

Smart Manufacturing Solutions for Rubber Industries

Introduction

According to Global Industry Analysts, the global tire industry is slated to reach 2.5 billion units of production by 2022. This growth equation further stands to be revolutionized by the emergence Realtime Vulcanisation monitoring systems

We know that for most of tire manufacturing and rubber industries vulcanization was an important step also during production it become essential and challenging to monitor and log real time critical curing parameters for analysis and improving the quality, performance by which overall product becomes much stronger, more flexible, and more resistant to heat and other environmental conditions.

Challenges

- ✓ Reduce the uncertain raw material costs and operational inefficiencies
- ✓ On time delivery of the operational and supply chain demands
- ✓ Connecting and capturing data from legacy and silos machines on single platform
- ✓ Minimise energy losses
- ✓ Achieve high performance
- ✓ Manufacture best quality products
- ✓ Ensure Operational and Environmental Safety

Step towards Smart Manufacturing

IIoT plays an important role for providing the desired solution to the industries bringing altogether running silos system online and capturing the parameters of interest from the vulcanization machines.

Some of multi fold benefits of the Vulcanisation Monitoring System(VMS) are:

- ☐ Monitor the real time curing parameters which further helps to improve curing process
- ☐ Complete Process Traceability and Transparency
- ☐ Track use of consumables, and direct and indirect material availability.
- ☐ To improve the curing process desired Control over the interest parameter such heating temperature and pressure can be achieved
- ☐ To log the batch wise production data
- ☐ Determine the mechanical properties of the tire after post curing
- ☐ Track and Reduce the rejections losses
- ☐ Track OEE
- ☐ Motoring of vulcanisation machines condition and performance
- ☐ Root cause analysis from the captured data for resolving performance and quality issues

Technological benefits

Modern technology plays important role by providing value driven solutions and to achieve the desired system goals for the vulcaniser

- ☐ Real Time Sensing Technology
- ☐ Fully Customisable web-based, highly scalable solution
- ☐ AR and VR features
- ☐ ML and Analytics

Vulcanisation Monitoring System

The VMS system can easily be configured with the multiple sensors such as temperature, pressure and integrate with PLCs or IoT gateway devices so that the captured data from these sensing sources can be posted to cloud platform by using standard industrial protocols.

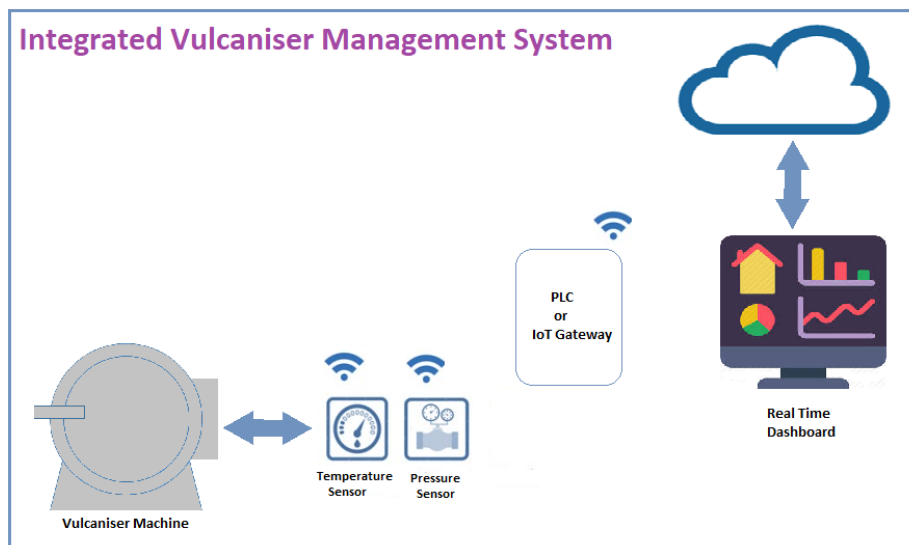
Integrating Software Modules and Services

- ☐ **Real Time Dashboard**
The dashboard shows the real time status of various sensors connected to the vulcanization machines. It also indicates the various parameter of interest and its graphical chart for analysis and monitoring purposes
- ☐ **Planning Module**
This module used to perform Production planning which includes mapping of trollies and employee with respect to vulcanization machines so that the stream line operations can be performed
- ☐ **Employee Shift Management Modules**
This module tracks the employee shift data which further helps to evaluate the performance of individual employee
- ☐ **Preventative Maintenance**
This module takes care for maintenance activity performed on the vulcanisation machines, regular maintenance ensures increase in asset life and avoid losses occurs due to breakdown thereby increase in uptime.
- ☐ **Escalation Module**
This module escalates the issues unresolved by the employee to the respective higher management and authorities. The escalation module evaluates MTTR and MTBF which ensures maximum uptime, optimized performance and best quality
- ☐ **Alert & Notifications Modules**
This module is used to generate alerts and notification with help of SMS and Email to the respective authority so that timely actions can be taken to prevent breakdown and improved quality production
- ☐ **Reports**
This module can used to draw various reports which can preserves the interest of Operator, R&D department and Management
 - ✓ Daily Production
 - ✓ Plan Vs Actual Production
 - ✓ Rejection reports

- ✓ Temperature log and Pressure logs
- ✓ Machine vs cycle log
- ✓ Number of Shots i.e. no of cycles run reports
- ✓ Cycle wise upper and lower die temperature log report
- ✓ Cycle wise hydraulic pressure log report
- ✓ Cycle wise curing time log report

Integrated VMS System

VMS system involves integration of Temperature sensors, Pressure sensor with PLCs or Gateway connected with standard industrial protocol



VMS Dashboard

Production Monitoring Dashboard

The production monitoring dashboard used monitor the real time parameters of interest, captured from various sensors connected to vulcaniser machine, these parameters captured from multiple locations of connected vulcanisers machines and displayed on to the PVMS system for visualisation and analysis purposes.

Vulcanizer Dashboard

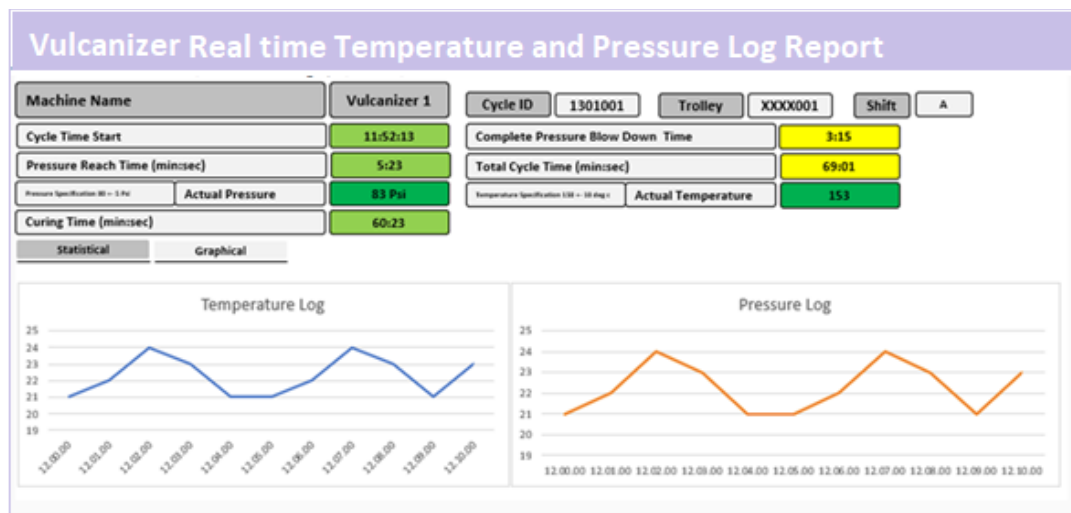
Machine Name		Vulcanizer 1							
Plan Qty	1500	Pressure Specification 88 ± 5 Psi	Actual Pressure	83 Psi					
Total Production Achieved	450	Curing Time (min:sec)	60:23						
Rejection Quantity	85	Complete Pressure Blow Down Time	3:15						
Cycle Time Start	11:52:13	Total Cycle Time (min:sec)	69:01						
Pressure Reach Time (min:sec)	5:23	Temperature Specification 150 ± 10 deg	Actual Temperature	153					
Statistical		Graphical							
Sr No	Date	Shift	Supervisor Name	Cycle ID	Trolley	Act Qty	Rej Qty	Avg Pressure	Avg Temperature
1	11/11/18	A	ABC XYZ	1301001	XXXX001	225	25	200	196
2	11/11/18	A	ABC XYZ	1301001	XXXX001	225	25	200	196
3	11/11/18	A	ABC XYZ	1301001	XXXX001	225	25	200	196
4	11/11/18	A	ABC XYZ	1301001	XXXX001	225	25	200	196
5	11/11/18	A	ABC XYZ	1301001	XXXX001	225	25	200	196
6	11/11/18	A	ABC XYZ	1301001	XXXX001	225	25	200	196
7	11/11/18	A	ABC XYZ	1301001	XXXX001	225	25	200	196
8	11/11/18	A	ABC XYZ	1301001	XXXX001	225	25	200	196
9	11/11/18	A	ABC XYZ	1301001	XXXX001	225	25	200	196

Reports

The VMS system comes with inbuilt reporting module however as per the requirement we can also develop custom reports of desired interest

Graphical Report: Vulcaniser Real time Temperature & Pressure Logs

This report shows the graphical representation of temperature and pressure captured in real time from vulcanisation machine during curing process



The ROI

With proper tuning of the following factors ensure management to achieve their predefined goals in time and further leads them towards reaching ROI and thereby the profitability. The VMS system implementation in rubber industry ensures yielding a 4 – 5% improvement in plant EBITDA with a payback period on a project of less than one year.

a) Efficient and Effective Production Management

The system can track production planning and batch data. Also, we can assign trolley to vulcaniser for loading and unloading. The system overall improves the production planning process and on timely production is achievable.

b) Track Consumables

The system ensures complete process traceability using product genealogy, right from mixing to storage. Thus, the consumables can be tracked, measured, analysed, and control through the curing process thus by minimising the usage of consumables and indirect materials reduces the significant material cost.

c) Completely Automated System

With the implementation of PVMS system brings automation by minimising the manual efforts and hence employee and management can spend their valued time on other key activities in the industry. Further automation ensures complete process traceability and transparency

d) Increase in Asset Life and Overall Performance

The system integrates various modules such as Planning, Employee Shift Management, Preventative Maintenance and Escalation helps to improve the

productivity of overall system and also due to timely maintenance activity the overall health and life of assets can be increased

e) Improvement in Product Quality

The system can track the batch wise rejection which further can be used find the causes of rejection of particular batch manufactured to improve the production quality

f) ML & Data Models can be constructed

Since the system captures data from the various sensors sources connected to the vulcaniser machines the data once captured enables management and R&D team with huge scope to detect anomalies, pre detects defects, develop desired data model of interest to achieve the optimised planning, high performance, best quality with minimum overall energy losses, minimise maintenance activity and increase in asset life.

With the availability of Curing data such as heating temperature, curing time and preheating temperature several model and simulations can be designed which overall improves the vulcanisation process

Conclusion

Smart manufacturing ensures process traceability, safety work environment, get production insight, achieve optimised performance, improve product quality and on time delivery.



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