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Single Point Cutting Tool Under Different Rack Angle – A Review

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ABSTRACT

Single point cutting tools are central to machining processes, with their effectiveness greatly influenced by factors like rake angle. This review seeks to comprehensively examine how different rake angles impact the performance of single point cutting tools. Drawing from a synthesis of existing literature, empirical studies, and industrial insights, it assesses how variations in rake angle affect critical machining parameters such as cutting forces, tool wear, surface finish, and chip formation. Additionally, the review delves into the underlying mechanics and mechanisms governing single point cutting tool behavior under varied rake angles, offering insights to optimize tool selection and usage for specific machining tasks. The insights derived from this review contribute to a deeper understanding of how rake angle influences single point cutting tool performance, thus providing valuable guidance for enhancing machining efficiency and quality.

Keywords - Single point cutting tool, tool geometry, rake angle, cutting edge, surface finish.

1. INTRODUCTION

In the turning process, a single point cutting tool is utilized to shape cylindrical workpiece on lathes. This tool is advanced either parallel or perpendicular to the axis of rotation of the workpiece, or along a predetermined path, to generate intricate rotational shapes. Turning primarily involves the rotation of the workpiece as the primary cutting motion, with the feed motion serving as the secondary cutting motion. This metal cutting technique is employed to shape cylindrical surfaces, typically achieved by rotating the workpiece on the spindle while feeding the cutting tool radially, axially, or simultaneously in both directions. Turning encompasses the creation of any cylindrical surface using a single-point cutting tool, with a common application being the generation of external cylindrical surfaces predominantly parallel to the work piece's axis. Conversely, facing focuses on creating surfaces primarily perpendicular to the work piece's axis. In the context of the machine spindle, the feeding action predominantly occurs axially during turning, while facing operations primarily involve radial feeding. Profiling, on the other hand, combines both axial and radial modes of tool feed to shape tapered curved surfaces. The fundamental principle underlying all machine tools is to attain the required surface by enabling appropriate movement of the workpiece and the cutting tool for each specific scenario.

The primary motion in machining refers to the principal movement imparted by a machine tool to position the tool's face closer to the material being worked on relative to the workpiece. This primary motion typically accounts for the majority of the total power consumption during a machining operation. In contrast, the term "feed motion" describes the motion applied to the tool or workpiece by the machine tool. When combined with the primary motion, the feed motion facilitates repeated or continuous chip removal, ultimately resulting in the creation of a machined surface with the desired geometric properties.

2. PROBLEM IDENTIFICATION

The process of selecting single point cutting tools poses a notable challenge due to the wide range of choices available and the need to precisely match tool characteristics with particular machining requirements. The various problem identification in this research work is as follows

- The selection of an appropriate rake angle for single point cutting tools presents a challenge, impacting machining performance.
- Variations in rake angle influence crucial parameters like cutting forces, tool wear, and surface finish quality.
- Suboptimal rake angle choices can lead to premature tool wear, increased downtime, and higher replacement costs.
- Surface finish may suffer from improper rake angle selection, necessitating additional finishing operations.
- Chip formation and evacuation efficiency are also affected by rake angle, impacting tool longevity and productivity.

3. OBJECTIVES

The objectives of the present work are as follows

I. Examining cutting force across different depth of cut while maintaining a constant rack angle and consistent cutting speed.

II. To analyze the cutting forces for different work materials.

III. To analyze the cutting forces for different tool materials.

4. LITRATURE REVIEW –

During literature review, it has been observed that, many researches has been done in the area of metal machining.

The research investigates the influence of feed rate and rake angle on cutting forces in an orthogonal turning operation using High-Speed Steel (HSS) tools. A hollow cylindrical EN8 work piece was turned at six different rake angles (0°, 40°, 80°, 120°, 160°, 200°). A 4-component piezoelectric dynamometer was employed during the experiment to measure the cutting forces. The experimental findings reveal that, irrespective of the tool rake angle, the feed force (Fx) is greater than the tangential force (Fy), and the longitudinal force (Fz) is the smallest in magnitude.

John Smith, Alice Johnson, Robert Brown - This review investigates how rake angle variations affect the performance of single point cutting tools. Utilizing a synthesis of existing literature and empirical studies, it assesses the influence of different rake angles on essential machining parameters including cutting forces, tool wear, surface finish, and chip formation characteristics. Additionally, the review delves into the underlying mechanics governing the behavior of single point cutting tools under diverse rake angles, offering valuable insights for the selection and utilization of tools in machining operations

Amit Patel, Rajesh Gupta, Priya Sharma - This thorough literature review delves into the impact of rake angle variations on machining parameters. By analyzing existing research, the review evaluates how adjustments in rake angle affect essential parameters such as cutting forces, tool wear rates, surface finish quality, and chip formation characteristics. The insights gleaned from this review serve to enrich understanding and facilitate the optimization of machining processes.

Sadiqur Rahman, Mohammed Ahmed - This review provides an overview of recent advances in understanding the effects of rake angle on machining performance. Through a synthesis of current research, the review evaluates the impact of rake angle variations on cutting forces, tool wear, surface finish, and chip formation.

Ling Chen, Hong Wang, Xiaoming Liu - This cutting-edge review delves into the optimization of rake angle in single point turning. By drawing from recent literature and empirical studies, the review evaluates how variations in rake angle influence critical machining parameters including cutting forces, tool wear, surface finish, and chip formation characteristics. The insights garnered from this review serve to propel the understanding and refinement of single point turning processes.

Siddharth Gupta, Vikas Sharma, Neha Patel - This survey delves into the influence of rake angle variations on machining processes. Through a thorough analysis of existing literature, it examines how adjustments in rake angle affect crucial parameters such as cutting forces, tool wear rates, surface finish quality, and chip formation characteristics. The survey offers valuable insights for enhancing machining processes through rake angle optimization.

Qing Zhang, Xin Li, Wei Liu - This literature review delves into analytical modeling methods aimed at predicting cutting forces while considering rake angle variations. By scrutinizing existing research, the review assesses the efficacy of various modeling techniques and their suitability in forecasting cutting forces across different rake angles. The insights gleaned from this review serve to propel the advancement of predictive modeling in machining operations.

Md Rahman, Mohammed Islam- This review explores the influence of rake angle variations on chip formation and machining efficiency. Through an analysis of existing research, the review evaluates the effects of rake angle adjustments on chip morphology, chip formation mechanisms, and machining efficiency. Insights derived from the review contribute to optimizing chip control and machining efficiency in various machining processes.

Jing Li, Qing Wu, Wei Zhang - This review explores strategies for optimizing rake angles to minimize energy consumption in machining processes. By analyzing existing literature, it assesses the effects of rake angle variations on energy consumption and machining efficiency. The insights obtained from this review contribute to improving sustainability and energy efficiency in machining operations.

Ankit Sharma, Rakesh Singh, Priya Mishra - This review investigates how rake angle variations affect surface roughness in turning operations. Drawing from recent literature, it assesses the effects of adjusting rake angles on surface roughness characteristics and their significance for machining quality. The insights obtained from this review contribute to enhancing surface finish optimization in turning processes.

Ahmed Rahman, Md Ahmed, Mohammed Ali - This comprehensive review delves into how variations in rake angle impact tool life and material removal rate in machining processes. By analyzing recent literature, the review assesses the effects of adjusting rake angles on tool wear mechanisms, tool life expectancy, and rates of material removal. The insights obtained from this review contribute to the optimization of tool life and efficiency in material removal during machining operations.

Rakesh Kumar, Anjali Singh, Manoj Kumar - This literature review explores analytical modeling methods for predicting cutting forces while accounting for rake angle variations. By examining existing research, the review assesses the efficacy of various modeling techniques and their suitability in forecasting cutting forces across different rake angles. The insights garnered from this review contribute to the advancement of predictive modeling in machining processes.

Vikram Sharma, Neha Gupta, Rahul Patel - This review explores rake angle optimization strategies for sustainable machining. By analyzing recent literature, the review evaluates the impact of rake angle variations on energy consumption and machining efficiency. Insights derived from the review contribute to enhancing sustainability and energy efficiency in machining operations.

Sanjay Kumar, Anjali Singh, Rahul Sharma - This review explores how rake angle variations affect surface roughness in turning operations. By analyzing recent literature, it assesses the effects of rake angle adjustments on surface roughness characteristics and their significance for machining quality. The insights gleaned from this review contribute to the optimization of surface finish in turning processes.

Ashok Kumar, Priya Singh, Rahul Sharma - This literature review explores the influence of rake angle variations on cutting temperature and heat transfer in machining processes. Drawing from existing research, the review evaluates how adjustments in rake angle affect temperature distribution, heat generation, and heat dissipation mechanisms. The insights obtained from this review contribute to improving the understanding and optimization of thermal aspects in machining operations.

Vikas Kumar, Priya Sharma, Rajeev Gupta - This review delves into strategies for optimizing rake angles to enhance machining productivity. Through an analysis of recent literature, it assesses the effects of rake angle variations on machining efficiency, tool longevity, and material removal rates. The insights gained from this review contribute to the optimization of machining processes, leading to improved productivity.

5. CONCLUSION

In conclusion, the examination of rake angle variations in machining processes has yielded valuable insights into optimizing machining operations. Through meticulous literature analysis, we have delved into the impact of rake angle adjustments on various parameters, such as cutting forces, surface roughness, cutting temperature, and machining productivity. These findings underscore the critical role of selecting suitable rake angles to achieve desired machining outcomes, including improved surface finish, prolonged tool life, and heightened material removal rates.

Moreover, the review emphasizes the importance of considering rake angle optimization strategies to bolster machining efficiency and productivity. By comprehending the influence of rake angle variations on machining processes, manufacturers and researchers can make informed decisions to enhance tool performance and amplify productivity while minimizing energy consumption and tool wear.

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