

Workplace Health and Safety Management Practices and Risk Assessment towards Productivity in Plastic Industry

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Abstract

Small and medium scale industries (SMIs) are often the main pillar of an economy. In India the plastic processing industries are highly fragmented which about 75% are consist of micro, small and medium scale industries in plastic sector, in which about 15% has registered the packaging industry, which is one of the fastest growing industries in comparison with all industries. Less awareness, minor or major accidents, machineries which are old or semi-automatic and problem of ergonomics have created a need for implementation of workplace health and safety practices in these industries. Implementation towards healthy working condition plays an important role and creates positive impacts on economic and social development. Incident prevention tools like, incident investigation and pre job safety analysis can significantly reduce work place incident. In this study the cause of accident and how could prevent their occurrences were discusses. After implementing the strategies in the industry the safety supervision is also must to ensure a functioning occupational health and safety management system to protect human health and safety during working at workplace. Risk assessment as well as implementation towards product safety during manufacturing process is also discussed for rejection control or for enhancing the productivity. The data was obtained from different working area of the industry. The accurate information in questionnaires from the employees of the industry is collected, which took couple of weeks. After the collection of data it was analysed for further improvement. Two machines were analysed or monitored for comparing the new implemented strategies with the old or running one, for product safety during manufacturing process. The result shows that the safety culture among the workers in industry is increased and the risk of incident occurrence decreased. After the safety management system are inadequate in the industry, market competitiveness, better efficiency, less risk were found to be most significant drivers and lack of awareness, financial constraints, resistant to change, lack of training are main barriers. The rejection control also seems in the production or increase in productivity seems, after implementation of new strategies towards process efficiency. The awareness towards the safety rules and policies increases which is also the main aim of this study. After implementing the new strategies in all phases of the industry, the risk decreased, decrease in rejection during process, all the employees and working parties seems to complies with safety procedure and rules and participate in all safety activities.

Keywords: Safety management, Actual case study, Accident prevention tools, working parties, Manufacturing equipments, Productivity

I. INTRODUCTION

In all over the world safety in plastic manufacturing seems very critical as in this; everyone deals with different areas such as machinery, raw material (generally petrochemical material) which is mostly flammable. The plastic manufacturing is becoming one of the most important fields in the manufacturing. By use of plastic into their product such as any equipment or any device all the manufacturers are tried to reduce the cost for economy growth. Plastic manufacturing reached at different field in which the production such as the automotive, medical equipment, aerospace, toys as well as packaging, which is started from the manufacturing of combs and buttons.

In this study, the comparison of money spent in case when accident occur due to low level safety to the cost of safety program which need to be implemented for workers health and safety of others such as machineries product etc. In India plastics market is comprised of around 25,000 companies and that employs about 3 million people. The downstream plastic processing industries are highly fragmented which consist of micro, small and medium industries. There are over 30,000 registered plastic processing industries of which about 75% are in the small-scale industries. The figure 1 shows about the information of the plastic processing technologies in India. The small-scale industries are however, accounts for only about 25% of polymer consumption. In India the small and medium scale industries (SMI) plays an important role towards their economies. In India the packaging industry is one

of the fastest growing industries in comparison with all industries, directly or indirectly. Indian packaging industry has registered about 15% in the last five years. India's gross domestic product (GDP) from SMIs covers 7%, in which 90% of industrial units are there and export from India is 35%. In every year more than 8000 products were producing in India through SMIs more than 55 million people generating more than 1 million jobs every year. SMIs also contributing to industrial output 45%, exports 40%, due to this the SMIs considered as the backbone of India's economy. India having a population of 1.15 billion and a work force of about 467 million, labour shortages are the main problem for the plastic factories. This has led to increased investment in technology such as automation and conveyor belt systems.

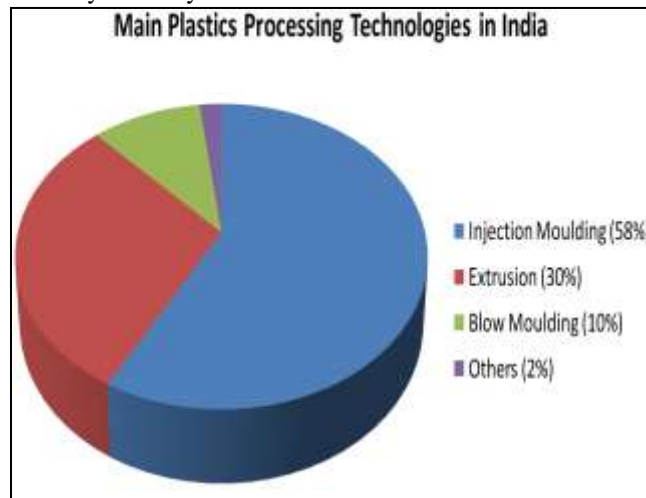


Fig. 1: Plastic manufacturing technologies in India

For taken safety in priority the more application of new technologies being implemented, advanced machineries, with more automation being applied to this industries.

Workplace Health and Safety must be adopted by the workplace at all over the place for keep the people healthy and safe from the working conditions, plant and equipment, manufacturing process etc. and other people. Some people such as contractors, consultants, employees etc. should be kept safe by the adopting the safe working practices, also by given a safe working environment, providing with adequate plants, tools and equipment and offered ongoing training and education for better efficiency in all phases at industry.

To become a world class competitor for any industries the safety performance plays an important role. Better personal equipment (PPE), training, good housekeeping, risk assessment can reduced occupational accidents. Work practices and work culture must be changed by the workers and also the workers need to be reoriented by adopting best practices to developed good safety culture. In all over world in developing countries the occupational accident are seems to be same as in India. Managers or safety management system should analysis or formulate the policies for improving the safety performance. In the small and medium scale industries (SMIs) many accident, injuries and loss in product quality are seems because of the lack of awareness at working conditions towards safety rules and policies, as in this industries (SMIs), there is no latest technologies were used and no any safe and healthy culture was presents, less and less automation were there and which is not so appropriate for better efficiency, productivity, efficiency in product design, supply chain and process; to improve this, the technology innovation must be implemented; more and more automation for the safety purpose of the worker and improvement in all above factors. Worker consciousness towards safety refers to an individual own awareness of safety issues.

The systematic and well study of risk assessment program for the safety purpose will more effective towards workers health on the workplace or any shop floor. By the study of risk assessment, the training and reinforcement of safety practices will helps in decreasing the occurrence of accident. The safety oriented culture, safety enhancing system must be implemented by the top management. In the organisation the value of safety culture depends on employee's behaviour or perceptions towards safety policies and programs, that how they interested or aware about this. Inspirational and motivational behaviour towards safety program or policies will motivate the employee to care and understanding about safety. The top management, managers must challenge to employee to think about the ways to improve safety and enhance their knowledge and interest in safety oriented behaviours. It is necessary to take leader ship of responsibility for safety performance which motivates the team members for work efficiency and work harder. The presence of health and safety executive or senior managers will helps to improve safety performance or achieving the safety culture, it also seems that their presence or by monitoring the safety policies or rules by them increased the industrial safety effectiveness.

If any industry's employees are following the safety rules or understanding the value of safety and if they complies attitude behaviours, norms and values, personal responsibilities and the HR responsibilities such as training and development is properly maintaining then there is no doubt to say that the industry having good safety culture. Increasing in risk is directly proportional to an incident occurring increases or the severity of injury increases. With the help of or if we are using the tool namely as incident investigation analysis and pre-job safety analysis the occurrence incident decreases as well as injury severity can be reduced.

Product manufacturing machine, that is Injection blow moulding process is analysed for the rejection controlled, in which temperature of the mould is controlled by mould temperature controller (MTC) also called temperature control unit (TCU). The solid polymer is fed into the barrel in which a single screw extruder has been used which melts the solid polymer by thermal condition and viscous shearing between a rotating screw and a barrel. Molten polymer is fed into mould which form external shape around the core rod for shape of the preform, the viscosity of the molten polymer is maintained by MTC which supply the hot water in the cooling channels in the preform mould. The blocking of the cooling channels will distract the product quality or disturb the continuity of the process, as for cleaning the channels the production or machine will stopped. In this work the new strategies will apply to reduce the frequency of blocking of cooling channels and compare with old procedure into another machine.

II. LITERATURE REVIEW

John Wesley Hyatt developed plastic material in 1868, called celluloid he used it to substitute ivory which was becoming more difficult and expensive to obtain after improvements, from that plastic industry was born (Bryce 1999). During the next 40-50 years others began to implement this new process and used it for manufacturing. During 1940's the plastic injection moulding industry became more popular because producing expensive mass products.

Apply safety to your industry and keeping your workers safe and healthy. There are different things to be done from machinery and electrical safety to dust handling requirements for example: careful management processes, commitment throughout the factory in addition to safety management including risk assessments, engineering controls, and emergency procedures and training. Good management process in plastic industry includes carefully implementing controls such as containers, use of appropriate personal protective equipment and safe handling procedures, because as mentioned before plastics are petrochemical materials that must be dealt with carefully. It is always recommended to have a good communication have to be in touch with the raw material companies in case any information is needed. In this type of industry to improve safety in all phase Health and Safety Executive (HSE) has to be work.

Machines which are new or old should comply with its regulations and meet the requirements which are needed. The workers; should be protected from moving parts of machinery, while machinery parts that require a tool to open must be opened by trained personnel only. The hand injury which is 25-50% of the total injuries is found in this industry. According survey, robots and automation are implemented to protect workers from injury. It is difficult to eliminate manual handling but they are trying to cut it down. Maximum accidents in blow moulding factories happen because inadequate or damaged safe guarding about another was because of defeated safeguards. To avoid these kinds of accidents it is recommended to: provide the right safer guarding and check it is kept in the position and working effectively or not.

Plastics are manufactured by refining petroleum products the most common are crude oil and natural gas. Fire in plastics manufacturing may generate black acrid smoke and poisonous gases including carbon monoxide. The fires may spread quickly and be difficult to extinguish. So to avoid this; sources of ignition should be controlled by prohibiting smoking and hot work in high risk areas.

It is necessary to keep safety as a priority at all levels, from operator to managers and it is also true that safety awareness is a key to safe operation. It is also necessary that top management must show a clear commitment and interest in safety before safety training can be effective. Some managers say that their major concern is that they do not have the resources to have a full time safety person in this case they can rent a safety supervisor in-order to reduce the cost.

III. METHOD

A. Data collection

In this study the implementation made towards technological issues which are beneficial for safety of workers. Team of employees which have good knowledge of process or experience candidate which know about the accidents which occurs previously were selected for the collection of the data.

Point wise methodology was prepared:

- Data was collected from the workplace by the machine operator; supervisors; managers. And the data which was collected having details of:
 - 1) Accident scenarios;
 - 2) Hazardous act at work place;
 - 3) Which technologies should be used
 - 4) Impact of technology on human health

After the collection of the data, the best policies should be applied to industry for safety point of view.

In the details of the collected data there must be information about the:

- 1) Process information
- 2) About product quality

On the next section (3.3) the above two points will discussed.

After survey in the industry, it is noted that, where the implementation were required regarding technology, manual work in machine, safe guards.

B. Accident prevention:

After the collection of the data the strategies were used prepared for controlling the occurrence of the accident. The two general tools of preventing the incident occurrence are Pre-job safety analysis and Incident investigation.

1) Pre-job safety analysis

As we know that in the work place the unexpected incident does not occur. The top management, managers, or supervisors, or health safety executive should provide the tools like the best environment, the training for hazardous task, the training on machine used for any purpose, about the work procedure (SOP). If the workers will familiar with these tools the probability of incident occurring reduced.

Table – 1
Important points related to worker safety

Worker	<ol style="list-style-type: none"> 1) <i>Environment: safe working environment is necessary</i> 2) <i>Training: worker should have proper training.</i> 3) <i>Procedure: Every task should have procedures which are performed by the workers.</i> 4) <i>Supervision: supervision to provide guidance to work before and while it is being conduct.</i> 5) <i>Colleagues: worker must also work with their colleagues to ensure that they are not endangered and are working safely for themselves and other.</i> 6) <i>Management: Management should take care of the system.</i>
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The Table 1 shows the important points related to worker safety.

2) Incident Investigation:

This is also the tool for preventing the incident from reoccurrence. During the investigation it is necessary to present management representative and one worker representative for examine the site, for analysis where the incident occurs and sets the preventive strategies. The representative should listen, the matter carefully and must note the points, for find out the root cause of the incident so that he can determine the ways to control the prevention of incident reoccurrence. After finding the cause of incident occurrence the new strategies were prepared to controlling the reoccurrence of the incident.

The two examples of incidents and prevention against their reoccurrence after an investigation were made.

– Grinding machine’s gate opens at the running time

The rejected material from the production area shifted to grinding area. In which the bottle is cut into small pieces by grinding machine, which having sharp blades. The sharp blades wheel is rotating by 40 hp motor which is connected to the shaft and v-belt. The speed of wheel rotation is very high. The operator is new joining in factory he opens the door of the machine at the running time, due to this the small pieces of bottle move upwards direction as the rotation of the wheel is very high, which cause injury to the operator eyes. After investigation the report is prepared by the questionnaires like; when, how, by whom etc. then precautions were made,

The limit switch is installed to the machine gate for safety purpose. If the doors opens at the running time, the limit switch will disconnect the power of the machine and towards the worker safety the gaggles is provided to machine operator which is compulsory to wear at the running time of machine to protect the eyes from injury.

– Fire extinguishers fails at the workplace

The operator is cleaning the mould by the alcohol, which is flammable liquid. The operator wears the gloves for the protection. The gloves get full contaminated from the alcohol as he was cleaning the mould. After cleaning the mould; nozzle needs heating from external source, for this the LPG cylinder is used. The operator did not remove the gloves and burns the cylinder; due to this the fire occurs in the gloves which are contaminated by alcohol. He removed the gloves in time, but through it on the corrugated box. Due to which fire occurs on the box. One of the workers gets the fire extinguisher which is dry powder extinguisher and he extinguishes the fire. The first extinguisher had gone failed to extinguish the fire because dry power extinguishers consists of particles having irregular shapes, which results in a poor flow of powder under discharge condition. The powder residue can cause damage to sensitive electronic equipment such as circuit boards, computers, production machinery etc. This type of extinguishers is replaced by cleaning agent types of extinguishers. Clean Agents are designed to provide a wide margin of human safety they are safe to use where people are present. Clean Agents rapidly vaporizes to gas during discharge and evaporates cleanly, leaving no residue behind, which means no costly cleanup, so that protection from fire can be done easily and strictly instructed to the worker to follow the procedure of working at the particular place. After investigation the safe working procedure was prepared towards the incident which is discussed above and implementation were made towards safety to prevent the reoccurrence of the incident.

C. Risk Assessment towards Productivity:

A risk assessment will identify risks within the process again, not only risk that hurt people but risk that impede production. In this study the analysis is discussed to improve the efficiency of process during manufacturing a product. The manufacturing are the step through which raw material are transformed into final product. Manufacturing system can be defined as the arrangement and operation of machine, tools, material, people and information to produce the value added physical, informational or service product whose success and cost is characterised by measurable parameters.

The purpose of this analysis is to improve the efficiency of the process. The efficiency of the manufacturing process is depends on the following factors.

- 1) Parameters: The parameters like delay time, speed, pressure, etc. are very critical parameters, which may disturb the process if any minor changes were made.
- 2) Heaters: Heaters control the viscosity of molten polymer, which melts by thermal conditions and viscous shearing between a rotating screw and a barrel.
- 3) (MTC) Mould temperature controller which are used to heat up the mould and maintain the temperature. High temperature water from the mould is returned to the cooling tower and cooled by direct cooling. Steady controlled temperature makes plastic moulding accurate in size and consistent with quality. Accurate mould temperature solves the problem of plastic flow patterns, reducing flow and weld lines, gloss appearance, record grooves effect, silver streaking, stress-whitening, warping etc
- 4) Utility: Machineries like air compressor, air handling unit (AHU) for controlling the humidity of production area. Cooling tower which cools down the temperature of hot water which is coming from process output. Cooling towers are vulnerable to a variety of contaminants that cause deposit formation, such as mineral scales and sludge or dust from air. Deposition interferes with heat transfer, increases corrosion rates, restricts water flow, and causes loss of process efficiency and production.

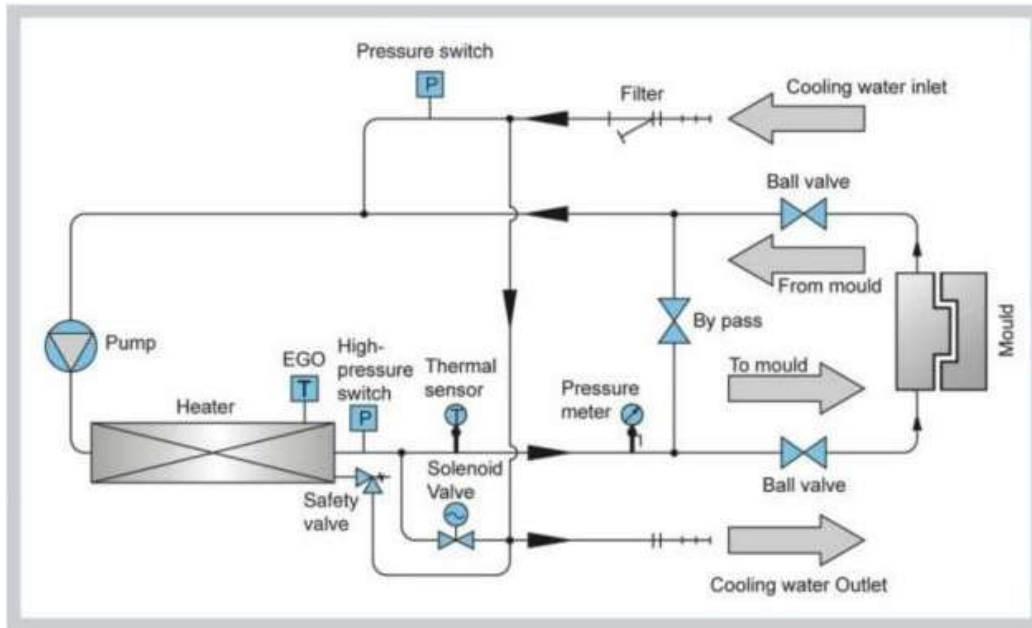


Fig. 2: MTC's water cycle.

The MTC inlet is taken from cooling tower outlet (which cools the temperature of water coming from process), and again supply to inlet or to the MTC after cooling.

The reasons of breakdowns during the running time of manufacturing process which are not visible are analysed and the implementations were made to control or minimise the reoccurrence.

As the cooling tower is situated at the outside of the plant so that it can also cool the hot water from the external source like air in the atmosphere. Cooling towers are vulnerable to a variety of contaminants that cause deposit formation, such as mineral scales and sludge or dust from air. Deposition interferes with heat transfer, increases corrosion rates, restricts water flow, and causes loss of process efficiency and production.

- As the outlet of cooling tower water is the inlet for the MTC which supply the water in mould hot water channels. The water which supplies in mould channels is contaminated with dust particle which block the channels up to 2 to 3 times in a week. If the channels block during the running process it disturb the product quality and unwanted rejection seems during process and also it disturbs the efficiency of process in the other machines. So to reduce this problem the extra water tank is made which is 6*6*6 in size, for the inlet outlet process which is only for the MTC and it is covered from the top. After this implementation, the frequency of the blocking of cooling channels reduced up to 20 -25 days. The result comes when we compare one of the machine who's process inlet and outlet is taken from the new tank and other machines from the cooling tower, it seems that the machine which had inlet and outlet process from the new tank have an improvement in the process efficiency compare to another machines it means the frequency of blocking of the channels is less when the inlet and outlet comes from new tank. Then after; all the connections for the process or MTC were made from the new tank, which seems results in increase in productivity at the month end.

The Figure 3 shows the statistics for the productivity increased after the implementation.

The machine 1 is connected to the cooling tower and the machine 2 is connected to the new water tank, the graph shows the scenario of the blocking frequency of the cooling channels which is also shows that the frequency of the blocking reduces in machine 2 which is connected to new tank.

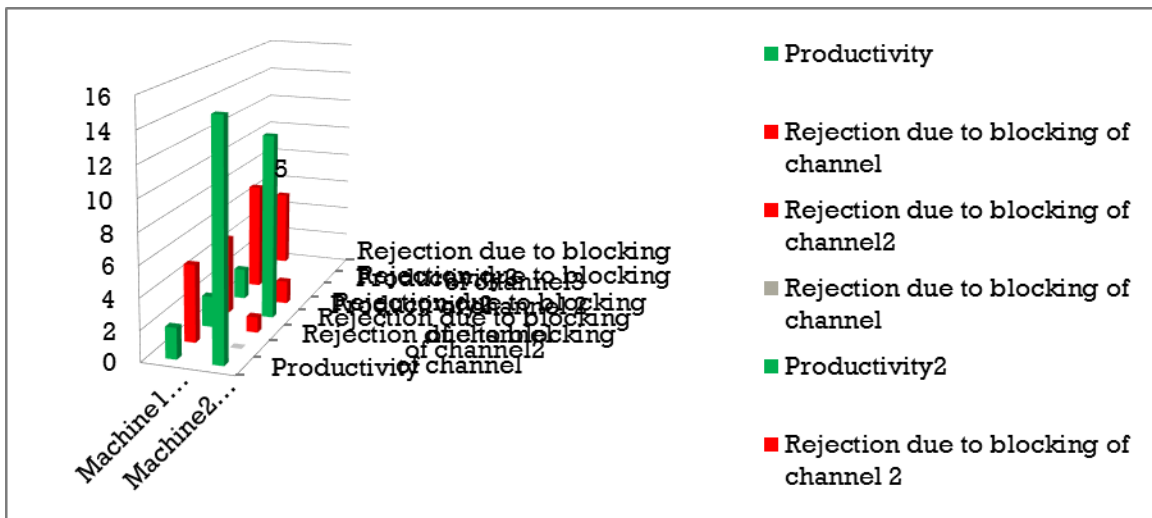


Fig. 3: Shows the frequency of the blocking channels in both of the machine; and also increases in productivity after implementation i.e. made new tank.

- It is also seems that at the time of the material feeding (HDPE) on the machine hopper, which is done manually by the operator of the machine; is the risky task to perform, as the operator has to climb above of the machine he can fall from top of the machine. It also seems that some time some amount of material fall at the ground at the time of manual feeding by the operator. As the material is very expensive, so even little amount of material should not to be wasted. So to avoid the accident as well as for material saving, it is necessary to installed the automatic conveying system which sucks the material from silo and feed it into the hopper which is located at the top of the barrel.
- The process get disturb when the operator changed the critical parameter of the process as he don't have sufficient experience on processing. Due to this the PLC of the machine is implemented and secure by the password, which is access only by the authorised person.

IV. RESULTS

The result shows that the risk of incident occurrence and the safety behaviour among the health of the workers in the factories is increasing day to day when the safety policies are adopted by the industry. The tools like competition in markets, efficiency in all phase are seems to be effective. Top management commitment was found to be more useful in order to manage safety in the workplace. Workers were adopting the safety policies and involving in the other activities, as they are getting motivation from top management. Safety increases after implementing the safe and clean technology. Due to the use of new technologies the risk decreased. Reduced risk in ergonomics problem due to automation in some of the machines, implementation of safety committees, machine guarding, etc. Increase in the productivity seems due to implementation of new strategies in the manufacturing process. The following shows the impact of the safety policies after applying to the industries.

- 1) The risk decreased due to due to applying automation during material feeding in the hopper, as the worker can slip or fall from the machine top area.
- 2) Risk decrease by the installation of the limit switch, which stops the grinding machine when the gate will open at the running time.
- 3) Risk decrease due to the use of overhead cranes at the time of mould maintenance.
- 4) Increase in productivity by implementing new strategies.
- 5) Risk decreased after providing the proper training, after following SOPs (standard operating procedure), updates the types of fire extinguishers in the production zones.
- 6) Risk decreased due to machine guarding for safety of machine valves, devices etc.
- 7) Risk decreased after regular testing of electrical connections.

V. CONCLUSIONS

The main contribution of this study is that workplace perspectives on safety and awareness on safety issues amongst the workers, recommendation like implementation in old technologies were put into practise. This study investigated on different phases that may influence safety management practices in the factory. The tools which were used for reducing the incidents occurring were discussed also with two example of the actual case of incident. If these tools are will be in practice then the positive outcome will seems towards safety.

Implementation towards the improvement of the manufacturing process efficiency was discussed and applied the new strategies. Some points were discussed below;

- 1) Controlling the wastage of the raw material and also operator safety by installed automatic conveying system.

- 2) Process efficiency improved after implementation that is made new water tank.
- 3) Security of the critical process parameter by password in old machine.
- 4) Change the type of the fire extinguishers.
- 5) Prepared the new strategies for workers safety.
- 6) Limit switch is installed in grinding machine for worker safety.

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