line in Sakthi Component Limited, Erode. This study further aims to suggest the ways of improving the performance of moulding units by reducing the breakdown.

This study found various reliability measures and key area tracker for continuous assessment of maintenance action carried out at mould line.

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1. INTRODUCTION

1.1 ABOUT THE STUDY

In today's scenario, maintenance gets special attention in any industry because down-time of facilities and equipment has become much more expensive. So, every industry irrespective of its size has a maintenance department to look after the upkeep of its equipment. The size and organisation of the maintenance department varies with the size of the industry depending upon the number of production machines and equipment, nature of production, etc. The maintenance department organises planned maintenance of the plant and machinery and also carries out routine maintenance work. Maintenance plays a prominent role in production management.

The efficiency of the production function depends solely on the functional reliability of the production facility. Hence, the objective of maintenance is to improve functional reliability of the production facility by Keeping break downtime down to the minimum and Keeping the manufacturing facilities in better working condition at the lowest possible cost. The responsibility of the maintenance function should be to ensure that production equipment/facilities are available for use for maximum time at minimum cost within stipulated time period.

Maintenance is an area of management in foundry which contributes towards effective energy management. If proper maintenance program is not followed in foundry it would cause production to be lost and there add cost of production. Proper steps to be laid towards effective maintenance are very essential which if not done would increase maintenance costs and decrease in product quality. It is thus very essential that proper steps and process must be set to prevent these costs and have proper maintenance plans set which otherwise would lead to issues in maintenance. Such maintenance measures if planned and carried out consistently at regular intervals of time helps in cutting the down time and improves the overall operations of the organization and thereby contributing towards overall energy consumption in a foundry.

1.2. ABOUT THE INDUSTRY

The Indian auto component sector is a thrust sector for India. The industry has more than 500 large to medium key participants that form the organized sector whereas there are more than 6,000 ancillary units which constitutes the unorganized sector. OEM dominates the auto component market constituting almost 75 per cent of the market while the replacement market has share of 25 per cent.

The Indian Auto component industry has transitioned from a supplier for the global aftermarket to becoming a full-scale global Tier 1 supplier. Industry policies like manufacturing and imports free from licensing and approvals, 100% FDI in auto sector and no local content regulation of the Government have helped the auto component sector to grow in the past.

The Indian auto components industry has been witnessing a moderation in its revenue growth since the beginning of this fiscal following the deceleration in sales volume growth across all automobile segments. As per industry estimates, out of the total turnover of the Indian auto components industry, around 60% is derived from sales to domestic OEMs, around 25% comes from sales to the domestic replacement market and around 15% is derived from exports. While lower year on year volume growth of domestic OEMs in 9m 2011-12, particularly those belonging to the passenger vehicle and Medium and Heavy Commercial Vehicle segments, translated into muted revenue growth for the auto components industry during this period; the sluggishness was partly arrested on the back of rise in component exports and higher domestic replacement market sales. While the long term prospects for the industry remain strong in line with the outlook for the OEM segment, the industry faces strong challenges in the form of threat of low cost imports, currency volatility and ability to invest on product development to be able to move up the value chain.

Most of industries use cast metal components in some form or another. Industrial revival, after steep recession, has given a boost to foundry industry. Improvement in infrastructure and power generation in particular shall further increase demand of castings. After service sector’s record growth in the last decade, manufacturing sector is poised to have accelerated growth now due to its potential to offer employment to growing population. This will obviously, result in increased demand of castings for sustained and increased growth of economy. There are around 5100 foundries both large as well small units registered in India. Of these, around 3000 units are grey iron foundries, producing about 5.1 million tons of grey iron casting.

The turnover of auto-components industry rose from $23 billion in 2008-09 to $39.9 billion in 2010- 11. The Automotive Component Manufacturers Association (ACMA) has an ambitious target—taking the turnover to $113 billion by 2020. This implies a compound annual growth rate of 17.5 per cent, compared to 21 per cent achieved during the period from 2005 to 2010. The sector's share in the GDP is expected to go up from 2.1 per cent to 3.6 percent during this period, making it an engine of growth for the economy. Auto-components sector expects to add a million skilled jobs in the next ten years. India's auto-component firms have won many prizes in recent times. The country has to emerge as the global manufacturing hub for small cars. The Indian auto-parts sector needs help. No doubt, the buoyancy in the domestic market will enhance the total size of the sector. The units are gearing to step up investment. The sector needs to invest at least $3 billion every year over the next decade to support the aggressive growth in the auto industry. Also, global auto original equipment manufacturers (OEMs) have created vehicle platforms in India. They are exporting parts to their markets. This has opened up opportunities for component units to become a part of OEMs' export strategy.

1.3 ABOUT THE COMPANY

The foundry division of Sakthi Sugars Ltd. was established in the year 1983 with the capacity to produce 3600 Tonnes per annum. Sakthi Group engaged in the manufacturing and service activities of sugar, alcohol, tea, textiles, ferrous castings, synthetic gems, soya foods, soft drinks, transport, retreading and finance. To exploit the opportunities in Auto Ancillary Industry, a separate company, called SAKTHI AUTO COMPONENT LIMITED (SACL) was formed during the year 1999. It is located at MukasiPallagoundenpalayam, Erode district, Tamil Nadu.

Sakthi Auto Component Limited is an auto and engineering component manufacturing unit having two foundries for producing ferrous castings and has got more than 350 CNC and general purpose machines for machining. SACL owns and operates two plants in India producing ductile and grey iron precision castings, with a capacity of 60,000 metric tons. Sakthi has market leadership in the production of steering knuckles, which are exported worldwide. As the result of acquisition with group of companies called “intermet Europe” from INTERMET International Inc. of Fort Worth, Texas, USA, the combined group will have a strong presence in both European and Asian markets. Sakthi Auto Component Limited has acquired two foundries in Germany and one in Portugal and the three organizations, namely SACL,SAAPL and INTERMET, Europe are called together as Sakthi Automotive Group.

In SACL, Foundry –“A” is a conventional jolt squeeze green sand moulding process where castings up to 50 kgs weight are produced. The ultimate capacity of this foundry is 1500/month.

Foundry – “B” has got the Disa Mould Making and conveyor system, which is the most advanced facility that produces dimensionally accurate castings very consistently. Capacity of first line is 1500 tonnes per month (350 moulds per hour); Disa moulding machine second line is added on 10.4.2007, whose capacity is 1200 tonnes per month (300 moulds per hour). It has integrated Auto pour furnace and Disa mould making and conveyor system.

Moulding line is supplied by M/s. Disa Technologies of Denmark. The fully automatic sand plant is controlled by computers, which ensure that sand, Bentonite, Carbonaceous material and water are mixed in the right proportion.

The Disa technology also facilitates easy storage and retrieval of production data, easy handling and changing of patterns. Synchronized belt conveyors system transfer the mould to the Disa cool drum where the castings are separated from sand which is transferred by conveyor systems for recycling.

SACL is the sole vendor for many critical components like steering knuckles, brake drums, brake discs, exhaust manifolds and case differentials for leading manufacturers in India equipments for machining rough castings to like Maruti, Suzuki, Hyundai, FIAT and Delphi.

PLANT AND MACHINERIES

Foundry Machineries

- 110 KV Sub Station
- George Fisher Converter
- Press pour OCC 50 Model
- DISA moulding machine
- DISA Sand Plant Control Panel
- DISA Cool
- Dust & Fume Collection System BMD GARANT
- Shot Blasting machine

Testing Equipments

- Scanning Electron microscope
- Nodularity checking by ultrasonic
- Vacuum/Emission spectro meter
- Roundness tester
- Double disc grinder
- FANUC Robo drill, etc.

QUALITY POLICY

SACL is committed to consistently provide products that meet customer and applicable regulatory requirements and will aim to enhance customer satisfaction. This is achieved through

- Establishing and maintaining a Quality Management System to International specifications.
- Identifying & meeting customer needs& expectations.
- Continual improvements.
- Up gradation of human resources.
- Maintaining clean and safe environment throughout the organization.

PRODUCTS PROFILE

The products of SACL are : Brake drums, Steering knuckle, brake disc, exhaust manifold, Brake calliper, wheel hub, diffcase, engine mount brackets, flywheel, housing, ARMS (short, covered), cross bar, wing nut, axle housing, pressure plate, brackets, crank case, carrier, bearing housing, shift yoke.

LIST OF CUSTOMERS

- Maruti udyog limited
- Delphi Automotive Systems private limited
- Honda Siel cars India limited
- Tafe limited
- Fiat India private limited
- Bosch chassis system India limited
- Mahindra Renault private limited
- Sundaram fasteners limited
- General Motors

1.3.1 COMPANY FOUNDRY

Casting is one of the processes used for making components by complicated shapes in larger quantity. It is the process of producing metal parts by pouring molten metal into the mould cavity of the required shape and allowing the metal to solidify. The solidified metal piece is called as “casting”. A plant where castings are made is called a “Foundry”. Therefore it is a collection of necessary materials, tools and equipments to produce castings.

MANUFACTURING PROCESS

The Manufacturing Process includes conventional foundry and DISAMATIC foundry Processes. The Overall Foundry process consists of the following major steps.

- Sand preparation and conditioning
- Preparation of sand moulds and cores
- Melting of raw materials in induction furnaces
- Melting of raw materials in cupola furnace
- Magnesium treatment to the metal
- Pouring of molten metal in the sand moulds
- Cooling and separation of castings
- Surface finishing of the castings
- Quality testing

Sand Preparation

Moulds of the required shape and size are prepared under Green sand moulding process. Under this process the required washed, dried and graded sand procured from outside is mixed with bentonite (clay) and coal dust, which acts as a binding material and water. Then they are thoroughly mixed in Intensive Mixer.

Sand Conditioning

Sand Conditioning is very important as there should be proper permeability to aloe the gases to escape and we should also get the right mould hardness to get quality castings without sand defects like sand drops, blow holes etc.

The surface finish of the casting also depends up on to a certain extent on proper sand conditioning. After proper conditioning of the sand, it is transferred to a storage hopper by means of conveyors. From the hopper the sand is transported using conveyors to the individual moulding machine hoppers. Proper metal to sand ratios will be adopted and the requisite quantity of fresh sand will be added in each mixing cycle. Similarly the unwanted sand in each will be discarded also.

Preparation of Sand Moulds and Cores

Fully automatic Programmable Logic Circuit (PLC) based sand plant with Sand Multi Controller checks and adjusts the compatibility and strength of every batch of the sand mixture before moulding so as to send only accepted quality of sand into the system.

Fully automatic moulding line with High Pressure Match plate Moulding Machines, with an average production rate of about 350moulds/hr, DISMATIC 130B for making vertical flask less moulds with dimension of 535×650×120-395mm (H×W×T).

Fully automatic and semi automatic core box machines along with shell core making facilities are available. The core box with core print is anchored and supported adequately.

Melting of Raw Materials in Induction Furnace

The raw materials charged into the induction furnaces are Pig iron, Steel scrap, Sorrel metal, Ferro alloy and graphite, foundry rejects and returns. Depending upon the type of castings to be produced the proportion of raw materials is varied. The raw materials are charged into the medium frequency induction furnace and melted to molten state by inducing electric current.

Medium frequency melting has been chosen as there is more flexibility, comparatively less installation cost and no heel metal is required in the crucible before switching on to melt. Similarly while tapping, the entire crucible can be emptied, fresh charge added without loss of time for each cycle of melting. The added advantage in induction melting is, if there is power interruption, the metal can be allow to be solidified and on resumption of power supply, the solidified metal can be re-melted.

Melting of Raw Materials in Cupola Furnace

The raw materials charged into the cupola furnaces are Pig iron, Steel Scrap, Sorrel Metal, Ferro alloy, Foundry rejects and returns. Depending upon the type of castings to be produced the proportion of raw materials is varied.

The raw materials are charged into the Hot Blast Cupola Furnaces and melted to molten state using coke as fuel. One (1) Hot Blast Cupola Furnace of 12.0-Tons/hr capacity will be used for melting.

Magnesium Treatment to the Metal

In case of grey iron there is no treatment of metal involved. However in the case of SG Iron, in converter vessel the molten metal with the right composition of other elements has to be treated with pure magnesium of the required percentage. This alloy reacts with the molten metal which when solidified gives properties of steel in physical strength and the properties of cast iron are retained.

Pouring of Molten metal in the Sand Moulds

In grey iron Castings the melted iron from the furnaces is tapped into ladles and then poured in the sand moulds. For SG iron castings preparation the converter treated molten metal is then poured.

Cooling and separation of castings

After pouring of molten metal in sand moulds, cooling is done artificially. After cooling, the castings are separated by vibratory means or by hammer from the mould.

1.3.2 DISAMATIC FOUNDRY PROCESS

Disamatic is an automatic production line used for fast manufacturing of flask less sand moulds for green sand castings. It is widely used for automated moulding. The Moulding line which has been supplied by M/s. DISA Technologies of DENMARK is one of their latest and most efficient moulding lines. It has the capacity to produce 440 flawless moulds / hour. This would ensure closer tolerance and low rejection rates. It has Automatic Pouring Unit procured from M/s. Asea Brown Boveri Ltd. and it maintains the consistency in the metal temperature. Technical collaboration for melting technology has been entered into with M/s.GEORGE FISHER FOUNDRY SYSTEMS, SWITZERLAND, who are the world leaders for manufacturing various precision components for the Automobile Industries.

Advantages

The DISAMATIC sand moulding process has several advantages comparing to other moulding processes. It does not use flasks, which avoids a need of their transporting, storing and maintaining. It is fully automatic and requires only one monitoring operator, which reduces labour costs. Moulding sand consumption can be minimized due to variable mould thickness that can be adjusted to the necessary minimum.

Working principle of DISAMATIC moulding machine

Step 1: Sand is blown into the Moulding Chamber from sand hopper.

Step 2(a): The Ram advances, pushing the Ram Pattern. This compresses the sand in the Moulding Chamber to form mould impressions.

2(b): The compression creates opposite halves of consecutive moulds to place in the mould string.

2(c): Castings cannot be formed using a single mould, but when a new mould is placed in the mould string; its leading edge meets the trailing edge of the previous mould to create a completed mould cavity.

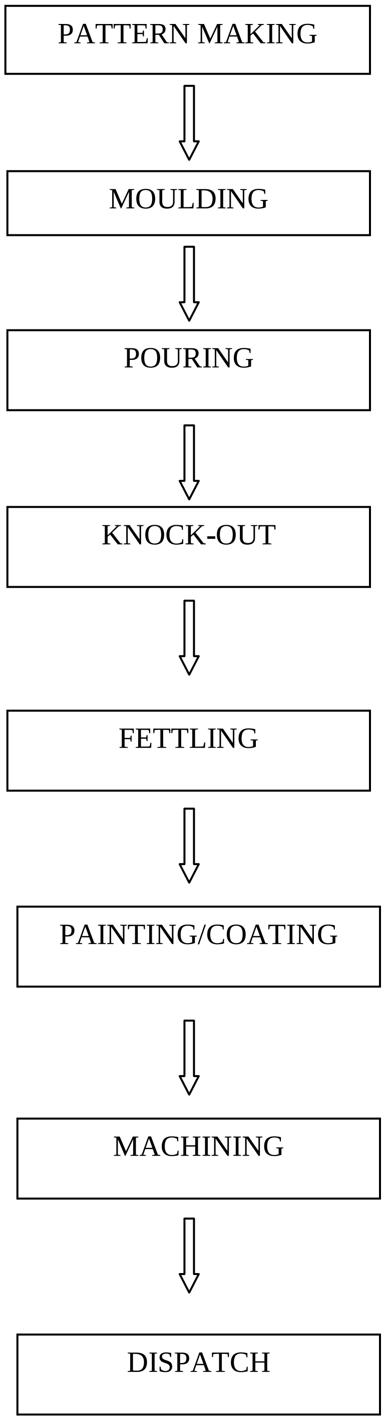
Step 3: The Swing Pattern moves back and up to allow the mould to exit the Moulding Chamber.

Step 4: The Ram extends, pushing the new mould into the existing mould string.

Step 5: The Ram and Swing patterns return to their original position to begin the process again.

Step 6: Sand is blown into the Moulding Chamber for the next mould. A little further down the mould string, iron is poured into the top of a formed mould via the pouring sprue left by the pattern impressions.

PROCESS FLOW DIAGRAM



1.4 STATEMENT OF THE PROBLEM

The foundry equipment is an important resource which is constantly used for adding value to products. So, it must be kept at the best operating condition. Otherwise, there will be excessive down time and also interruption of production if it is used in a mass production line. Poor working of equipments will lead to quality related problems. Hence, it is an absolute necessity to maintain the equipment in good operating conditions with economical cost.

The issues related with foundry equipment are all avoided if proper maintenance is carried out for these equipments at regular intervals. Proper maintenance program helps in identification of foundry equipment which needs replacement at essential times. These steps towards improved process for maintenance and help in reducing risks and issues and there by helps in achieving an effective efficient system in an organization.

Hence the project is conducted to study the maintenance management programmes carried out at Disamatic moulding line in SACL, Coimbatore.

1.5 SCOPE OF THE STUDY

The study covers the maintenance program carried out at several units of Disamatic moulding line. The mathematical analysis is used to evaluate Mean time between failures, Mean time to repair and availability of machines. Detailed analysis of machine failures and their corrective actions provides the need for improving the performance of machines of Disamatic mould line. Further the effective maintenance actions need to be studied to reduce the machine downtime.

CHAPTER- 2

REVIEW OF LITERATURE

S.Kukla [1] presented a study on analysis of stoppages in automatic foundry lines operation, and basing on assumptions from complex maintenance system undertaken himself, developed a service maintenance schedule for machinery installed in the line. He has proposed a possibility of implementation of manufacturing systems modelling and simulating technique in management of production machinery operation in a foundry shop. Within framework of the simulation experiment schedules of production, schedules of maintenance and has forecasted indices of general productivity of the machinery for a various scenarios of events on example of casting line having in-series structure of operational reliability is developed.

Manu Dogra, Vsihal S. Sharma, Anish Sachdeva, J.S. Dureja [2] adopted five step plans for the implementation of TPM in the cold rolling plant. Total productive maintenance (TPM) is a maintenance program, which involves concepts for maintaining plant and equipments effectively. Results achieved are quite encouraging in terms of motivated employees, improvement in overall equipment effectiveness (OEE) and reduction in no. of accidents on shop floor.

Vasile Deac, Gheorghe Carstea, Constantine Bagu, Florea Parvu [3] assigned a new dimension to the maintenance activity. One of the imperatives imposed to this action is represented by modern means of informing through the maintenance's operational computerization.

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[1] S.Kukla - Total productive maintenance on example of automated foundry lines-vol.9, Issue 3, April 2009, ISSN (1897-3310)

[2] Manu Dogra, Vsihal S. Sharma, Anish Sachdeva, J.S. Dureja -TPM- A key strategy for productivity improvement in process industry, Vol. 6, No. 1 (2011) 1 - 16

[3] Vasile Deac, Gheorghe Carstea, Constantine Bagu, Florea - The Modern Approach to Industrial Maintenance Management- Informatics Economică vol. 14, no. 2/2010

Maintenance's operational computerization is able to offer the necessary and sufficient information to the maintenance department and to the other departments involved in maintenance with a satisfying rapidity, accessibility and selectivity.

S. Takata, F. Kimura, F.J.A.M. van Houten, E. Westkämper , M. Shpitalni , D. Ceglarek, Jay Lee [4] presented a maintenance framework which shows management cycles of maintenance activities during the product life cycle. According to the framework they identified technical issues of maintenance and discussed the advances of technologies supporting the change in the role of maintenance.

Steve Krar [5] presented new service business model to change maintenance systems into smart service and asset management solutions. It helps to reduce downtime and provide the ability to look ahead at the quality of products before the products ship by closely watching equipment performance and machine wear.

Ki-Young Jeong, Don T. Phillips [6], and a loss classification scheme for computing the overall equipment effectiveness (OEE) are presented for capital-intensive industry. Based on the presented loss classification scheme, a new interpretation for OEE including state analysis, relative loss analysis, lost unit analysis and product unit analysis is attempted. A methodology for constructing a data collection system is presented and developing the total productivity improvement visibility system to implement the proposed OEE and related analyses also discussed.

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[4] S. Takata, F. Kimura, F.J.A.M. van Houten, E. Westkämper , M. Shpitalni , D. Ceglarek, Jay Lee Maintenance - Changing Role in Life Cycle Management.

[5] Steve Krar- The importance of maintenance (Changing from a *FAIL and FIX* Approach to a *PREDICT and PREVENT* Approach)

[6] Ki-Young Jeong, Don T. Phillips -Operational efficiency and effectiveness measurement

A.J. Thomas, G.R. Jones, P. Vidales [7] presented an integrated approach to TPM and Six Sigma which was developed as a result of work undertaken in the castings industry. The effectiveness of the approach is subsequently evaluated highlighting the benefits, the host organization received through this new approach by measuring the effects of implementation against the seven Quality, Cost and Delivery (QCD) measures.

Mahesh Pophaley, Ram Krishna Vyas [8] investigated the present state of Plant Maintenance Management Practices, based on studies conducted in different countries and published in a variety of journals over the past two decades .These studies focused more on maintenance problem solving and the main difficulties are reported along with probable solutions and also to determine the trends in maintenance management studies and recommend future direction for research.

Paul S. Ray, Robert G. Batson, William H. Weems, Quan Wan, Gary S. Sorock, Simon Matz and John Cotnam [9] presented a model to determine whether a correlation exists between maintenance audit score and injury frequency. A maintenance audit was conducted at 28 manufacturing plants located in Alabama Data from each plant's OSHA 200 log were also collected. The Spearman rank correlation analysis was conducted for individual components as well as the aggregate relationship between maintenance score and plant injury indices. The finding supports the hypothesis that better maintenance (as represented by higher audit score) is associated with lower injury frequency. Ultimately, development and use of a high-quality instrument for evaluating maintenance function will help employers improve plant maintenance and enhance safety in the workplace.

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[7] A.J. Thomas, G.R. Jones, P. Vidales - An Integrated Approach to TPM and Six Sigma Development in the Castings Industry

[8] Mahesh Pophaley, Ram Krishna Vyas -Plant maintenance management practices in automobile industries: A retrospective and literature review – V3, JIEM, 2010, ISSN: 2013-8423

[9] Paul S. Ray, Robert G. Batson, William H. Weems, Quan Wan, Gary S. Sorock, Simon Matz and John Cotnam -Impact of maintenance function on plant safety

CHAPTER- 3

RESEARCH METHODOLOGY

Research methodology is the systematic way to solve the research problem. It gives an idea about various steps adopted by the researcher in a systematic manner with an objective to determine various manners

3.1 TYPE OF RESEARCH

The research design used for this study is descriptive and analytical research type. Descriptive research is mainly done to have a quantitative idea of the variables under study. It is concerned with describing the characteristics of a particular individual or a group. Analytical research involves in-depth study and evaluation of available information in an attempt to explain complex phenomenon. The information already available is used to evaluate about the material.

3.2 OBJECTIVES OF THE STUDY

3.2.1 Primary Objectives

To analyse the Mean time between failures, Mean time to repair and Breakdown percentage of DISMATIC mould line using mathematical analysis.

3.2.2 Secondary Objectives

- To calculate the productivity and quality.
- To find the availability of machines at various sections in DISAMATIC mould line.
- To calculate the downtime percentage.
- To identify the reasons for breakdown.
- To analyse the benefits of key result area improvements.

3.3 DATA AND SOURCES OF DATA

Data is the raw material for almost all research studies. In this study there is a need to gather primary as well as secondary data. The source of the information and the manner in which data are collected could well make a big difference to the rigor and effectiveness of the research project.

3.3.1 PRIMARYDATA

Primary data refer to first hand information obtained by the researcher on the variables of interest for the specific purpose of the study. Here observational primary data is used.

3.3.2 SECONDARY DATA

Secondary data refer to information gathered from sources already existing. Such data can be internal or external to the organization and accessed through the internet or perusal recorded or published information. There are several sources of secondary data, including books and periodicals, statistical abstracts, data bases, the reports of the companies. Here the chart constructed to view the major defects is collected from the maintenance reports of Sakthi Auto Components Limited, Pallagoundenpalayam.

The advantage of seeking secondary data sources is savings in time and cost of acquiring information. However, secondary data as the sole source of information has the drawback of becoming obsolete, and not meeting the specific needs of the particular situation or setting. Hence, the sources that offers current and up to date information.

3.4 TIME PERIOD COVERED

The data taken for the study is from January 2012 to June 2012 having six months of duration.

3.5 UNITS OF DISAMATIC MOULD LINE

The units included in this study are DISA I,DISA II,DISA III, INDUCTION FURNACE, CUPOLA FURNACE, EIRICH SAND PLANT and SAND PLANT.

3.6 FORMULA USED

MTBF, MTTR, MTTF and **FIT** are reliability terms based on methods and procedures for lifecycle predictions for a product. Customers often must include reliability data when determining what product to buy for their application. MTBF (Mean Time Between Failure), MTTR (Mean Time To Repair), MTTF (Mean Time To Failure) and FIT (Failure In Time) are ways of providing a numeric value based on a compilation of data to quantify a failure rate and the resulting time of expected performance.

3.6.1.1 MTBF

Mean Time Between Failures (MTBF) is the mean or average time between successive failures of a product. Mean time between failures refers to the average time of break down until the device is beyond repair. It can be represented as follows

$$\textbf{MTBF} = \frac{(TOTAL\ RUNNING\ TIME - TOTAL\ DELAY\ TIME)}{NUMBER\ OF\ FAILURES}$$

3.6.1.2 MTTR

Mean Time to Repair (MTTR) is the arithmetic mean of the time required to perform maintenance action. MTTR is defined as the ratio of total maintenance time and number of maintenance action. It can be expressed as follows,

$$\textbf{MTTR} = \frac{TOTAL\ DELAY\ TIME}{NUMBER\ OF\ FAILURES}$$

3.6.1.3 AVAILABILITY

Availability is the ratio of the time at which equipment is available for the designated operation to the total time of operation and maintenance of the equipment.

$$\textbf{AVAILABILITY} = \frac{MTBF}{(MTBF+MTTR)}$$

3.6.1.4 BREAKDOWN percentage

Breakdown percentage can be calculated as follows,

$$\textbf{BREAKDOWN percentage} = \frac{TOTAL\ DELAY\ TIME}{TOTAL\ RUNNING\ TIME} * 100$$

3.7 LIMITATIONS OF THE STUDY

- The study was conducted only in the selective units of the automated line.
- The data used for calculation is based on six months data only.
- The calculation of Overall Equipment Efficiency is difficult for the automated line taken for study.
- All the maintenance measures are not fully covered.

CHAPTER – 4

ANALYSIS AND INTERPRETATION

4.1 RUNNUNG TIME

Table 4.1: Table Showing Running Time (minutes)

S.no	AREA	JAN	FEB	MAR	APR	MAY	JUN
1	DISA-1	36001	44850	35880	44850	44850	44850
2	DISA-2	44850	44850	35880	44850	44850	44850
3	DISA-3	44850	44610	35880	44610	44610	44850
4	FURNACE	44850	44850	35880	44850	44850	44850
5	CUPOLA	48300	35880	48300	38640	48300	48300
6	SAND PLANT	27134	44850	35880	44850	45540	44850
7	EIRICH SAND PLANT	27048	44850	35880	44850	44850	44850
	Total	273033	304740	263580	307500	317850	317400

The table shows the running time (in minutes) of seven units of Disamatic moulding line.

4.2 DELAY TIME

Table 4.2: Table showing Delay Time (minutes)

S.no	AREA	JAN	FEB	MAR	APR	MAY	JUN
1	DISA-1	2696	839	1052	687	490	2003
2	DISA-2	102	530	702	982	1166	734
3	DISA-3	1499	1883	648	1140	722	876
4	FURNACE	592	340	529	3964	1445	844
5	CUPOLA	55	289	950	1657	648	651
6	SAND PLANT	4243	1616	1311	1442	668	1010
7	EIRICH SAND PLANT	958	238	165	200	390	453
	Total	10150	5735	5357	10072	5529	5829

The table shows the delay time (in minutes) of seven units of Disamatic moulding line.

4.3 NUMBER OF FAILURES

Table 4.3: Table showing Number of failures

S.no	AREA	JAN	FEB	MAR	APR	MAY	JUN
1	DISA-1	52	20	25	22	34	31
2	DISA-2	9	20	23	31	34	34
3	DISA-3	35	55	44	34	25	28
4	FURNACE	27	20	16	62	38	34
5	CUPOLA	2	9	20	21	10	13
6	SAND PLANT	75	39	23	35	17	30
7	EIRICH SAND PLANT	15	11	10	10	22	27

The table shows the number of failures which had occurred in the seven units of Disamatic moulding line.

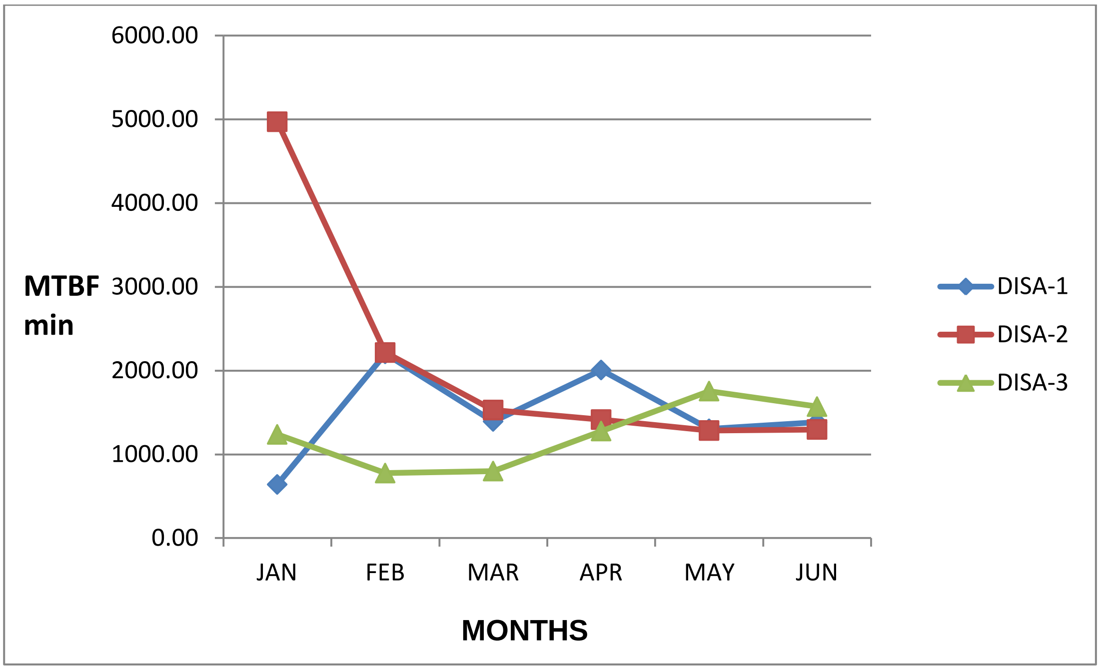
4.4 MEAN TIME BETWEEN FAILURES (MTBF)

Table 4.4: Table showing Mean time between failures (minutes)

S.No	AREA	JAN	FEB	MAR	APR	MAY	JUN
1	DISA-1	640.48	2200.55	1393.12	2007.41	1304.71	1382.16
2	DISA-2	4972.00	2216.00	1529.48	1415.10	1284.82	1297.53
3	DISA-3	1238.60	776.85	800.73	1278.53	1755.52	1570.50
4	FURNACE	1639.19	2225.50	2209.44	659.45	1142.24	1294.29
5	CUPOLA	24122.50	3954.56	2367.50	1761.10	4765.20	3665.31
6	SAND PLANT	305.21	1108.56	1503.00	1240.23	2639.53	1461.33
7	EIRICH SAND PLANT	1739.33	4055.64	3571.50	4465.00	2020.91	1644.33

The above table shows the Mean time between failures (in minutes) of Disamatic moulding line units.

4.5 GRAPHS FOR MTBF



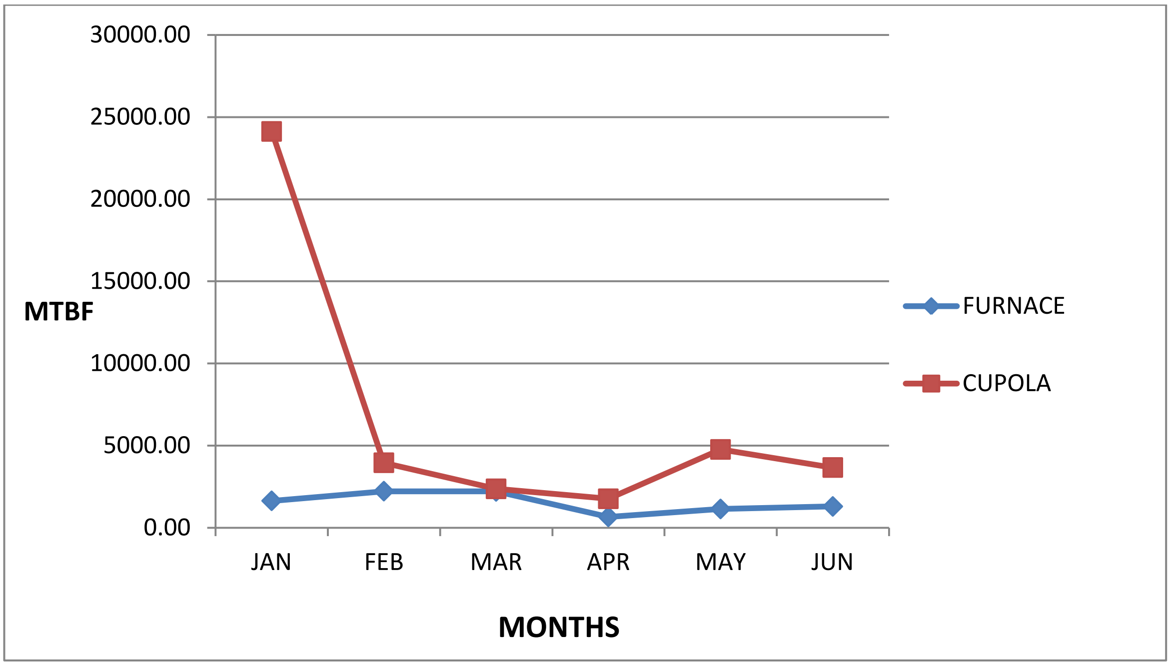
Graph 4.1: Graph showing MTBF for DISA 1, 2, 3

Interpretation

The MTBF of DISA 2 shows great variation from 4972 minutes to 2216 minutes between months of January and February. DISA- 3 MTBF declines for two months and improved for the month of April, May and drops on June.

Inference

The MTBF for DISA –1 improves continuously expect for the month of March and it shows it is reliable one compared to other two DISA units. The MTBF for DISA – 2 declines continuously and it needs more maintenance action compared to other two DISA (1& 3) lines.



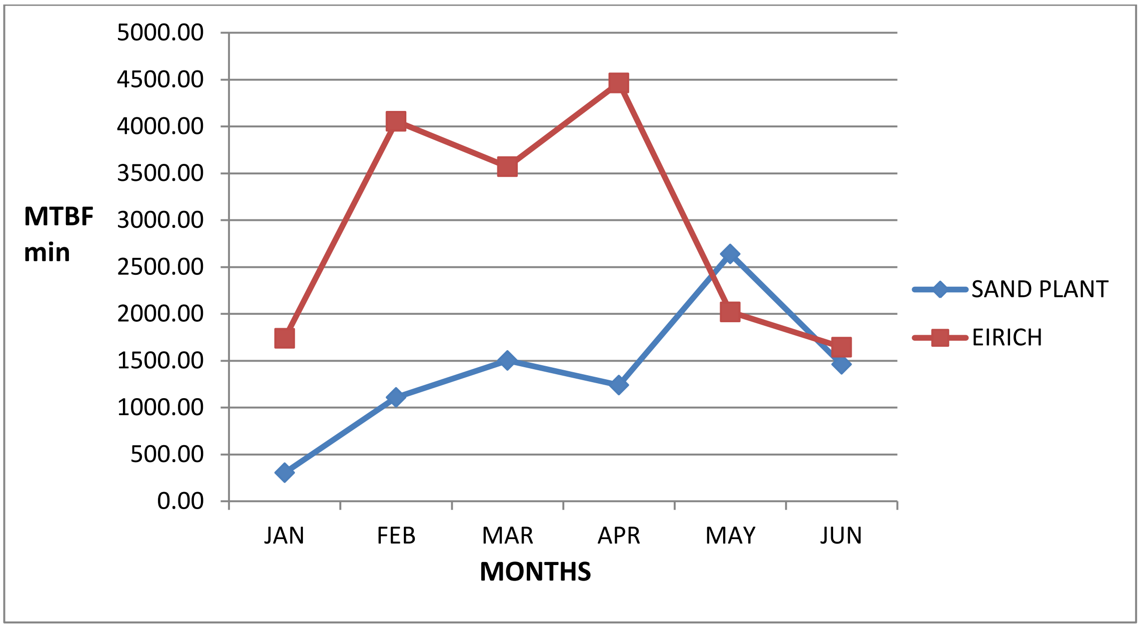
Graph 4.2: Graph showing MTBF for FURNACE and CUPOLA

Interpretation

The MTBF for Cupola furnace declined largely from 24122.50 min. (JAN) to 3954.56 min (FEB) and it shows improvement from April and it increased during May. The induction furnace values are in close range.

Inference

The decline in MTBF of Cupola furnace occurred due to increased number of failures. The induction furnace maintains close MTBF values.



Graph 4.3: Graph showing MTBF for SAND PLANT and EIRICH PLANT

Interpretation

The EIRICH plant MTBF increased from 1739.33 minutes to maximum of 4465 minutes and the sand plant has maximum MTBF of 4079.27 during the month of May.

Inference

The EIRICH plant shows increased MTBF compared to sand plant up to April month and it varies during May due to increase in no. of failure at EIRICH plant and MTBF improved for sand plant due to failure gets decreased during May.

CHART

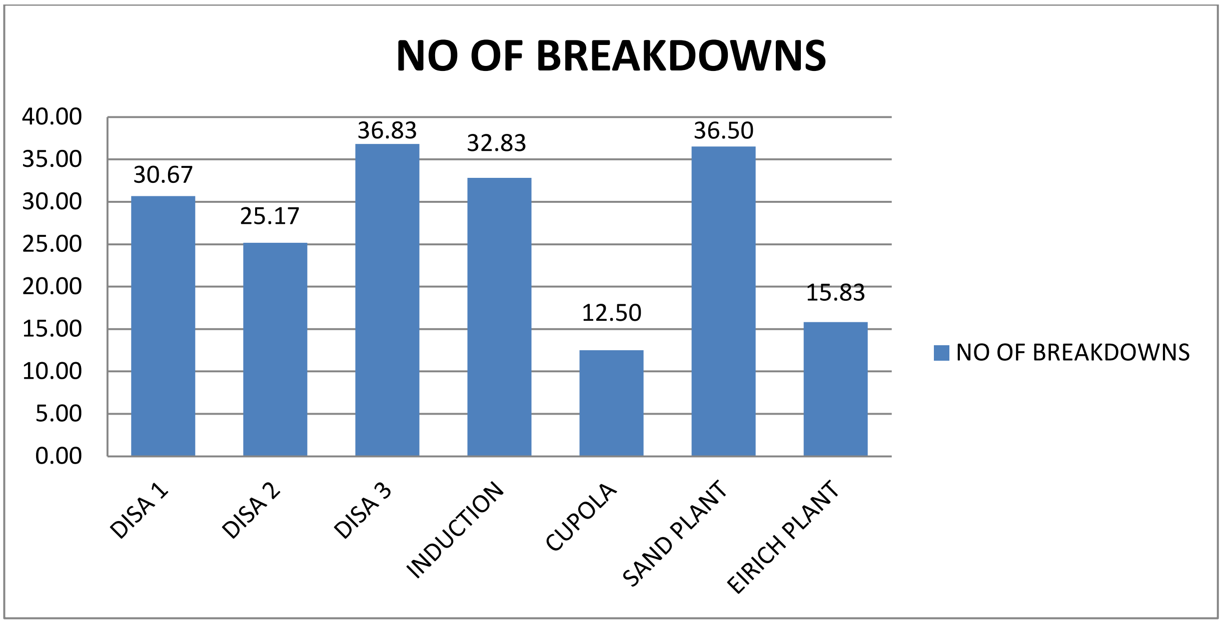


CHART 4.1: Chart showing average number of breakdowns

Interpretation

The DISA 3 is having more breakdowns than DISA 1and DISA 2 and it needs more maintenance action.

The induction furnace breakdowns are more compared to Cupola furnace.

The sand plant has more breakdowns compared to Eirich plant.

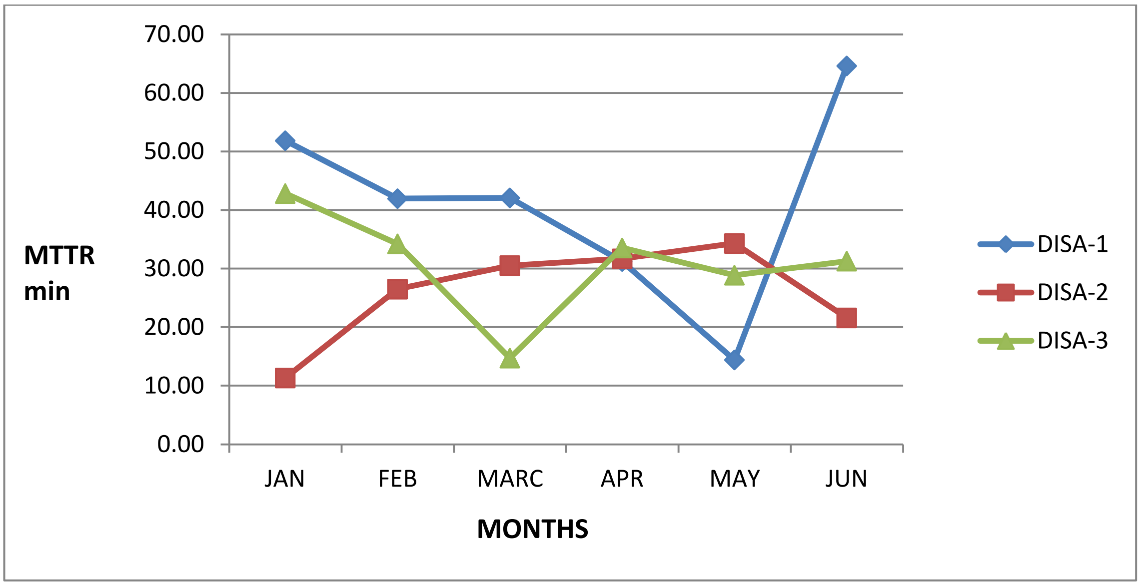
4.6 MEAN TIME TO REPAIR (MTTR)

Table 4.5: Table showing Mean time to repair (minutes)

S.No	AREA	JAN	FEB	MAR	APR	MAY	JUN
1	DISA-1	51.85	41.95	42.08	31.23	14.41	64.61
2	DISA-2	11.33	26.50	30.52	31.68	34.29	21.59
3	DISA-3	42.83	34.24	14.73	33.53	28.88	31.29
4	FURNACE	21.93	17.00	33.06	63.94	38.03	24.82
5	CUPOLA	27.50	32.11	47.50	78.90	64.80	50.08
6	SAND PLANT	56.57	41.44	57.00	41.20	39.29	33.67
7	EIRICH SAND PLANT	63.87	21.64	16.50	20.00	17.73	16.78

The table shows the Mean time to repair (in minutes) for seven units of Disamatic moulding line.

4.7 GRAPHS FOR MTTR



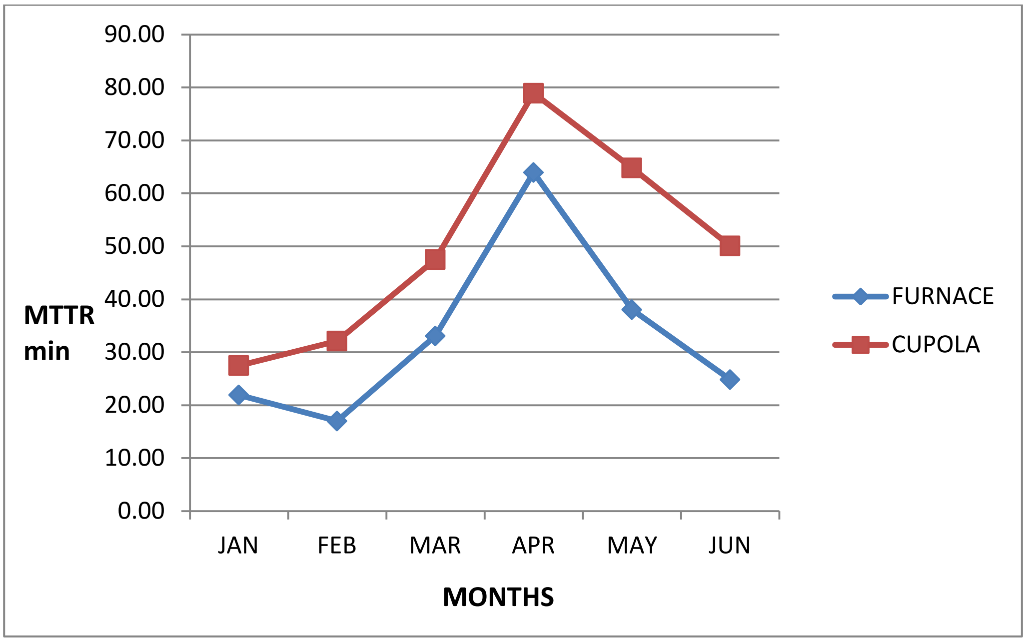
Graph 4.4: Graph showing MTTR of DISA – 1, 2, 3

Interpretation

The MTTR for DISA -1 drops from 51.85 minutes to 14.41 minutes starts from January to May.

Inference

The MTTR for DISA – 1 drops for first five months due to decrease in delay time over these months and it increased for the last month. The MTTR for DISA -2 increases over months and it is due to delay time increase in that line due to breakdowns. For DISA –3 the trend decreases for first three months and increases due to fault in its unit.



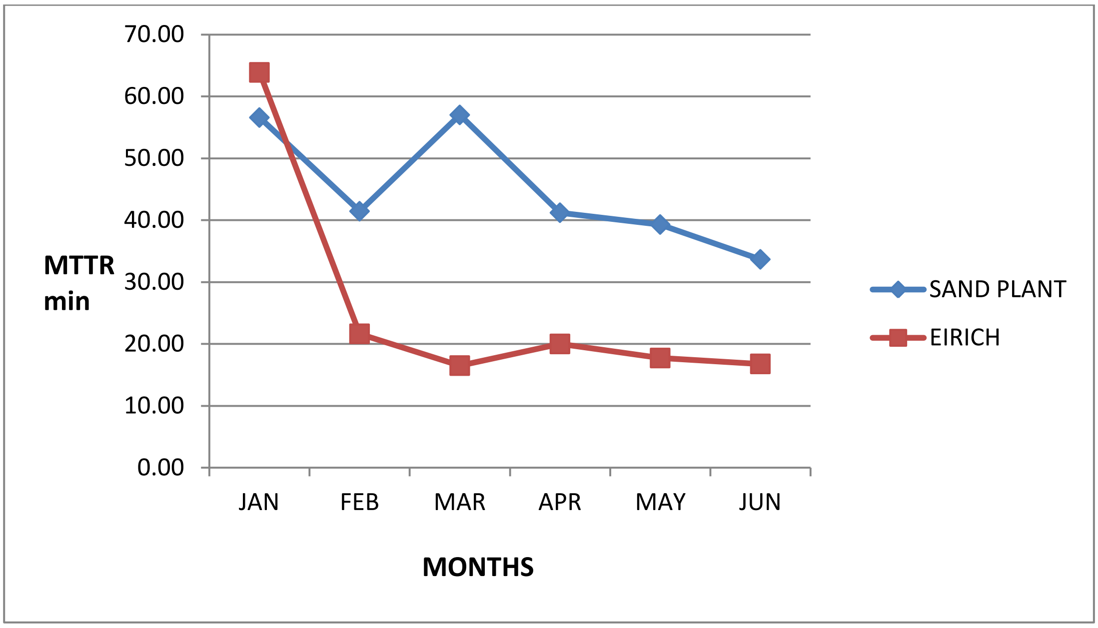
Graph 4.5: Graph showing MTTR of FURNACE and CUPOLA

Interpretation

The MTTR for induction furnace reached maximum of 63.94 minutes during April and cupola also increased to 78.90 minutes during the same month.

Inference

The MTTR for both Furnace and Cupola furnace shows increasing trend for first four months and it is due to increase in delay time at both these units. The delay time occurred due to breakdown of machinery. The condition gets reversed for the next two months due to decreased delay time.



Graph 4.6: Graph showing MTTR of EIRICH and SAND PLANT

Interpretation

The MTTR for Eirich plant declined to 21.64 minutes from 63.87 minutes and sand plant reached minimum of 33.67 minutes during June.

Inference

The Eirich plant shows favourable condition due to its decreased MTTR and the sand plant shows declining MTTR from April till June due to decrease in delay time. The drop in delay time favours the sand plant availability.

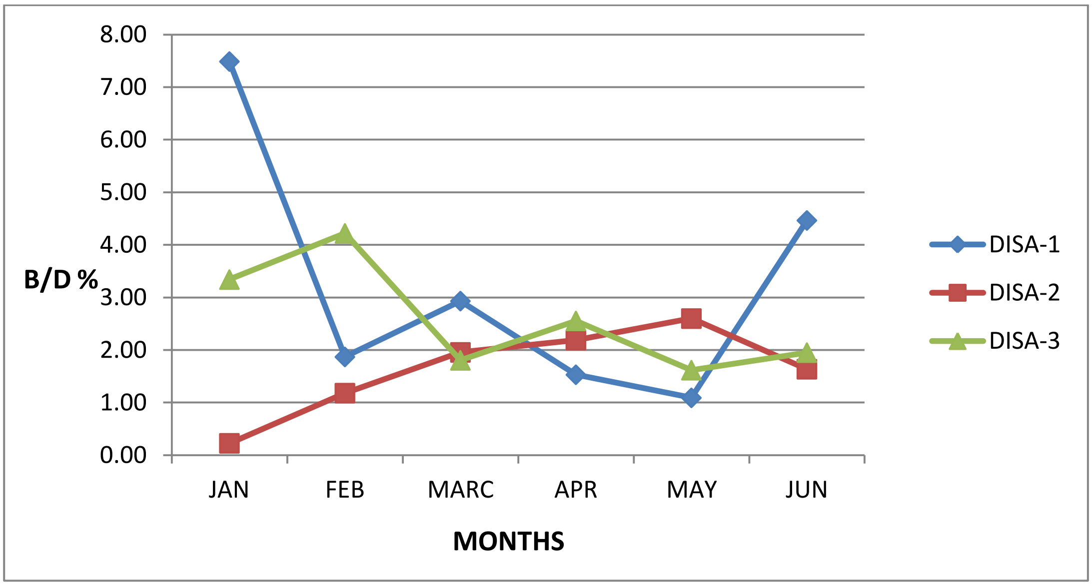
4.8 BREAKDOWN PERCENTAGE

Table 4.6: Table showing Breakdown Percentage

S.No	AREA	JAN	FEB	MAR	APR	MAY	JUN
1	DISA-1	7.49	1.87	2.93	1.53	1.09	4.47
2	DISA-2	0.23	1.18	1.96	2.19	2.60	1.64
3	DISA-3	3.34	4.22	1.81	2.56	1.62	1.95
4	FURNACE	1.32	0.76	1.47	8.84	3.22	1.88
5	CUPOLA	0.11	0.81	1.97	4.29	1.34	1.35
6	SAND PLANT	15.64	3.60	3.65	3.22	1.47	2.25
7	EIRICH SAND PLANT	3.54	0.53	0.46	0.45	0.87	1.01

The table shows the breakdown percentage for seven units of Disamatic moulding line during six months duration.

4.9 GRAPHS FOR BREAK DOWN PERCENTAGE



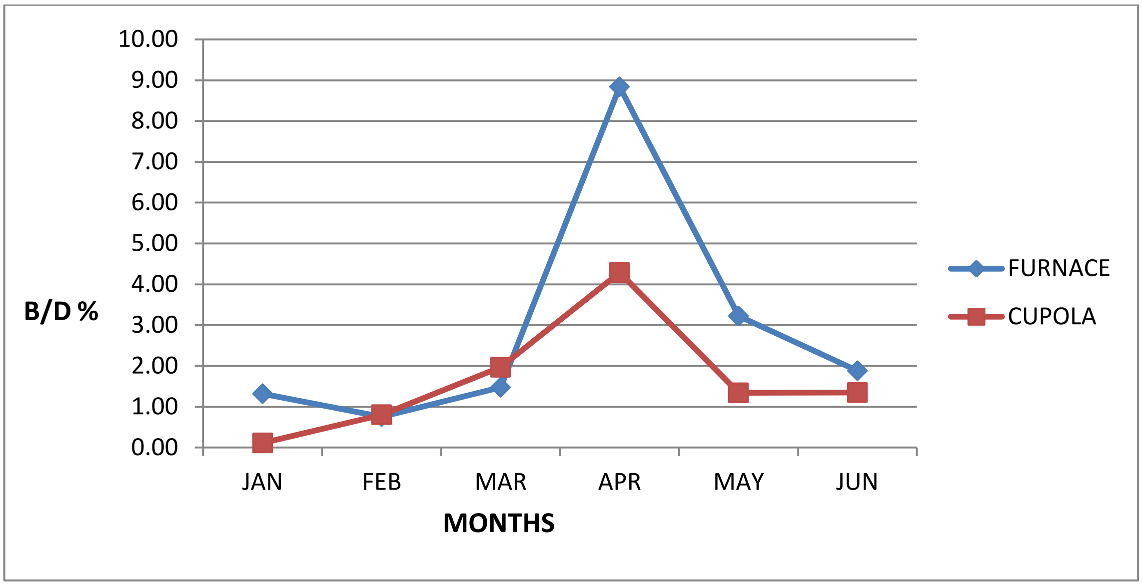
Graph 4.7: Graph showing BREAKDOWN percentage of DISA -1, 2, 3

Interpretation

The breakdown percentage of DISA 2 increases from 0.23% to 2.60% during the first five months. The DISA 1 and DISA 3 has got lower B/D % of 1.09% and 1.49% during May and June respectively.

Inference

The breakdown percentage for DISA 2 shows increasing pattern due to increase in MTTR and the other two DISA lines generates non linear trend for all the six months.



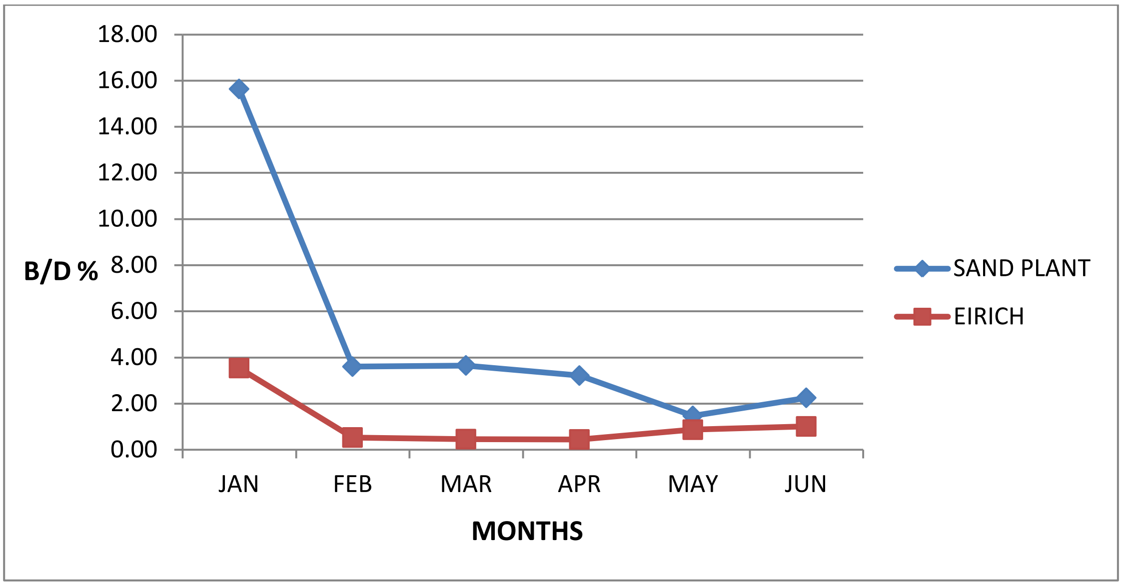
Graph 4.8: Graph showing BREAKDOWN percentage of FURNACE and CUPOLA

Interpretation

The induction furnace breakdown percentage increased from 1.57% to 8.84% during March and April month whereas for the cupola it was 1.97% to 4.29%.

Inference

The induction furnace breakdown % increased largely from March to April due to increase in MTTR and variation in MTBF. The cupola breakdown% also shows increasing trend for first four months due increased number of breakdowns and decreases later and maintains nearly same value.



Graph 4.9: Graph showing BREAKDOWN percentage of SAND PLANT and EIRICH PLANT

Interpretation

The sand plant breakdown percentage dropped from 15.64% to 3.60% during January and February and Eirich plant lowered to 0.45% during April month.

Inference

The sand plant breakdown percentage decreases from January to may due to minimum breakdowns occurred during this period and cupola maintained minimum breakdown percentage compared to sand plant due to lower downtime .

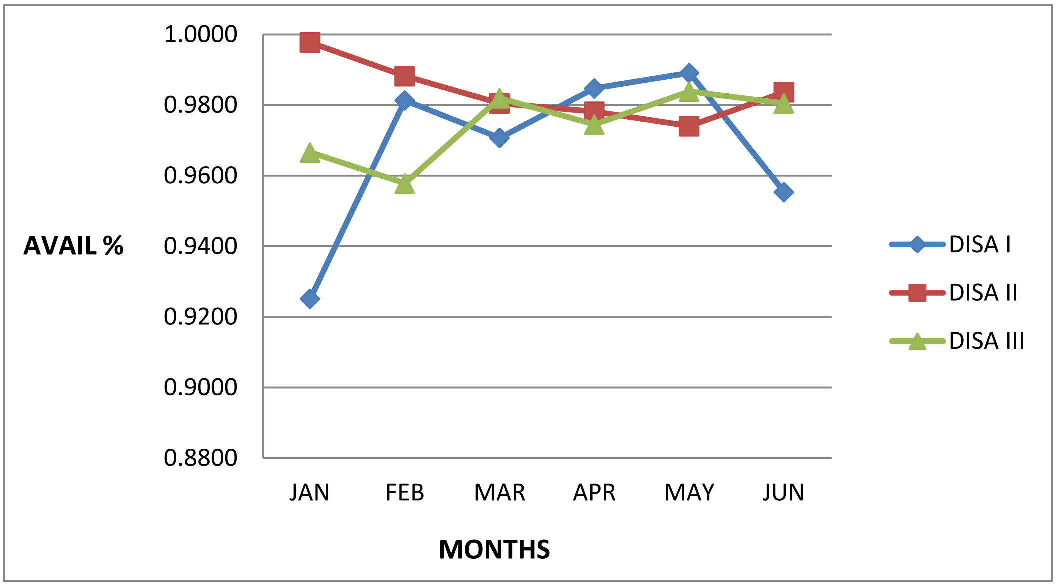
4.10 AVAILABILITY

Table 4.7: Table showing AVAILABILITY

S.No	AREA	JAN	FEB	MAR	APR	MAY	JUN
1	DISA-1	0.9251	0.9813	0.9707	0.9847	0.9891	0.9553
2	DISA-2	0.9977	0.9882	0.9804	0.9781	0.9740	0.9836
3	DISA-3	0.9666	0.9578	0.9819	0.9744	0.9838	0.9805
4	FURNACE	0.9868	0.9924	0.9853	0.9116	0.9678	0.9812
5	CUPOLA	0.9989	0.9919	0.9803	0.9571	0.9866	0.9865
6	SAND PLANT	0.8436	0.9640	0.9635	0.9678	0.9853	0.9775
7	EIRICH SAND PLANT	0.9646	0.9947	0.9954	0.9955	0.9913	0.9899

The table shows the availability of machineries for operation during six month duration.

4.11 GRAPHS FOR AVAILABILITY



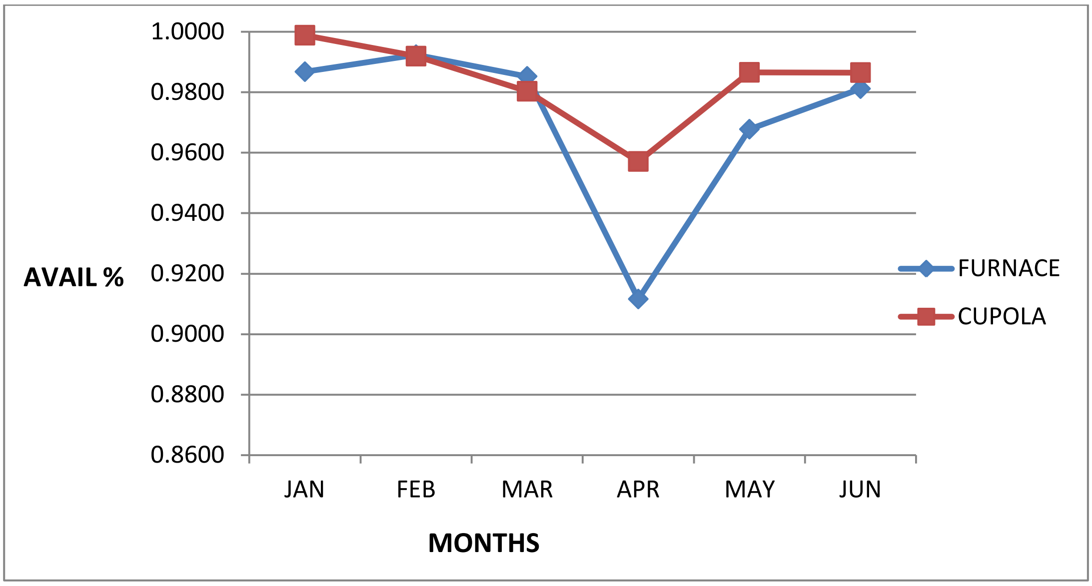
Graph 4.10: Graph showing AVAILABILITY of DISA I, II, III

Interpretation

The availability of DISA I increased from 92.51 percent to 98.13 percent from January and February and maximum of 98.91 percent during May. The DISA II availability dropped from 99.77 % to lower of 97.40 percent. The DISA III has got 98.38 percent during May month.

Inference

The availability of DISA I increases and it has reached its maximum at May. The DISA –II shows declining trend due to decrease in MTBF value and DISA III varies month to month due to variation in its breakdown frequencies.



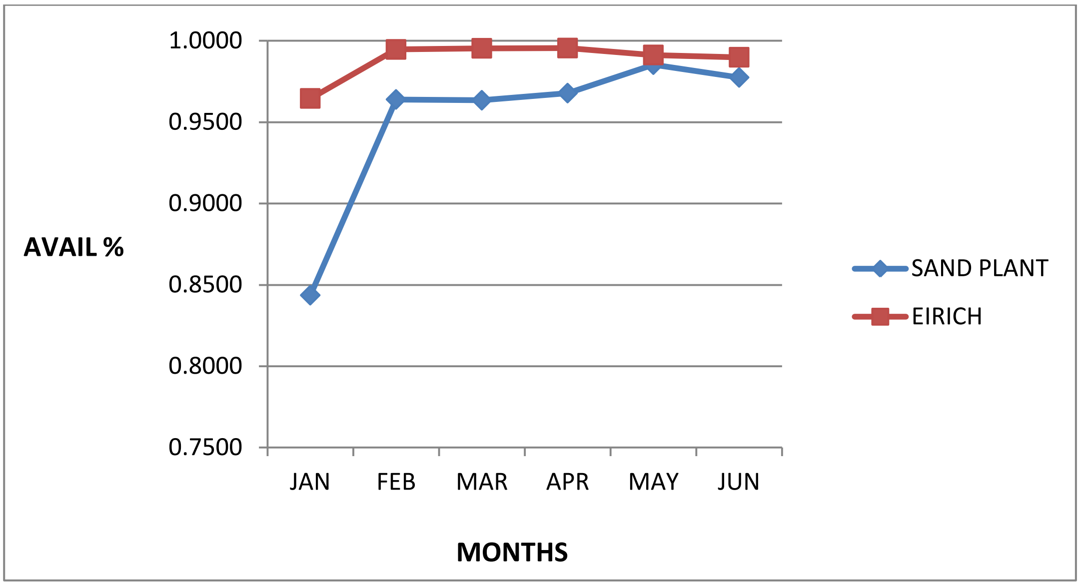
Graph 4.11: Graph showing AVAILABILITY of FURNACE and CUPOLA

Interpretation

The Induction furnace availability lowered to 91.16 percent during April month. The cupola furnace availability during the same month dropped to 95.71 percent.

Inference

The Cupola availability is more compared to arc furnace due to minimum number of breakdowns.



Graph 4.12: Graph showing AVAILABILITY of EIRICH and SAND PLANT

Interpretation

The Eirich plant high availability value is 99.55% during the month of April and for sand plant it is 98.53% during May.

Inference

The Eirich plant exhibits good availability value compared to sand plant and the sand plant value gets increased from February with maximum value of 98.53%.

4.12 KEY RESULT AREA TRACKER

Key result area tracker helps to trace the maintenance action by fixing the target and comparison of the actual value with target helps to identify deviation and to take corrective action.

4.12.1 **PRODUCTIVITY (MTTR)**

Table 4.8: Table showing PRODUCTIVITY (minutes) for Q1 and Q2

Week	DISA I	DISA II	DISA-III	FURNACE	CUPOLA	SAND PLANT	EIRICH SAND PLANT
TARGET	**45**			**40**	**45**	**30**	**25**
WK-1	21	10	**51**	16.63	0	**63.33**	137.5
WK-2	40.71	10.67	**70.6**	14	0	**42.55**	15.5
WK-3	**92.8**	0	22.17	29.8	27.5	**74.62**	14.5
WK-4	**50.38**	16	**73.5**	27.29	0	**71.05**	13
WK-5	**66.75**	11.33	**73.5**	20	29.8	28.36	0
WK-6	20.94	18.17	**54**	11.8	27	24.56	23.8
WK-7	**50.86**	**49.5**	31.56	22.2	26	**72.79**	15.33
WK-8	37	22.3	17.5	0	55	22.27	0.81
WK-9	0	0	0	0	50	0	0
WK-10	0	0	0	0	0	0	0
WK-11	23.67	20.83	8.86	28.8	42	10	5.33
WK-12	38.14	**52.5**	**95.43**	31.33	40.83	15.5	17
WK-13	19.5	28.5	19.5	13	31.4	**62.88**	22
WK-14	36.6	43.33	25	11.71	0	**90.75**	0
TARGET	**40**			**35**	**40**	**25**	**20**
WK-15	**40.67**	18.2	14	**96.33**	**43.08**	39.22	**33.33**
WK-16	8.33	9.5	23.88	**79**	37.33	**63.6**	11.33
WK-17	35	11.75	**53.17**	**39.74**	**270**	**46**	19
WK-18	**50.83**	**49.38**	16	**53**	**43.75**	25.6	**28**
WK-19	17.5	7.5	**47**	**37.5**	0	19.67	9.5
WK-20	8.71	15.63	19.5	30.45	17.69	**50.86**	18.75
WK-21	16.2	16.5	16.2	**49.38**	0	0	17
WK-22	15.85	25.5	25.5	26.5	0	**40.5**	13
WK-23	12.4	40	**44.18**	**42.86**	**105**	25	18.67
WK-24	20	0	0	20.67	0	0	**22.6**
WK-25	23.17	23.67	32.63	**54.67**	**96**	18.27	**44.88**
WK-26	20	19.13	**49.67**	24.4	**52.67**	18.75	16.71
WK-27	16.75	22.43	31.57	20.58	28	**37**	11.25
WK-28	20.1	24.55	26.8	23.75	**45.2**	**67.13**	**24.14**
WK-29	**54**	6	22.2	13	20	16.33	3

The table shows the productivity deviations from target value set for Q1 and Q2.

4.12.2 QUALITY (MTBF)

Table 4.9: Table showing QUALITY (minutes) for Q1 and Q2

Week	DISA I	DISA II	DISA III	FURNACE	CUPOLA	SAND PLANT	EIRICH SAND PLANT
TARGET	**1000**			**1500**	**3000**	**1400**	**1500**
WK-1	1240.71	4475	1230.43	**1104.63**	9660	**684.17**	**1357.5**
WK-2	**804.2**	8954	**954.89**	**1481**	9660	**405.95**	2227
WK-3	639.62	2978.67	1723.4	1764.2	4802.5	**615.38**	2228
WK-4	1054.5	8954	**725.33**	**1254.14**	9660	**401.5**	8957
WK-5	1055	2979	4411.5	4465	**1764.2**	**787.09**	8970
WK-6	**539.69**	1476.83	**418**	**885.2**	**1768**	**536.06**	1770.2
WK-7	2193	2193	**514**	**874.8**	8915	**567**	2974.67
WK-8	2205.5	**795**	**431**	8970	8920	**974**	2965.67
WK-9	**0**	8970	8970	8970	**966**	0	0
WK-10	**0**	8970	8970	8970	**1569**	0	0
WK-11	1471.33	1474.71	398.86	1794	9599	1783.8	2984.67
WK-12	1243.29	4432.5	1775	2958.67	**1569**	4469.5	8953
WK-13	**125.17**	**719**	**728**	8957	**1900.6**	**1058.5**	**1473**
WK-14	1757.4	2946.67	1769	**1269.71**	8970	**1030.5**	8970
TARGET	**1450**			**1750**	**3000**	**1450**	**2900**
WK-15	2949.33	1775.8	2976	**501.67**	**827.27**	**957.44**	2956.67
WK-16	1486.67	2232.75	**1067.38**	**561.71**	3182.67	**833.4**	2978.67
WK-17	1759	2230.75	**694.33**	**350.26**	**2950**	2944	8951
WK-18	**1444.17**	511.25	**1105.25**	**1068.25**	**2371.25**	**871.4**	8942
WK-19	4467.5	4477.5	2943	4447.5	9660	2970.33	4475.5
WK-20	**1272.41**	**1105.63**	2223	**785**	**1610**	**1230.57**	2223.75
WK-21	1777.8	544.13	1729.8	**640.62**	9660	9660	2225.5
WK-22	**685.62**	**863.3**	**1095.75**	2216	9660	2202	**1482**
WK-23	1781.5	**775.45**	1076.38	**1238.57**	**2310.5**	1470	2971.33
WK-24	2223	8970	8970	2939.33	9660	8970	1771.4
WK-25	1471.83	1471.33	**1088.63**	2935.33	4735	**797.18**	**1106.38**
WK-26	1475	**1102.13**	2940.33	1769.6	3167	2223.75	**1264.71**
WK-27	**1104.5**	**1259**	**1249.86**	**726.92**	4802	2205.5	2231.25
WK-28	**876.9**	**790**	1767.2	**723.75**	**1887**	**1054.13**	**1257.29**
WK-29	8916	4479	1771.8	4472	9640	2973.67	8967

The table shows the quality deviations from target value set for Q1 and Q2.

4.12.3 DELIVERY (DOWNTIME)

TABLE 4.10: Table showing DELIVERY (%) for Q1 and Q2

Week	DISA I	DISA II	DISA III	FURNACE	CUPOLA	SAND PLANT	EIRICH SAND PLANT
TARGET	**3**			**2.5**	**2.5**	**2.5**	**2**
WK-1	**3.2**	0.22	**4**	1	0	**8.47**	**9.2**
WK-2	**10.4**	0.4	**4.2**	1	0	**9.5**	0.7
WK-3	**7.3**	0	**3.9**	2	0.6	**10.8**	0.7
WK-4	**6.0**	0.2	2.9	2	0	**15.5**	0.1
WK-5	**4.2**	0.4	1.6	0	1.7	**4.5**	0.0
WK-6	**3.7**	1.2	**11.4**	1	0.6	**4.4**	1.3
WK-7	**4.0**	2.2	**5.8**	2	1.5	**11.4**	0.5
WK-8	1.7	2.5	**3.9**	0	0.6	2.3	0.8
WK-9	0	0	0	0	0.6	0.0	0.0
WK-10	0	0	0	0	0	0.0	0.0
WK-11	1.6	1.4	2.2	4	**5.67**	0.6	0.2
WK-12	3.0	1.2	1.1	1	2.5	0.4	0.2
WK-13	**5.1**	**3.81**	2.6	0.14	1.63	**5.6**	1.47
WK-14	2.04	1.5	1.4	1	0	**8.1**	0.0
TARGET	**2.5**			**2**	**2**	**2**	**1**
WK-15	1.4	1.1	0.47	**16**	**5.8**	**3.94**	**1.11**
WK-16	0.5	0.4	2.2	**12**	1.2	**7.1**	0.3
WK-17	2.0	0.5	7.2	**10**	**8.4**	1.5	0.2
WK-18	**3.4**	**8.8**	1.4	**5**	1.8	**2.9**	0.3
WK-19	0.4	0.2	1.6	1	0.0	0.7	0.2
WK-20	0.7	1.4	0.9	**4**	**2.4**	**4.0**	0.8
WK-21	0.9	**2.9**	1.0	**7**	0.0	0.0	0.8
WK-22	2.3	**3.8**	2.3	1	0.0	1.8	0.9
WK-23	0.7	**4.9**	**4.0**	**3**	**4.3**	1.7	0.6
WK-24	0.9	0.0	0.0	1	0.0	0.0	**1.3**
WK-25	1.6	1.6	2.9	2	1.98	**2.2**	**1.3**
WK-26	1.3	1.7	1.7	1	1.6	0.8	**1.3**
WK-27	1.49	1.8	0.0	**3**	0.6	0.0	0.5
WK-28	2.2	**3.0**	1.5	**3**	**2.3**	**6.0**	**1.9**
WK-29	0.6	0.1	1.2	0.3	0.2	0.6	0.0

The table shows the delivery deviations from target value set for Q1 and Q2.

4.12.4 SAFETY

Table 4.11: Table showing SAFETY for Q1 and Q2

WEEK	NO. OF ACCIDENTS	NO. OF TOOLS DAMAGED	NO. OF EQUIPMENT DAMAGED	NO. OF PREMATURE FAILURE
TARGET	**0**	**0**	**0**	**0**
WK-1	0	0	0	0
WK-2	0	0	0	0
WK-3	1	0	0	0
WK-4	0	0	0	0
WK-5	0	0	0	0
WK-6	0	0	0	0
WK-7	1	0	2	0
WK-8	0	0	0	0
WK-9	0	0	0	0
WK-10	0	0	1	0
WK-11	0	0	0	0
WK-12	1	0	1	0
WK-13	0	0	0	0
WK-14	0	0	0	0
TARGET	**0**	**0**	**0**	**0**
WK-15	0	0	0	0
WK-16	0	0	0	0
WK-17	1	0	0	0
WK-18	0	0	0	0
WK-19	0	0	0	0
WK-20	0	0	0	0
WK-21	1	0	2	0
WK-22	0	0	0	0
WK-23	0	0	0	0
WK-24	0	0	1	0
WK-25	0	0	0	0
WK-26	0	0	1	0
WK-27	0	0	0	0
WK-28	1	0	0	0
WK-29	0	0	0	0

The table shows the safety deviations from target value set for Q1 and Q2.

4.12.5 MORALE

Table 4.12: Table showing MORALE for Q1 and Q2

Week	PREVENTIVE MAINTENANCE SCHEDULE VS. DONE	NO. OF DESIGN CHANGES	NO. OF IMPROVEMENTS
TARGET	**100%**	**1**	**2**
WK-1	100%	0	1
WK-2	100%	0	0
WK-3	90%	0	0
WK-4	95%	0	0
WK-5	95%	0	0
WK-6	95%	1	0
WK-7	95%	0	1
WK-8	95%	0	1
WK-9	95%	0	0
WK-10	98%	0	0
WK-11	25%	0	0
WK-12	90%	0	0
WK-13			
WK-14	95%	0	0
TARGET	**100%**	**1**	**2**
WK-15	100%	1	1
WK-16	100%	0	0
WK-17	90%	0	0
WK-18	95%	0	1
WK-19	95%	0	0
WK-20	95%	0	0
WK-21	95%	0	1
WK-22	95%	0	1
WK-23	95%	0	0
WK-24	98%	0	0
WK-25	25%	0	1
WK-26	90%	0	0
WK-27	95%	0	1
WK-28	95%	0	1
WK-29	95%	0	1

The table shows the morale deviations from target value set for Q1 and Q2.

4.13 WHY WHY WHY ANALYSIS

DISA I

4.13.1 CORE SETTER PROBLEM

PLUNGER STUCK UP

↓

EXCESS MOISTURE IN AIR LINE

↓

ONLINE AIR FILTER WATER TANK FILLED

↓

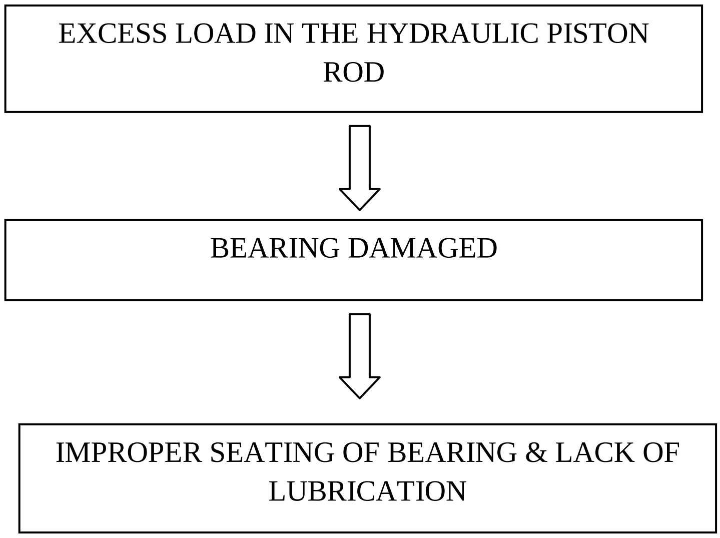
IMPROPER HANDLING BY MACHINE OPERATOR

CORRECTIVE ACTION

1. Valve changed
2. Train the operator to drain the water

DISA –II

4.13.2 CSE CYLINDER ROD CUT

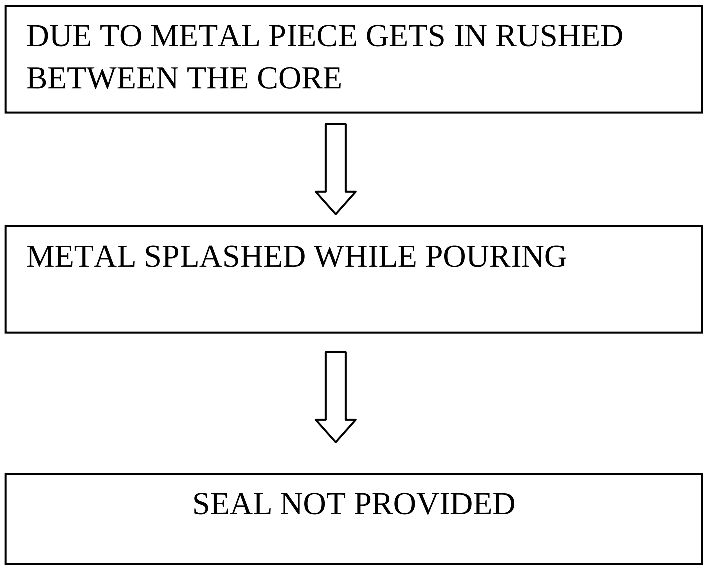


CORRECTIVE ACTION

1. Arm repaired and pin changed
2. Re machine arm bearing seating area, replacing of bearing pin

DISA – III

4.13.3 INDUCTOR PROBLEM

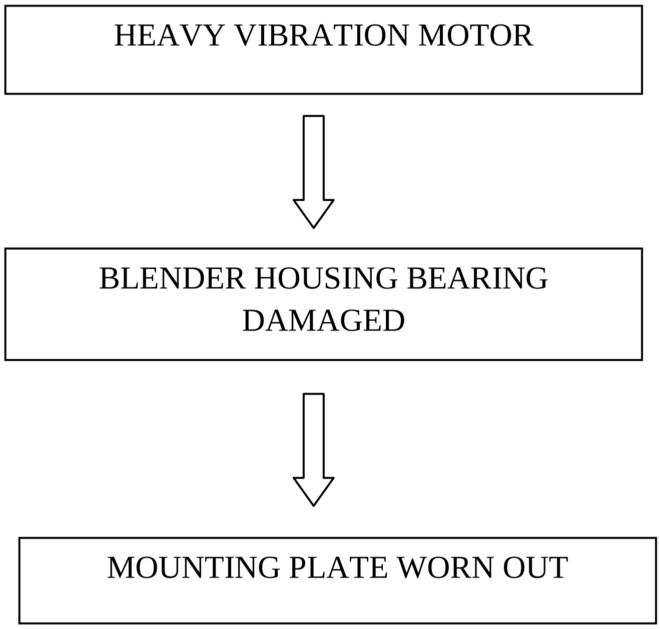


CORRECTIVE ACTION

1. Inductor core red hotted
2. Seal provided

SAND PLANT

4.13.4 MIXER BLENDER HOUSING PLATE CHANGE

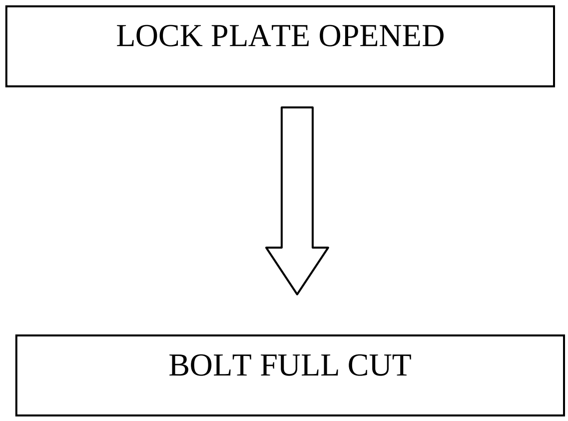


CORRECTIVE ACTION

1. Plate replaced.
2. Aging of mounting plate rectified.

CUPOLA

4.13.5 CHARGING BUCKET ROLLER FELLDOWN



CORRECTIVE ACTION

- Roller fixed
- Lock plate fixed with bolt
- Oil lubrication daily

5. FINDINGS, SUGGESTIONS AND CONCLUSION

5.1 FINDINGS

- The MTBF for DISA II foundry line decreases continuously compared to other two DISA lines (I & III).
- The more reliable unit based on MTBF is DISA III.
- The breakdown increases in these units due to continuous DMM hardware and CSE problem week after week.
- The sand plants MTBF improves month wise.
- Even though the Cupola and Arc furnace show low range MTBF, they are in close range without much variation.
- The MTTR for furnaces are in decreasing trend.
- The MTTR for DISA I increased during June due to maximum delay time that occurred because of DMM cooling drum tyre problem.
- The breakdown at DISA moulding lines are more in number compared to sand plants and furnace which needs more maintenance.
- The availability of sand plant and EIRICH sand plant are in range above 96%.
- DISA III moulding line availability value is favourable compared to other two mould lines.
- Based on key result area tracker, the sand plant productivity based on MTTR is unfavourable as the actual value 41.33 min. is more than target fixed for Q1 i.e. 30 min. and it also continued during Q2 also, MTTR value 31.2 min. against 25 min. (target).
- Furnace and Cupola furnace MTTR value deviates more from target value fixed for Q2.
- The quality measure based on the MTBF for furnace drops below the target fixed for Q1 and Q2.
- The safety measure based on accidents, tool damages, equipment damages and premature failure are favourable.
- The morale of the employees is also good.

5.2 SUGGESTIONS

The breakdowns are attended by the few maintenance personnel only at various units of Disamatic moulding line and it consumes time due to less manpower availability for maintenance and cost of maintenance also high. To overcome this manpower shortage, autonomous maintenance practice can also be implemented in addition to breakdown maintenance, predictive maintenance and predictive maintenance actions. The practice of autonomous maintenance helps the machine operators to carry out corrective actions on their own without the intervention of maintenance personnel and they also become responsible of their system.

The manpower requirements of the maintenance system can be carefully evaluated based on the time study and motion study.

Training and continuous assessment helps the workforce to learn more about the modern techniques, recent trends in DISAMATIC automatic maintenance and helps to meet the growing demands of the industry.

The computer has become an indispensable requirement in maintenance management. So, there is an increasing trend in application of information based decision support systems in various units of moulding line and it is also a reliable tool for maintenance plan implementation.

5.3 CONCLUSION

Maintenance is not only a repair function, but relates to any action that provides the plant and machinery to an acceptable condition. The condition of good plant depends on maintenance action that takes place at the plant, which results in increased productivity. The productivity, quality of Disamatic automatic moulding line based on various reliability measures evaluated gives idea of importance of maintenance plan at each units of Disamatic moulding line. The planned maintenance action for Disamatic moulding line followed at Sakthi Auto Component Limited greatly helps to minimizes failure and rejection rates. It also meant to increase life and operational availability of the foundry line.

5.4 SCOPE FOR FURTHER STUDY

This study is conducted to know the maintenance management program carried out at seven units of Disamatic moulding line and mathematical analysis also done to evaluate MTBF, MTTR, AVAILABILITY and BREAKDOWN PERCENTAGE. Further study could be done to calculate the maintenance cost and estimation of economic life of the equipment. This study conducted only in few areas further study could be done in large moulding lines of SACL.

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