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Design And Manufacturing Of A Conveyor Cleaning Unit For Chain Polish Conveyors

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ABSTRACT :

This paper presents the design and manufacturing process of a conveyor cleaning unit specifically tailored for chain polish conveyors. The primary aim is to address dust contamination, improve operational efficiency, enhance product quality, and achieve cost savings. The unit integrates a Tampico fibre brush and a Keyence Mini Compact SJ-LF static eliminator. Significant improvements were observed in dust reduction, operational uptime, product quality, and cost efficiency, validating the effectiveness of the cleaning unit in a high-precision manufacturing environment.

Keywords: Conveyor Cleaning Unit, Chain Polish Conveyor, Dust Control, High-Precision Manufacturing, Tampico Fiber Brush, Static Eliminator, Operational Efficiency, Product Quality, Cost Savings, Maintenance Reduction, Industrial Hygiene

Introduction :

Conveyor systems are the backbone of modern manufacturing operations, playing a critical role in the efficient movement of materials and products across various stages of production. From automotive and electronics to food processing and pharmaceuticals, conveyors are indispensable in ensuring streamlined processes, reducing manual handling, and boosting overall productivity. Among the various types of conveyors, chain polish conveyors are particularly notable for their application in high-precision manufacturing environments, where the cleanliness and condition of the conveyor are paramount to maintaining product quality and operational efficiency.

One of the persistent challenges in using conveyor systems, particularly chain polish conveyors, is dust contamination. Dust can originate from multiple sources, including the materials being transported, the ambient environment, and the wear and tear of conveyor components. In high-precision manufacturing, such as electronics or pharmaceuticals, even minute particles of dust can cause significant defects or failures. Therefore, effective dust control is critical to ensuring the high standards required in these industries.

Importance of Dust Control in Manufacturing

The presence of dust in manufacturing environments can lead to several issues, including product contamination, mechanical wear, increased maintenance downtime, and health risks for workers. Dust particles can accumulate on conveyor surfaces and the products being transported, leading to defects and compromised quality. In industries where precision and cleanliness are crucial, such as semiconductor manufacturing or medical device production, dust contamination can have severe consequences, including product recalls and damage to the company's reputation.

Moreover, dust can interfere with the mechanical operation of conveyors, causing wear and tear that necessitates frequent maintenance and leads to unexpected downtime. This not only disrupts production schedules but also incurs additional costs related to repairs and parts replacement. Ensuring a clean and safe working environment is not only a regulatory requirement but also a key aspect of maintaining a productive and motivated workforce. Dust control, therefore, plays a crucial role in maintaining both operational efficiency and product quality.

Problem Statement :

The main problem addressed in this project is the significant dust contamination experienced on chain polish conveyors, which impacts product quality, operational efficiency, and maintenance costs. Traditional cleaning methods have proven insufficient in effectively managing dust levels, necessitating the development of a specialized conveyor cleaning unit to address these challenges.

Objectives of the Project

The primary objectives of this project are:

1. Design and Develop a Cleaning Unit: Create an effective conveyor cleaning unit specifically for chain polish conveyors that can significantly reduce dust contamination.
2. Improve Operational Efficiency: Enhance operational efficiency by reducing maintenance downtime and associated costs.
3. Enhance Product Quality: Minimize defects related to dust contamination, thereby improving overall product quality.
4. Achieve Cost Savings: Reduce maintenance expenses and increase productivity, resulting in significant cost savings.
5. Design Considerations for the Cleaning Unit
6. Several key design considerations were identified to develop a solution that addresses dust contamination effectively. These considerations include the choice of cleaning materials, the integration of static elimination technology, and the overall configuration of the cleaning unit to ensure it can be easily integrated into existing conveyor systems.

Cleaning Materials: The choice of cleaning materials is crucial for effectively removing dust without damaging the conveyor or the products being transported. Tampico fiber brushes were selected for their durability and effectiveness in capturing fine dust particles. Tampico fiber, derived from the agave plant, is known for its resilience and gentle cleaning properties, making it ideal for use on polished surfaces.

Static Elimination Technology: Static electricity can exacerbate dust problems by attracting and holding particles on surfaces. To combat this, the cleaning unit incorporates a Keyence Mini Compact SJ-LF static eliminator. This device neutralizes static charges, preventing dust from adhering to the conveyor and the products. The inclusion of static elimination technology is a critical aspect of the cleaning unit's design, ensuring comprehensive dust control.

Configuration and Integration: The cleaning unit is designed to be modular and easily integrated into existing conveyor systems. This involves ensuring the unit can be installed without significant modifications to the conveyor infrastructure, allowing for seamless integration and minimal disruption to operations. The unit's compact design also ensures it can be deployed in space-constrained environments, making it versatile and adaptable to various industrial settings.

3. Design and Methodology :

3.1 Design Specifications

The conveyor cleaning unit was designed to address the specific dust control needs of Industry' chain polish conveyors. Key components include:
Tampico Fiber Brush: Known for its durability and effectiveness in removing fine dust particles.
Keyence Mini Compact SJ-LF Static Eliminator: Utilized to neutralize static charges and prevent dust from adhering to conveyor surfaces.

3.2 Manufacturing Process

The manufacturing process involved several stages:
Conceptual Design: Initial designs were created using CAD software, focusing on the integration of the brush and static eliminator into the conveyor system.
Prototyping: A prototype was developed to test the design's feasibility and effectiveness.
Fabrication: The final design was fabricated using high-quality materials to ensure durability and performance.
Installation: The unit was installed on Industry' chain polish conveyor system, ensuring minimal disruption to existing operations.

3.3 Testing and Evaluation

The cleaning unit's performance was evaluated over several months, with data collected on:
Dust Levels: Measured using particle counters to assess the reduction in dust contamination
Operational Efficiency: Monitored through downtime records and maintenance logs.
Product Quality: Evaluated by tracking defect rates related to dust contamination.
Cost Savings: Analysed by comparing maintenance costs and production output before and after installation.

4. Results & Discussion :

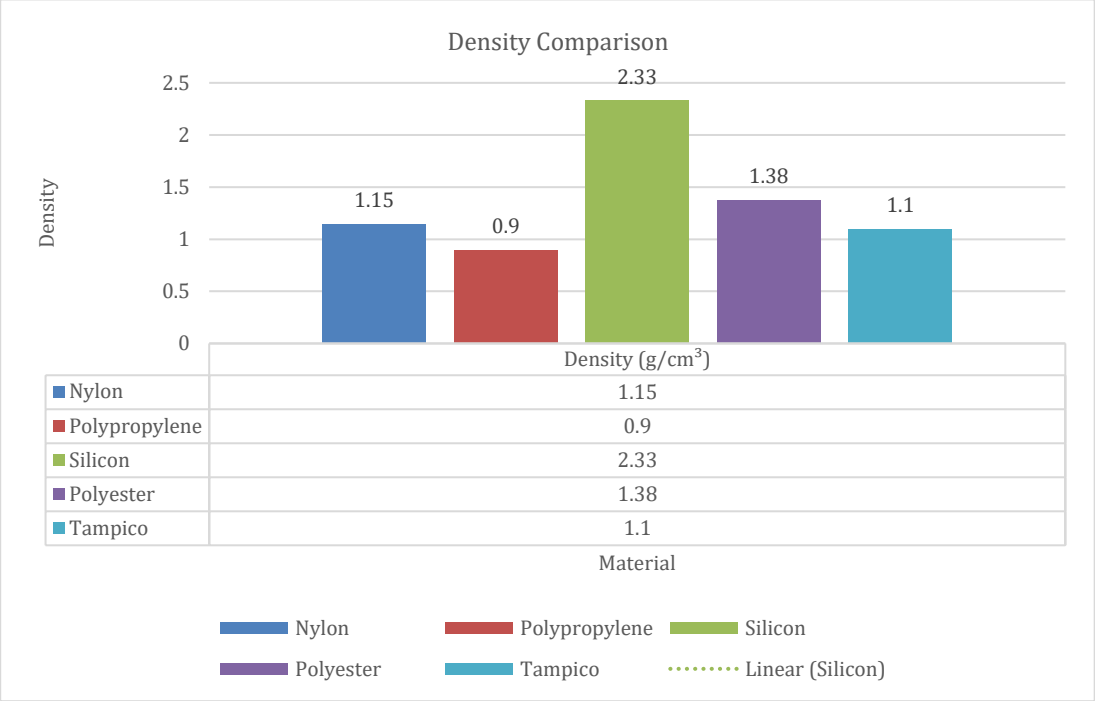
Result

4.1 Dust Reduction Efficiency

The cleaning unit significantly reduced dust contamination, with average dust levels decreasing from 300 particles/m² to 45 particles/m², representing an 85% improvement.

4.2 Operational Efficiency

Operational efficiency improved markedly, with downtime due to maintenance reducing from 30 hours per month to 12 hours per month, a 60%



Property	Nylon	Polypropylene	Silicon	Polyester	Tampico
Density (g/cm³)	1.15	0.9	2.33	1.38	1.1
Tensile Strength (MPa)	70-90	25-40	05-Dec	50-70	Moderate
Melting Point (°C)	190-350	160-170	Does not melt, degrades at 1414°C	250-265	N/A (natural fibre)
Thermal Conductivity	Moderate	Low	High	Moderate	Low
Chemical Resistance	Good	Excellent	Excellent	Good	Good
Water Absorption	High	Very Low	Hydrophobic	Low	Moderate to High
Abrasion Resistance	Excellent	Good	Poor	Excellent	Good
UV Resistance	Poor	Poor without additives	Excellent	Poor without additives	Good

4.3 Quality Improvement

Product quality saw substantial improvement, with defects related to dust contamination decreasing from 15 per month to 4 per month, a 73.33% improvement.

4.4 Cost Savings

Monthly maintenance costs were halved from 30,000rs to 15,000rs, resulting in a 50% cost saving. Additionally, production output increased from 1,000 units per month to 1,500 units per month, demonstrating a 50% improvement in productivity.

Discussion

5.1 Dust Reduction Efficiency

The significant reduction in dust contamination highlights the cleaning unit's effectiveness in maintaining a cleaner working environment, crucial for high-precision manufacturing processes.

5.2 Operational Efficiency

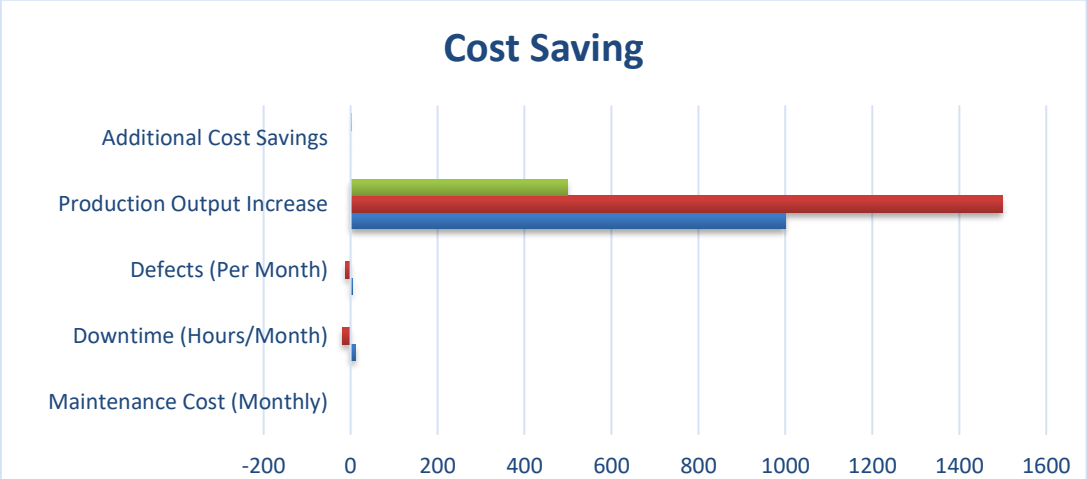
The reduction in downtime reflects the positive impact of the cleaning unit on operational efficiency. Increased uptime allows for higher productivity and smoother production processes.

5.3 Quality Improvement

The decrease in defects underscores the cleaning unit's role in enhancing product quality, aligning with commitment to delivering reliable and high-quality products to its customers.

5.4 Cost Savings

The cost savings achieved through reduced maintenance expenses and increased operational efficiency contribute to



	Maintenance Cost (Monthly)	Downtime (Hours/Month)	Defects (Per Month)	Production Output Increase	Additional Cost Savings
Percentage Change	-50%	-60%	-73.33%	500	100%
Change	0	-18	-11	1,500	0
After Implementation	0	12	4	1,000	0

6. Conclusion :

The implementation of the conveyor cleaning unit has yielded significant benefits for Industry, including improved dust reduction efficiency, operational efficiency, product quality, and cost savings. Future research could explore additional enhancements to the cleaning unit, such as automated monitoring and adjustment features, to further optimize its performance.

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