

IDENTIFYING AIR LEAK LOCATION WITHOUT MANUAL INTERVENTION TO AVOID HAND CRUSH INJURY

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Technology degree in Chemical Engineering

By

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**DEPARTMENT OF CHEMICAL ENGINEERING
SCHOOL OF BIO AND CHEMICAL ENGINEERING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **SRIKANTH G (38690013)** and **RAJU C (38690012)** who carried out this Project entitled **"IDENTIFYING AIR LEAK LOCATION WITHOUT MANUAL INTERVENTION TO AVOID HAND CRUSH INJURY"** under my supervision from June 2021 to October 2021.

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DECLARATION

We, **SRIKANTH G (Reg.No. 38690013) and RAJU C (Reg.No. 38690012)**,
hereby declare that this Project Report entitled “**IDENTIFYING AIR LEAK
LOCATION WITHOUT MANUAL INTERVENTION TO AVOID HAND CRUSH
INJURY,**” done by us under the guidance of **Dr.S.Sathish, M.E , PhD., Professor** at
Sathyabama Institute of Science and Technology is submitted in partial fulfillment of
the requirements for the award of Bachelor of Technology degree in Chemical
Engineering.

DATE:

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SIGNATURE OF THE CANDIDATES

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2. RAJU C

ABSTRACT

Safety is a first priority to each member whose working in Industries, so that we need to ensure the safety of each employees, and train up their attitude towards safe acts & Train them to take initiatives to eliminate unsafe conditions in working area. & This is our first priority & policy

We faced two major hand crush injury in our tyre building machine while checking air leakage by hand, hence we took a containment action to eliminate the risk by introducing Air leak detecting device by the brain storming & valuable ideas from our team at lowest cost.

Our device can sense air leak from any of the critical segments of machine part by the flexible sensing part without manual intervention. We can suggest the device for machines which are having most critical pneumatic assemblies.

ACKNOWLEDGEMENT

The satisfaction and elation that accompany the successful completion of any task would be incomplete without the mention of people who have made it a possibility. It is our great privilege to express deep gratitude and respect to all those who have guided us and inspired us during the course of the project work.

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CHAPTER 1

1. INTRODUCTION

Innovation age in the Indian tire industry has noticed a decent lot of ability and flexibility to retain, adjust and change worldwide innovation to suit Indian conditions. This is reflected in the quick innovation movement from cotton (support) corpse to superior outspread tires in a range of forty years. Globalization has prompted the connecting of the economies of the multitude of countries and along these lines significant Indian players in the tire business are seeking after worldwide systems to upgrade their seriousness in world business sectors. The current area extensively embraces an outline of the Indian tire industry through an assessment of its development patterns concerning creation, products and obtaining of innovative capacities.

1.1 KEY FEATURES

Key part are MRF, JK Tires, and Apollo Tires and CEAT, which represent 63% of the coordinated tire market. The other vital participants incorporate Modi Elastic, Kesoram Enterprises and Goodyear India, with 11%, 7% and 6 percent share separately. Dunlop, Hawk, Tire Partnership of India Restricted (TCIL), TVS-Srichakra, Metro Tires and Balkrishna Tires are a portion of the other huge players in the business.

At the point when the tire enterprises is for the most part overwhelmed by the coordinated ventures, the disorderly businesses is prevalent regarding bike tires.

The businesses are the significant purchaser of the homegrown elastic market. Regular elastic contributes 80% while manufactured elastic comprises just 20% of the item content in Indian tires. Obviously, around the world, the extent of regular to engineered elastic in tires is 30:70

The area is natural substance venture, with natural substance representing 70% of the complete expenses of creation

Complete creation figures in weight: 11.35 lakh MT and absolute creation of tires in all classifications: 811 lakh (2007-08)

95% for all traveler vehicle tires, 12% for light business vehicles and 3% for weighty vehicles (truck and transport) falls on Radialisation

Utilized and Retreaded tires are confined since April 2006

Bringing in of new tires and cylinders are permitted without limitations, aside from outspread tires in the truck/transport portion which has been put in the confined rundown since November 2008

1.2 INDUSTRIAL SAFETY VISION.

Yearly thousands of industrial accidents are being happening & these things realize us the importance of safety rules & Safe acts with technological improvements in manufacturing. Day by day our dangers in human life are keep on increasing, In order to avoid those accidents, each employees should have the awareness on industrial safety principles & Unsafe areas of that industry, Here we are going to discuss some of the reasons why industrial safety is important:

- For the safety of employees in industries
- To protect the environment against damage from industrial accidents.
- To protect the businesses against serious losses from damage to the industries & machines.
- For eliminating unsafe work & product loss
- For creating awareness of the safe practice & In-depth knowledge on dangers of machineries
- For providing basic safety training with well-established techniques for safety systems.

- For assisting employees and technicians to support and participate in the safety culture activities at their workplace with good background knowledge on safety.

Because of priority on safety rule, all industrial persons should have enough knowledge on safety aspects of man, machine & materials & other infrastructures to avoid major & minor accidents or incidents. So Every employee must know the safety measures even before he operates the machine or equipment's & It should be governed by the higher authority of the coYearly a large number of modern mishaps are being going on and Those things acknowledge us the significance of security rules and Safe demonstrations with innovative enhancements in assembling. Step by step our risks in human existence are continue to increment, to stay away from those mishaps, every representatives ought to have the mindfulness on modern wellbeing standards and Hazardous spaces of that industry, Here we will talk about a portion of the justifications for why modern security is significant:

- For the security of workers in businesses
- To shield the climate against harm from modern mishaps.
- To shield the organizations against genuine misfortunes from harm to the ventures and machines.
- For wiping out risky work and item misfortune
- For making attention to the protected practice and inside and out information on risks of hardware

As a result of need on security rule, all modern people ought to have sufficient information on wellbeing parts of man, machine and materials and different foundations to stay away from major and minor mishaps or occurrences. So Every representative should realize the security gauges even before he works the machine or hardware's and It ought to be administered by the more significant position of the concern.

CHAPTER 2

2. PROCESS FLOW

2.1 MIXING

Vulcanizable rubber cannot be used without compounding. Various additives like curing agents, protective agents, reinforcing agents, cheapeners and other process aids has to mixed with the rubber or rubber blend “to make a homogenous mass of all these ingredients, which will process satisfactory and on Vulcanization will give the product can able of give the desired performance, at lowest expenses of resource, time & energy.”

Because of the visco elastic nature and very high viscosity of rubber, power intensive machinery like banbury mixers is necessary to attain the mixing of additives into the rubber. The ingredients are in phase of liquids, solid powders or solid agglomerates.

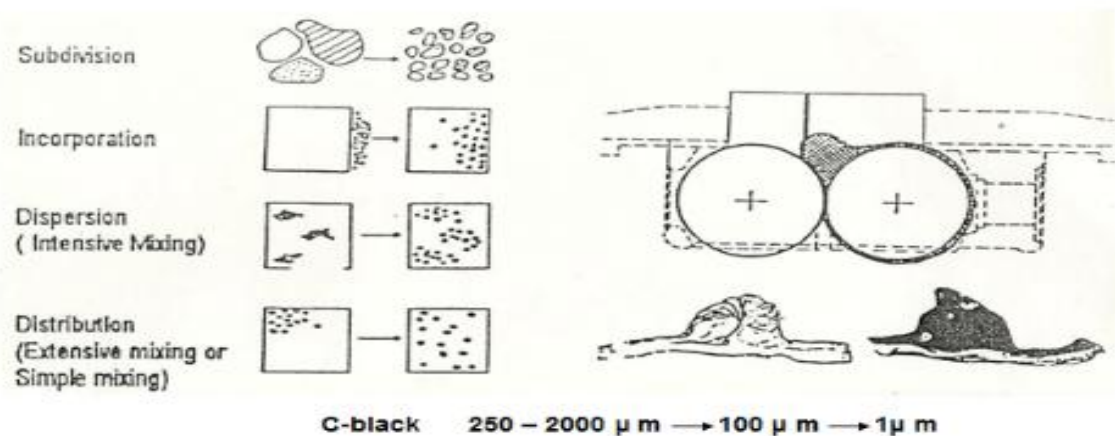


Figure 2.1 : Compound Mixing

The mixing of solid chemicals into the solid rubber occurs in state. During subdivision large aggregates or agglomerates are cutting down into smaller particles suitable for disperse into the rubber.

For example, carbon black particles which have size of 250-2000 μm get broken down into amorphous form with dimensions of the order of 100 μm . To attain the coherent mass, the amorphous particle has to mix with the polymer

During mixing, shear creates within the rubber which tends the rubber into shearing stress mass which overload in turn on these amorphous and breaks these into their utmost fine size which in case of carbon particles is of the order of about 1 μm . in size. This phase is also known as homogenized mixing

Dispersion in micro molecular level is “the moving of the particles from one point to another, without changing the shape of the fine powder to maximize randomly in mixture”. The particles mixing is a very slow process.

Another method of minimizing incorporation time is to use powdered rubbers. In a simple ribbon blender, the powdered rubbers can be mixed with the other compounding materials.

The powdery mass is enough in another machine and then fed to the banbury mixer. Hence the large surface area of the powdery rubbers, the insertion into rubber is very fast and only a very short cycle of banbury mixer, which is enough to attain the mixing.

Even after all mixing of all chemicals & polymers, dispersion/distribution of the ingredient is incomplete. Good dispersion is comparably easy to achieve by paying proper attention to cutting and folding operations on a mixing mill or by just long time mixing cycle in a banbury mixer.



Figure 2.2 : Rebuild Farrel F270 Mixer from Pelmar Engineering Ltd

Dispersion is depends upon the shear stresses creates within the rubber compound and hence good dispersion may not be achieved by long time mixing Careful considering is necessary not only as regards the time of the mixing cycle but also for the order of addition of ingredients to the rubber.

Viscosity reduction occurs during mixing and is important for smooth processing of the stock.

Degree of dispersion of carbon black influence the physical properties of the cured rubber compound. Undistributed carbon black which is above 9 microns act as gritty particles. Under tension, cracks develop at these spots.

Demerit properties like tensile strength, tear strength and consequently abrasion resistance will get reduced as the degree of dispersion also reduce.

2.2 EXTRUSION

Extrusion process is nothing but the injection of polymers continuously within a screw along with high temperature & Pressure, which make the polymer softened & compacted and finally it is injected through the die as per our need.

In tyre manufacturing, Extrusion is an essential operation. Some tire

Components like the tread and the sidewall have specified profile size that can only be get into the process of extrusion.

The major tire parts that are formed by extrusion are the sidewall, Inner liner, Bead cushion, Belt edge filler, Shoulder cushion, Carcass, Tread cushion and the

tread. These components are constructed by forming two different specific compounds into tread profiles by putting the rubber through an extruder. Other parts including apex. Extruders can produce tread at long dimension, which are cooled and cut into the length as per our requirement



Figure 2.3: Tyre Component Extruding Machine

2.3 CALENDERING

Calendering is one of the oldest rubber processing technologies. This is the process in which the textile materials covered by the rubber compound by mechanically

Rubber Calendering process is classified into two based calendaring material. Our operation should be consistent & Continuous

Rubber calendar is used to perform Rubber calendaring and it performs various functions. This is a heavy-duty machinery consisting of two or more rolls that rotate in opposite directions.

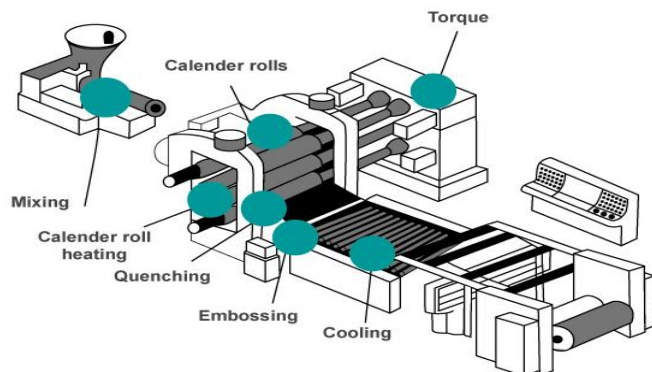


Figure 2.4 : Diagram of Calendaring Process

2.4 BEAD WINDING.

A majority of helically twisted tire globules are made by twisting them on a shaping wheel at two foreordained strain levels. The pressure levels are produced by a slowing down pulley and attractive molecule brake related to a programmable rationale regulator. The initial not many turns of wires are made at a moderately low pressure level. Ensuing turns are made at a higher strain level. The lower pressure level adds to longer existence of the framing wheel gathering.

This development identifies with a technique and contraption, for shaping tire dabs, and all the more especially to a strategy and mechanical assembly for framing a majority of tire globules of one or the other lash or hex design while diminishing wear and coming about personal time on the, dab making device.

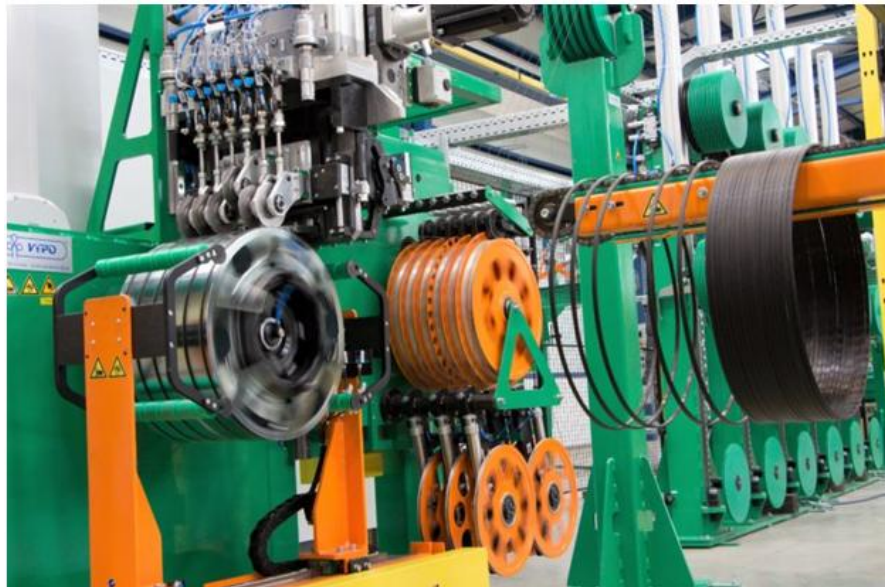


Figure 2.5: Bead Winding Machine

For example, globule making machines, for instance, those uncovered in U.S. Pat. No. 2,902,083 consolidate a molding drum concerning which a wire is wrapped a larger part of times to outline the spot. The wire is maintained with under tension to get explicit execution attributes in the tire spot. Sadly, maintaining with the basic tension in the wire while molding the globule will

overall obliterate explicit pieces of the touch making contraption in a tolerably short period of time, requiring expensive get-away and fix.

In current practice, every globule to be manufactured has its own particular wire acquainted with the touch making gadget. A flexible covering is removed onto each wire at the extruder and each individual versatile covered wire is facilitated to the spot making contraption.

2.5 TYRE BUILDING MACHINE

A Tire Building Machine (or TBM) is a vital tire hardware that gathers all parts like track, sidewall, inward liner, body employ, dab, and string body together to fabricate green tires. Each cycle is customized to do the different tasks and simultaneously, to give a reasonable structure cycle.

Motorization of TBM especially for quicker synchronization of machine regions, including let-off, feed shaper, splicer, and wind-up; achieve better strain and edge control, ergonomics and overseer security, higher precision of cut to-length independent of machine speed, slip amendment among belts and tire building material; and capacity to set changes in tire estimations with assumptions for movements in deficiency assurance would be more careful.

Tire creators are reliably connected with either green field or hearty hued field exercises to satisfy their creating business area needs. They demand from you the most un-set-up an optimal chance for TBM compromise, mechanical and electrical improvement and wiring. Driving TBM producers like VMI have advanced models for process spans of 36 seconds, full hands-off/eyes-off creation, with customized unite really checking out systems, a robot for green tire departure, relationship with a green tire transport structure, apexed spot unstacking and stacking.

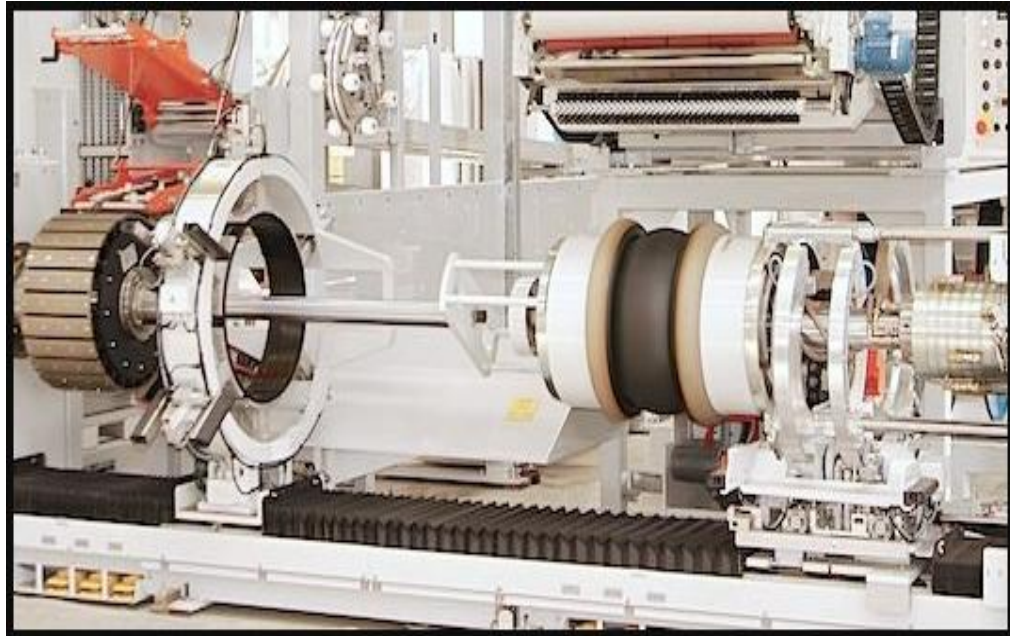


Figure 2.6: Tyre Building Machine

2.6 CURING / VULCANIZING TYRES

Restoring is the method involved with applying strain to the green tire in a form to give it its last shape. This is customarily the bottleneck of each tire maker. For restoring presses, the accentuation would be on upgrading the interaction effectiveness and decreasing the energy utilization.

One noticeable pattern among tire makers is to deliver more modest parcel sizes. This will require more forms and more continuous shape changes. Speedy shape change gadgets will turn into a one of a kind offering highlight for hardware developers to contend on. Driving makers like HF have models that accomplish the shape change-time in under 30 minutes.

Pressure driven restoring presses are liked (over its mechanical partners) since they have repeatable precision throughout their life time. Furthermore, they offer higher yield which monitors the tire makers process cost. To further develop the cycle effectiveness and lessen relieving time, post fix inflators are wanted.

Relieving presses involve a huge land space inside a plant. So when the relieving press makers offer hardware with high-effectiveness, tire makers save significantly – not just by lessening the interest in amount of apparatus required (CAPEX) yet additionally as far as space usage. Jacob Peled, Executive Chairman of Pelmar Engineering, anticipates that split restoring (track and body independently) will ultimately rule the business.



Figure 2.7 : Tyre Curing Press

CHAPTER 3

3. PROBLEM BACKGROUND

As a one of the central part in tire industry, we wanted to give a protected workplace to our representatives; Hence we took more drives and advancements in wellbeing throughout the previous 10 years, Even however we had a significant mishaps in one of our specific activity

Our tire building machine is completely constrained by mechanical activity with pneumatic control, So the hardware having "n" no of air passing/releasing zone, In request to confirm the controlled activity of gear, our administrator needs to check air spill area physically manually.

In view of the manual intercession while checking air spillage, we confronted in excess of 500 quantities of close to miss occurrences and 50 no's of minor hit wounds.

Finally we confronted Two significant hand squash wounds as a mishap achievement at the year 2019 and 2020 brought about right and left hand center finger and ring finger got broken.

Mishaps in the work environment can immensely affect any business, as they can cause loss of efficiency, decrease of deals, low staff spirit, loss of notoriety – and to say the least – conclusion. In the event that any laborer experiences a physical issue during their business, they are qualified for laborers' pay.

3.1 2019 - ACCIDENT

Date & Time of accident	: 21.07.2019 & 6.15 AM
Location of accident	: Tyre building machine C5
Type of accident	: Lost time injury
Part of body got injured	: Right hand index & middle finger
Type of injury	: Fracture on right hand
Total period of service of injured person	: 8 Years

Description of Accident :

Employee During tyre building operation ,While checking air leak in bladder adaptor forward/backward cylinder, suddenly bladder adaptor unit came backward and Right hand index & middle finger got crushed between machine frame & bladder adaptor unit with more bleeding

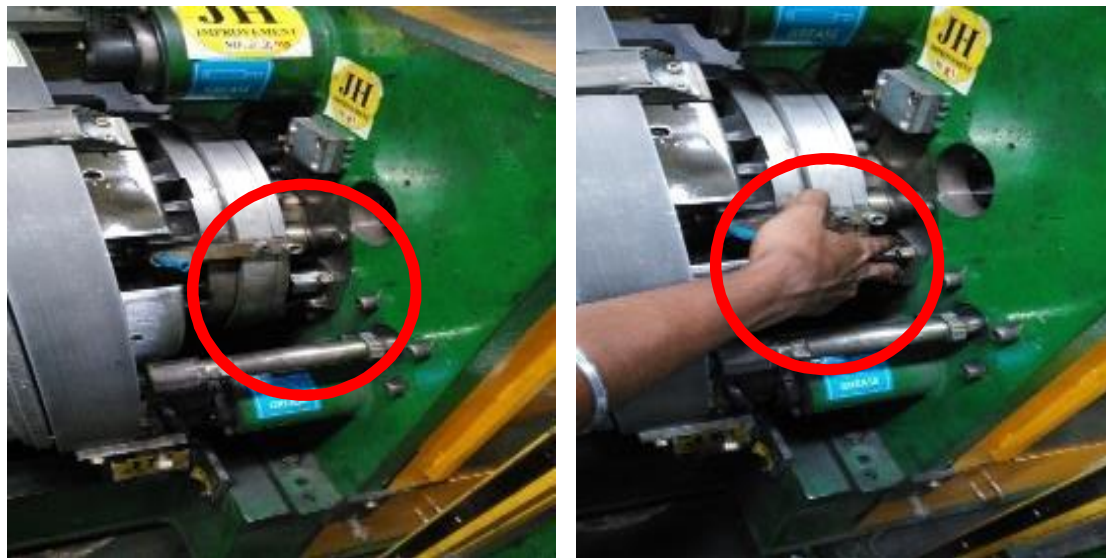


Figure 3.1: Checking Air Leakage Manually (2019 Accident)

3.2 2020 - ACCIDENT

Date & Time of accident	: 26.09.2020 & 10.45 AM
Location of accident	: Tyre building machine C2
Type of accident	: Lost time injury
Part of body got injured	: Left hand palm
Type of injury	: Fracture on left hand
Total period of service of injured person	: 7 Years

Description of Accident :

Employee while checking air leakage in head stock turn-up assembly, his left hand got stuck between the cylinder frame and sensing plate due to operation of pneumatic cylinder

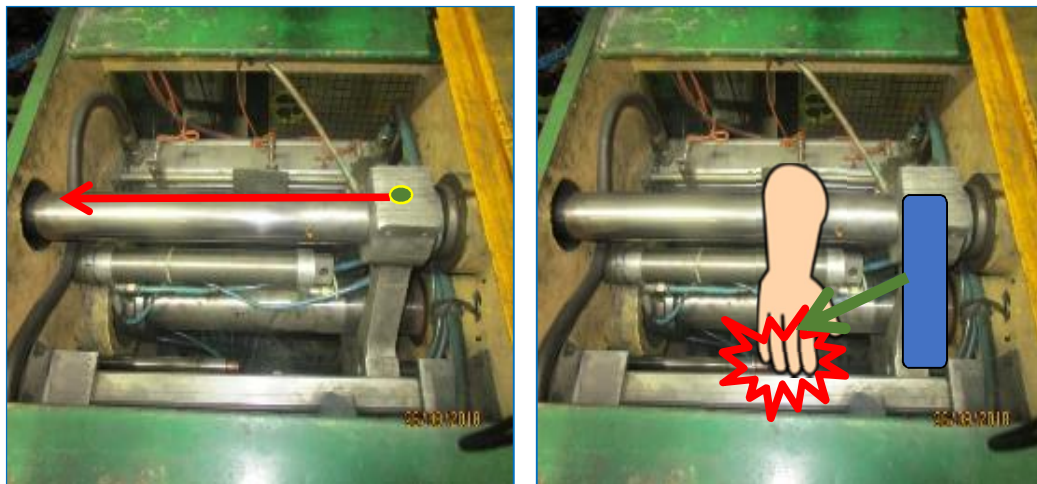


Figure 3.2: Checking Air Leakage Manually (2020 Accident)

3.3 LAST 10 YEARS OF NEAR MISSES & MINOR INJURIES

Table 3.3: Last 10 Years of Near Misses & Minor Injuries

No of near Miss happens in last 10 yeas			
Years	No of machines	No of Minor hit injury	No of near misses
2010	2	1	15
2011	2	2	18
2012	2	3	19
2013	2	2	23
2014	4	5	46
2015	4	4	47
2016	4	6	43
2017	4	4	46
2018	6	9	86
2019	6	8	82
2020	6	8	83

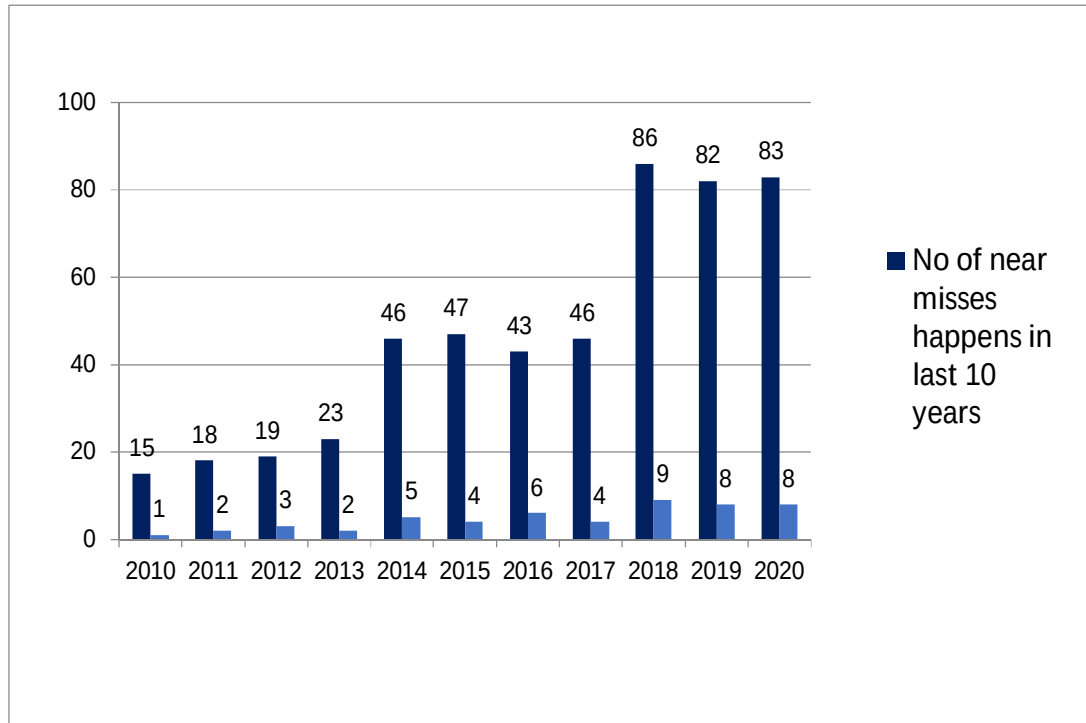


Figure 3.3 : Near Misses & Minor Incidents Trend for the Last 10 Years

3.4 IMPACT OF INDUSTRIAL ACCIDENTS

Mishaps in the work environment can enormously affect any business, as they can cause loss of usefulness, decrease of deals, low staff assurance, loss of notoriety – and best case scenario – conclusion. On the off chance that any laborer experiences a physical issue during their business, they are qualified for laborers' remuneration.

For instance modern mishaps in Spain tremendously affect the wellbeing of laborers and on the economy by and large, which is reflected in the passing, handicap and individual enduring of laborers on one hand, and in nonattendance from work, loss of usefulness and wellbeing costs on the other. The overall information given by the Ministry of Labor and Social Affairs give a thought of the greatness of the issue: each year more than 1 million modern mishaps happen, of which around 660,000 include time off work, more than 10,000 are not kidding and around 1,000 are lethal. All in all, consistently roughly one out of eight laborers experiences some sort of mishap, and three to four specialists bite the dust each day. Both the yearly figures and the latest things are a reason for concern. Somewhere in the range of 1990 and 1997 there were right around 5 million non-genuine modern mishaps including time off work, 92,429 genuine mishaps and 9,220 lethal mishaps. In 1990 there were 696,703 modern mishaps including time off work, and 1,446 passings. The figures diminished logically up to 1993, however in the course of the most recent couple of years the pattern has been switched and there has been an unmistakable expansion in the mishap rate once more. Over the most recent two years there have been increments of 8.8% and 10.2% individually. There was likewise a descending pattern in deadly mishaps somewhere in the range of 1990 and 1996, however somewhere in the range of 1996 and 1997 the number expanded by 8.7%, and in 1998 the figure remained essentially something similar. These patterns are clear in the development, administrations and rural areas on account of complete mishaps, and in the administrations and development areas on account of lethal mishaps.

As per the third public review of working conditions completed in 1997, the two areas in which laborers see most obviously the danger of mishaps are

development (87.4%) and metalworking (81.9%). Comparable to the sort of business contract, 58% of mishaps include laborers on transitory agreements and 49% influence laborers with short of what one year of administration in the organization. Additionally, laborers on transitory agreements are over two times as prone to experience a mishap as those on long-lasting agreements, particularly in the development area. This more serious danger influences all mishap types, all ages, both genders and all areas of the economy.

The figures are similarly persuasive on the monetary effect of mishaps at work. Somewhere in the range of 1990 and 1997 130,244,200 working hours were lost because of modern mishaps, that is, around 15% more than the functioning hours lost due to strikes. In 1994, 58% of the mishaps brought about at least three days off work, and the all out financial expense is assessed at around ESP 2,200 billion, or around 3% of Gross Domestic Product. In 1997 there were 227,800 retirements because of modern mishaps and work related sickness with an expense for the federal retirement aid arrangement of more than ESP 245 billion, notwithstanding the clinical and drug costs. For that very year, the complete financial expense of modern mishaps was assessed at ESP 2,500 billion.

Notwithstanding, given the constraints in the current wellsprings of data, the above information ought to be considered with alert. To begin with, since the revealing framework doesn't permit the checking of genuine modern mishaps, the quantity of deadly mishaps has most likely been thought little of by somewhere in the range of 6% and 9%. Also, the current data framework doesn't consider the mishaps of laborers not covered by the government backed retirement framework, it overlooks the quantity of mishaps that happen in the "underground" economy and it presumably thinks little of the quantity of slight mishaps. Second, there is no satisfactory depiction of the reason and kind of injury experienced in the mishaps, nor of their geographical area in regions less than a region. Third, in spite of the fact that information on modern mishaps are for the most part accessible in huge organizations, there is undeniably less data in little and medium-sized organizations. At last, there is next to no data on pertinent monetary or social factors. For instance, "just four out of 10

organizations guarantee to have information on the yearly financial expense of modern mishaps happening in their working environment". Notwithstanding the absence of exact data on direct expenses like insufficiency for work, benefits, pay or wellbeing costs, there is additionally an absence of data on roundabout expenses like harm to hardware, preparing of substitution laborers and loss of seriousness. Moreover, the absence of data on the length of the agreements among mishap casualties in unreliable business forestalls the exact investigation of agreement term and mishap chances.

3.5 LEARNING FROM INCIDENTS HAPPENED IN TBM

One of the major focus areas for the Chennai plant is ensuring safest workplace for the employees. If we take action for the first some incidents, the accidents were eliminated for the upcoming years. In last two years, two LTI incidents occurred in our tyre building process. Both the accidents & the past incidents were occurred while checking the air leakage in the machine. The process involves manual intervention to detect the location of air leakage in the machine. To overcome this manual intervention we have been searching for advanced technologies to detect the air leak location

CHAPTER 4

4. OBJECTIVES

As we discussed so far, we can conclude that we need to sense the air leak location with advanced Technology tool to avoid hand crush injury from our tyre building machine to avoid major hand crush injury in future.

4.1 ABOUT MACHINERY

A Tire Building Machine (or TBM) is a basic machine that gathers all tire parts like track, sidewall, internal liner, body employ, globule, dot pad, Sets of belts, Belt cushions and string body together to assemble green tires. Each cycle is modified to complete the different tasks and simultaneously, to give a reasonable tire building activity. and We have the different strides of gathering tasks and 10 no. of gatherings

4.2 VARIOUS STEPS OF OPERATION

- Let-off
- Feed cutter
- Splicer
- Wind-up
- Tyre building drum assembly
- Auto splice checker
- Green tyre remover

We have 10 different assemblies & each assemblies & steps of operations having “n” no. of critical pneumatic connections. So that there is a possibilities of air leakage from those assemblies.

4.3 CHALLENGES FACED

- If we take action in one assembly, can't be deployed in other sets of assemblies.
- We have internally tried to modify the checking procedures but we could not able to create a robot system to handle this issue.
- We tried with external agencies for the advanced technique to detect the location of air leak but it is not feasible for our process & the cost was very high
- We discussed with other plant technicians to sort out this issue, But we could not attained the solution
- We were able to take only containment action for the issues

CHAPTER 5

5 IDEA GENERATION & SOLUTION

5.1 INNOVATIVE IDEA

Develop an air leak location detection system in-house which should detect air leakages in all the assemblies. The tool should be flexible and reach through confined space.

Our team developed by brain storming & came out with the innovative idea to detect the location of air leak using simple electrical circuit contains probe and LED indication.

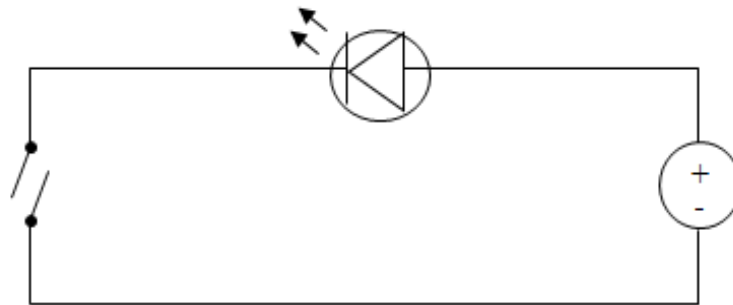


Figure 5.1 : Electrical Circuit

By using this device in the machine parts, if there is air leakage, nip portion will get contact each other and the LED will glow.

With this idea, we can able to detect the location of air leaks without any manual intervention.

5.2 REALIZATION

5.2.1 Prototype Device



Figure 5.2: Device Rough Model

5.2.2 Final Product



Figure 5.3 : Final Product

5.2.3 Before & After Condition Diagram

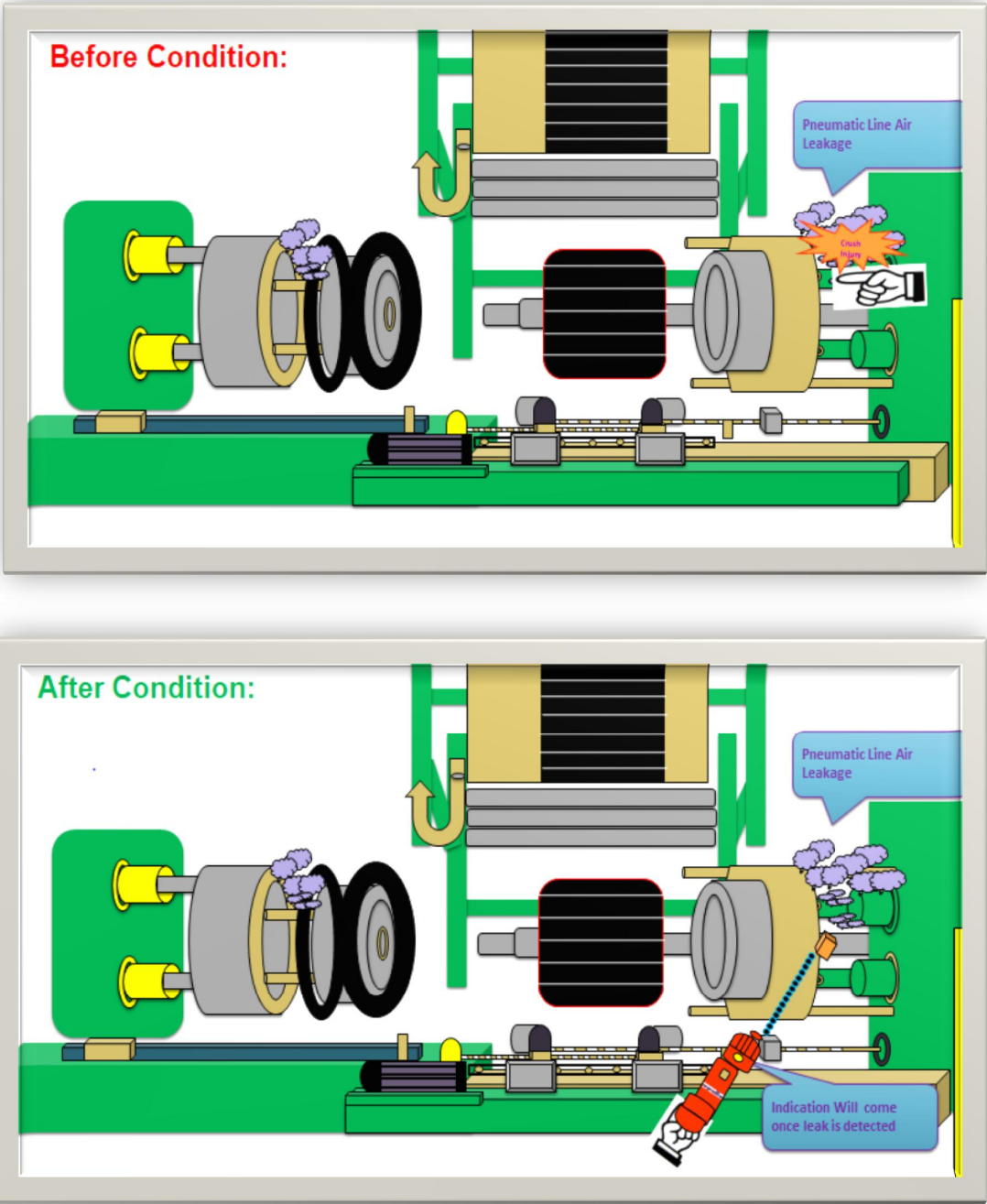


Figure 5.4 : Before and After Condition Diagram

5.2.4 Before & After Condition In Reality

BEFORE



Figure 5.5 : Checking Air Leakage Manually

IMPROVED CONDITION AFTER IMPLEMENTATION

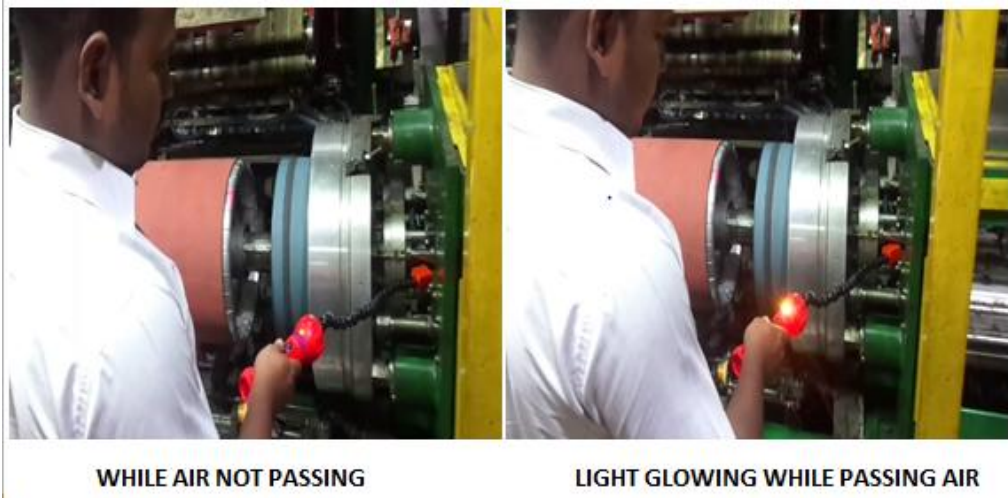


Figure 5.6 : Sensing Air Leakage using Air Leak Location Detector

CHAPTER 6

6. CONCLUSION

After implementation of Air detecting device our team self-confidence developed on each problem solving task & some other horizontal improvements are achieved by the team

6.1 ACHIEVED IMPROVEMENTS

- Unsafe act eliminated – Hazard elimination
- By eliminating the manual intervention, Fatigue reduced.
- Bunches of Near miss & minor & major accidents happened for the last 10 years were eliminated
- Lost time of Man hours eliminated
- Horizontal deployment planned for all other process in plant.

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