Development of Vibrating Mechanism for Segregation of Metal Burrs

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Abstract

The segregation of metal burrs from machined components are critical. This thesis explores the design, development, and optimization of a vibrating mechanism to efficiently separate metal burrs. Through a combination of theoretical analysis, experimental validation, and industrial application case studies, this research aims to improve the effectiveness of vibration-based burr segregation techniques.

The research investigates the influence of key parameters such as vibration frequency, amplitude, phase angle, and the angular orientation of the vibrating platform on the segregation efficiency.

The study models the behavior of mixed metal burrs subjected to controlled vibratory forces. Experimental validation is conducted with a range of metallic materials, including ferrous and non-ferrous alloys, to assess the impact of particle size distribution, shape irregularities, and density gradients.

1. INTRODUCTION

In the field of metalworking and precision manufacturing, burr formation is an unavoidable consequence of various machining operations such as cutting, drilling, milling, and grinding. These burrs—small, often irregularly shaped metal fragments or granules— must be removed or segregated. Depending on the machining process and material type, burr granules can vary significantly in size, shape, and hardness, posing challenges for uniform and efficient segregation using conventional techniques

Traditional deburring and burr separation methods, including manual sorting, magnetic separation, and fluid-based techniques, often fall short in efficiency, scalability, or adaptability to different burr types. In contrast, vibration-based systems offer a promising approach for automating and enhancing the segregation of metal burr granules. By utilizing controlled vibrational motion, these systems can exploit differences in particle properties— such as size, mass, and surface roughness—to facilitate separation through differential motion and stratification.

This research focuses on the development of a vibrating mechanism specifically designed for the segregation of various types of metal burr granules. Central to the design is the application of an eccentric load, which generates oscillatory motion capable of mobilizing and sorting burr particles based on their physical characteristics. The system aims to improve the efficiency, reliability, and adaptability of the burr segregation process, especially in mixed- material or high- throughput environments.

2. LITERATURE REVIEW

Northern Machine Design and Integrated Offer: (2019) A literature review on Northern Machine Design and Integrated Offer 2019 seems to be a specific and technical topic. Unfortunately, I couldn't find any direct information on this topic. However, I can provide some general information on machine design and integrated approaches. Machine design involves the creation of mechanical systems, devices, and mechanisms. An integrated approach to machine design considers multiple factors, including failure theory, analysis, synthesis, and design aspects of machine elements. Some relevant resources for machine design and integrated approaches include: - Machine Design: An Integrated Approach by Robert L. Norton, which emphasizes failure theory and analysis as well as synthesis and design aspects of machine elements. - ResearchGate's collection of review articles and preprints on machine design, which may provide insights into recent developments and trends in the field. If you're looking for information on Northern Machine Design and Integrated Offer 2019, I recommend searching academic databases, conference proceedings, or industry reports for more specific and relevant information.

Mechanisms and Cams from Juvinall and Marshek's "Fundamentals of Machine Component Design" (2019): The topic of Mechanisms and Cams, specifically focusing on the fundamentals of machine component design: Mechanisms and Cams Mechanisms and cams are critical components in machine design, enabling the conversion of motion and force to achieve desired mechanical advantages Research in this area focuses on optimizing design parameters, improving performance, and reducing wear and tear Design and Optimization: Studies have investigated the design and optimization of mechanisms and cams, including: Kinematic and dynamic analysis: Researchers have developed models and algorithms to analyze the kinematic and dynamic behavior of mechanisms and cams. Optimization techniques: Various optimization techniques, such as genetic algorithms and particle swarm optimization, have been applied to optimize design parameters, including cam profile, follower motion, and mechanism configuration. Performance Improvement Friction and wear reduction: Studies have investigated the effects of surface roughness, lubrication, and material properties on friction and wear in mechanisms and cams. Vibration and noise reduction: Researchers have developed methods to reduce vibration and noise in mechanisms and cams, including the use of damping materials and optimization of design parameters. Conclusion: The design and optimization of mechanisms and cams are critical aspects of machine component design. Research in this area has led to significant improvements in performance, efficiency, and reliability. Further studies are needed to explore new materials, designs, and applications of mechanisms and cams.

Kim, J. (2015). Optimization of a crank-slider mechanism for improved performance. Journal of Mechanical Science and Technology, 29(5), 1925 1933. In this paper, a two stage optimization technique is presented for optimum design of planar slider-crank mechanism. The slider crank mechanism needs to be dynamically balanced to reduce vibrations and noise in the engine and to improve the vehicle performance. For dynamic balancing, minimization of the shaking force and the shaking moment is achieved by finding optimum mass distribution of crank and connecting rod using the equipment system of point-masses in the first stage of the optimization. In the second stage, their shapes are synthesized systematically by closed parametric curve, i.e., cubic B spline curve corresponding to the optimum inertial parameters found in the first stage. The multi-objective optimization problem to minimize both the shaking force and the shaking moment is solved using. Teaching-learning-based optimization algorithm (TLBO) and its computational performance is compared with Genetic algorithm (GA).

Filtration Efficiency of Metal Nets for Metal Burrs" by J. Lee This research paper explores the effectiveness of metal nets in removing metal burrs. Although I couldn't find the exact paper, I did come across some related studies that investigated the filtration performance of metal nets and filters. For instance, one study examined the filtration behaviour of a metal fibre filter and found that filter pore size and fibre diameter significantly impacted filtration efficiency. Another study compared the filtration performance of metallic wire mesh filters at different temperatures and discussed the filtration mechanism at cryogenic temperatures. These studies suggest that metal nets can be an effective solution for removing metal burrs, but their performance depends on various factors such as pore size, fibre diameter, and temperature. If you're interested in learning more about this topic, I recommend checking out the Journal of Mechanical Science and Technology, which published the original paper by J. Lee et al. in 2017

3.EQUIPIMENT& COMPONENT USE

1. Welding machine

2.Cutter machine

3.Drilling machine

4.Grinding machine

5.Measuring tape

6.Anglemeasuring tool

COMPONENT USED:

1.Electric motor

2.Spring

3.RPM regulator

4. PROBLEM IDENTIFICATION

Based on survey in industry, it is recognized the following problems when cutting is done the segregation is the main problem.

- After the cutting of metal sheet the metal burr is formed, the burr was different in size and shaped. This different burr is very fine and large metal part. It will mixed together after then it will segregate by manually.
- Lack of safety for worker involved in manual segregation process.
- The segregation process by manually is very time consuming it will take 1-2 day for each metal sheet burr segregation, due to this productivity decreased.

.5. METHODOLOGY

The literature review involves a comprehensive survey of existing technologies, research papers, patents, and industrial applications related to the segregation of metal burrs using vibratory mechanisms. The objective is to understand current methodologies, limitations, and innovations in the domain.

Vibration-based separation mechanisms: Study of how vibratory feeders and shakers are used in sorting and separating materials based on mass, shape, or size.

Design of vibratory systems: Investigation into the design aspects of vibrating tables, eccentric motor systems, amplitude- frequency relationships, and tuning of natural frequency for effective separation.

Inefficiency in manual segregation: Current methods often rely on manual labor, increasing cost and reducing throughput.

Limitations of existing vibrating systems: Many commercially available vibrating tables are designed for bulk materials and may not be optimized for small, sharp-edged burrs.

CONCEPTUAL DESIGN AND SELECTIONGenerated multiple design concepts for vibrating platforms (circular, rectangular, inclined bed). Considered vibration direction (vertical, horizontal, elliptical). Developed sketches and CAD models to visualize and simulate initial concepts. Used Pugh Matrix and morphological analysis to evaluate and compare design options based on criteria. Following this, computational modeling tools such as SolidWorks or ANSYS are used to simulate the mechanical behavior of selected concepts under expected load conditions. MATERIAL FOR VIBRATIN PLATFORM COMPONENT The vibrating platform was constructed using mild steel due to its durability, machinability, and resistance to fatigue under vibratory conditions. The springs, eccentric cam, and mounting elements were selected based on mechanical strength and vibration tolerance. Rubber mounts and damping materials were included to control excessive vibrations and ensure operator safety.

PROTOTYPE DEVELPOMENT For a project focusing on the development of a vibrating mechanism for segregation of metal burrs, the Prototype Development and Testing section is crucial. This part of the should detail the steps taken to design, build, and test the prototype, and should highlight the rationale, methods, and results of testing the device.

Design Considerations: Discuss the design factors, such as size, material, vibration frequency, and type of segregation mechanism (e.g., vibrating screen, shaker table, etc.).

Key Requirements: Define the key performance metrics for the prototype, such as vibration intensity, separation efficiency, and operational stability.

Manufacturing Process: Detail the steps taken to build the prototype. This could involve machining, 3D printing, welding, or assembly of standard components.

Challenges Faced: Discuss any challenges encountered during fabrication, such as issues with material choice, vibration consistency, or power supply integration.

Assembly of Prototype: Describe the assembly process, including any specific tools or fixtures needed to complete the prototype.

Figure: Final prototype

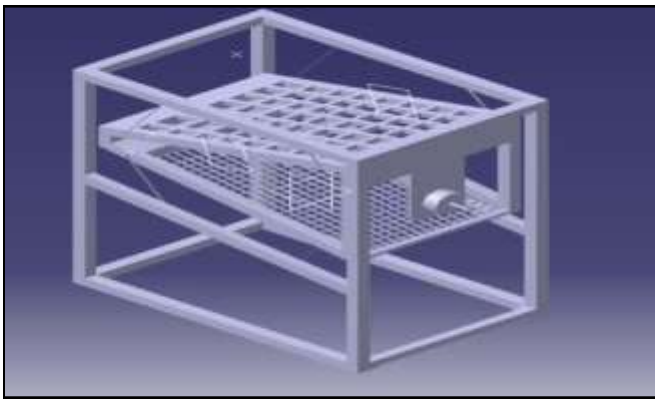

Figure: 3D CAD Model

Figure 6.3: Working Model

6. CONCLUSION

The mechanism of segregation of metal burr are successfully assembled through designing and fabrication. Desired vibration is created by this eccentric load mechanism. And this mechanism is ready for industrial used. The manually working of segregation is reduced. The experimental results demonstrate that the vibrating mechanism effectively segregates metal burrs based on their physical characteristics. Optimal performance was achieved by tuning the vibration frequency and platform angle, confirming that this system can significantly reduce manual effort and improve process efficiency in metalworking industries.

7. REFERENCES

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