International Journal of Research in Advent Technology, Special Issue, March 2019
E-ISSN: 2321-9637
3rd National Conference on Recent Trends & Innovations In Mechanical Engineering
15th & 16th March 2019
Available online at www.ijrat.org

Studying The Effect Of Co-Efficient Of Friction On The Work Piece In Grinding By Fea

Arun S K[1], Raghavendra N Savannanavar[2], Jagadish Mankur[3]
[1,3] *Assistant professor, Department of Mechanical Engineering, NNRG, Hyderabad, INDIA*
[2] *Assistant professor, Department of Mechanical Engineering, GCET, Hyderabad, INDIA*
arunragha29@gmail.com, 91-8277685572

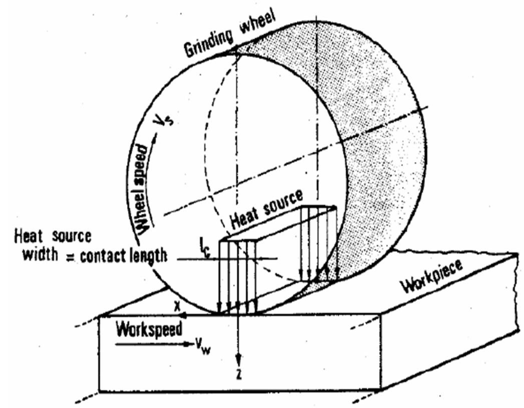
Abstract*:* High surface finish required for making products is generally done by grinding, in this process stresses are induced in the work piece due to loading.
This paper reflects the methodology and results obtained from ANSYS software tool which is used for evaluating the stress induced and contact pressure under static condition of work piece. The grinding wheel of titanium carbide is used to grind different materials [iron and steel in this paper are considered] of work pieces for different co-efficient of friction. The result of the different combinations of work piece and co-efficient of friction are tabulated and compared.
Index terms: Grinding, Grinding wheel, Stress, Contact pressure

1. INTRODUCTION

Grinding is an abrasive material removal and surface generation process used to shape and finish components made of metals and other materials. The precision and surface finish obtained through grinding can be up to ten times better than with either turning or milling.

Grinding employs an abrasive product, usually a rotating wheel brought into controlled contact with a work surface. The grinding wheel is composed of abrasive grains held together in a binder. These abrasive grains act as cutting tools, removing tiny chips of material from the work. As these abrasive grains wear and become dull, the added resistance leads to fracture of the grains or weakening of their bond. The dull pieces break away, revealing sharp new grains that continue cutting. The requirements for efficient grinding include:

- Abrasive components which are harder than the work
- Shock- and heat-resistant abrasive wheels
- Abrasives that are friable. That is, they are capable of controlled fracturing



FEA

Modeling is the process of producing a model is a representation of the construction and working of some system of interest. One purpose of a model is to enable the analyst to predict the effect of changes to the system. On one hand, a model should be a close approximation to the real system and incorporate most of its salient features. On the other hand, it should not be so complex that it is impossible to understand and experiment with it. A good model is a judicious trade-off between realism and simplicity. Modeling are two types they are 2-D geometric modeling, 3-D modeling.

2. ANALYSIS

Treatment of engineering problems basically contains three main parts: create a model, solve the problem, analyze the results. ANSYS, like many other FE-programs, is also divided into three main parts (processors) which are called preprocessor, solution processor, postprocessor.

<u>Preprocessor</u>

Within the preprocessor the model is set up. It includes a number of steps and usually in the following order:

- Build geometry
- Define materials
- Generate element mesh

The element mesh can in ANSYS be created in several ways. The most common way is that it is automatically created, however more or less controlled. For example you can specify a certain number of elements in a specific area, or you can force the mesh generator to maintain a specific element size within an area. Certain element shapes or sizes are not recommended and if these limits are violated, a warning will be generated in ANSYS. It is up to the user to create a mesh which is able to generate results with a sufficient degree of accuracy.

Solution processor

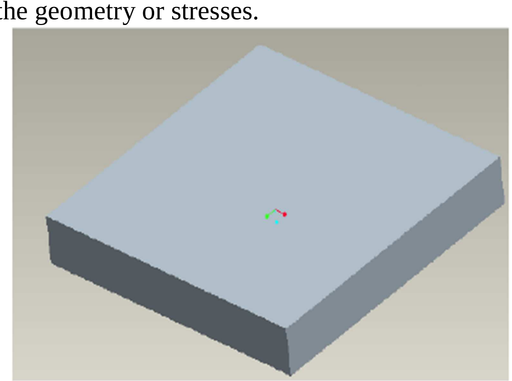
Here you solve the problem by gathering all specified information about the problem:

- **Apply loads**: Boundary conditions are usually applied on nodes or elements. The prescribed quantity can for example be force, traction, displacement, moment, rotation. The loads may in ANSYS also be edited from the preprocessor.
- **Obtain solution**: The solution to the problem can be obtained if the whole problem is defined.

Postprocessor

Within this part of the analysis you can for example:

- **Visualize the results**: For example plot the deformed shape of the geometry or stresses.



3-D model of work piece

Analysis planning for grinding wheel

In this steps mainly concentrated on frictional and contact pressure in between work piece and grinding wheel with the variation of base material and co efficient of friction.

- **List the results**: If you prefer tabular listings or file printouts, it is possible.

3. RESEARCH SURVEY

SGS-1632AH/AHD

An excellent choice for medium surface grinder, Sunny Machinery Co., Ltd. provides four types specification of selection in this surface grinding machine series. Models with table sizes ranging from 260 x 600 mm to 400 x 1000 mm for CNC and hydraulic feed machines, popular for its fully automatic lubrication system and fully supported table eliminates overhang problems.

SGS-1020 H/AH/AHR/AHD/SD

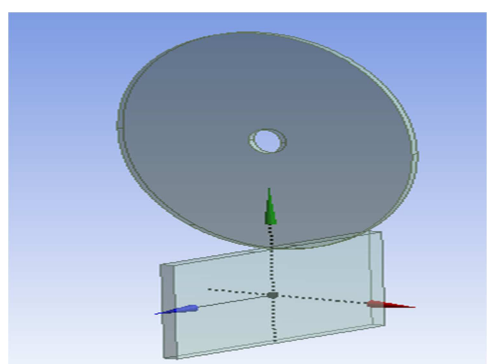
Sunny Machinery Co., Ltd. manufactures three types of Surface Grinding Machine models specification for the small precision series, with table sizes ranging from 230 x 500 mm to 260 x 600 mm for CNC and hydraulic feed machines. The SGS series does have CNC and hydraulic feed versions, selling well for its features of adjustable, rotates easily, and high intensity.

SGS-2040AH/AHD/SD

To meet the needs of customers across multiple industries, we offer a wide selection, from small hand-feed types to the most sophisticated extra large capacity machines. This is the large type Surface Grinding Machine that we offer, models with table sizes ranging from 500 x 1000 mm to 600 x 1500 mm for diverse CNC and hydraulic feed machines.

4. METHODOLOGY

The vitrified bond of grinding wheel with a speed of 15-25mpm is been analyzed under static structure analysis in ANSYS 14.5 version software. For modeling purpose CATIA V5 version is used, by applying various commends like sketch, extrude, Boolean operation, the 3D model is prepared and is given below.



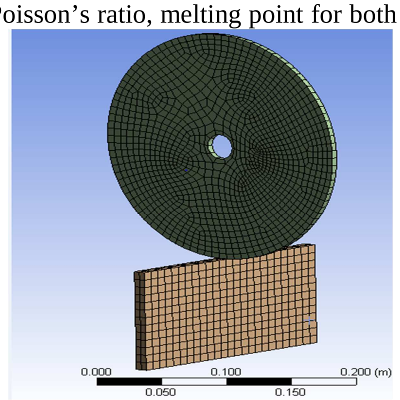
Grinding wheel and work piece assembly

Steps are as follows

- Importing 3-d model from CATIAS V5 (.igs format)
- Setting the engineering materials for grinding wheel and base metal

- Meshing or discritization process.
- Checking the nodes and connection of elements in meshed geometry.
- Applying boundary conditions.
- Solver manager
- Solution

A specified grinding wheel and work piece assembly is converted to .igs format for supporting analysis software. For imported geometry the material properties will be fixed from engineering data like tensile, compression, shear, density, young's modulus, Poisson's ratio, melting point for both work piece and grinding wheel. For efficient multi physics solution the meshing is adopted, more appropriate meshing will be building blocks for engineering simulation. The triangular elements with 3 nodes are used to meet all the requirements during analysis. Boundary conditions like fixed support, pressure, co efficient of friction for grinding wheel and work piece is applied and the default iteration is set to be 500. The determination of contact pressure and the frictional stress will be carried by the solver manager. Solution step will provide all results like stress distribution contact pressure, counter plot for various parameters.

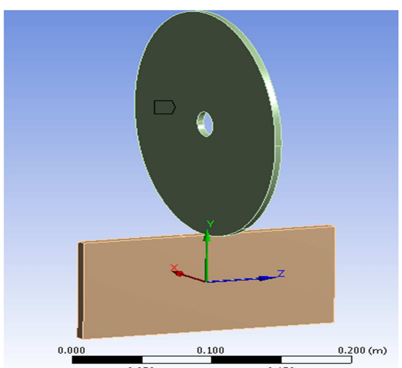


Meshed geometry

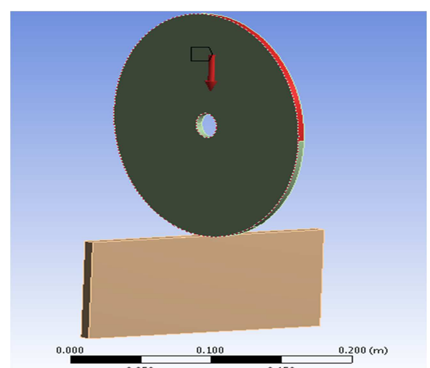
Details of "Mesh"

Defaults	
Physics Preference	Mechanical
Relevance	0
Sizing	
Use Advanced Size Fun...	Off
Relevance Center	Fine
Element Size	8.e-003 m
Initial Size Seed	Active Assembly
Smoothing	Medium
Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	5.e-003 m

Meshing Details



Displacement boundary condition



Remote force boundary condition

5. MATERIAL SURVEY

Grinding wheel

Surface grinding wheels are generally used to grind flat stock or flat surfaces within a work piece. The wheel moves over the work piece in a flat plane or vice versa. Hardness is rated from A-Z with 'A' being the weakest bond and 'Z' being the strongest. A weak bond is preferred for grinding harder materials while a stronger bond is desired for softer materials. A typical weak bond for steel would be in the 'F, G or H' range. A medium hardness would be in the 'I, J or K' range. And stronger bonds in the 'L, M, or O' range. Hardness is dependent on the grit type, the material being ground, the amount of stock removed, and a number of other factors.

Properties of Titanium carbide

Chemical formula	Density	Melting point	elastic modulus	shear modulus	Poissons Ratio	Shear Strength
TiC	4.93 g/cm^3	3,160 °C	400 GPa	188 GPa	0.18 - 0.19	89.0 MPa

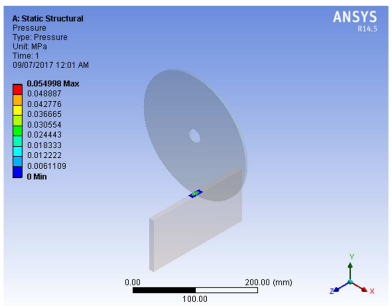
Properties of Work piece

Steel

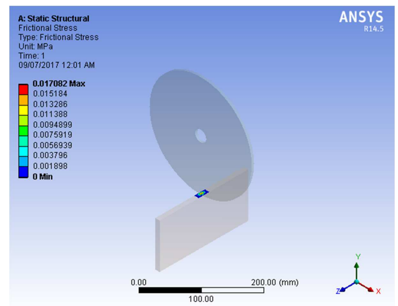
Density	Melting point	elastic modulus	shear modulus	Poissons Ratio	Shear Strength
7.872* 10^3 kg/m^3	1370^0 C	210 Gpa	81 Gpa	0.3	240 Mpa

6. RESULT

Grinding Wheel: Tungsten Carbide, Work piece: Iron and Co-efficient of friction: 0.7

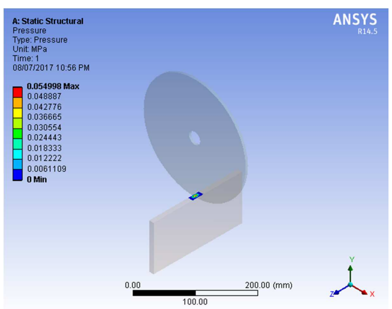


Contact pressure

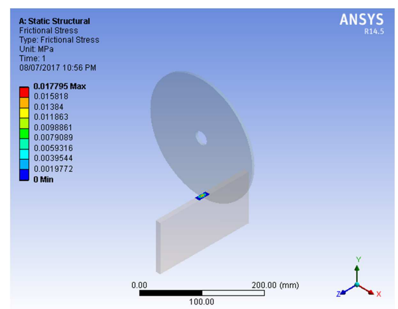


Frictional stress

Grinding Wheel: Tungsten Carbide, Work piece: Iron and Co-efficient of friction: 0.8

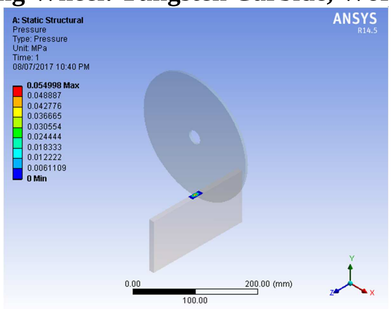


Contact pressure

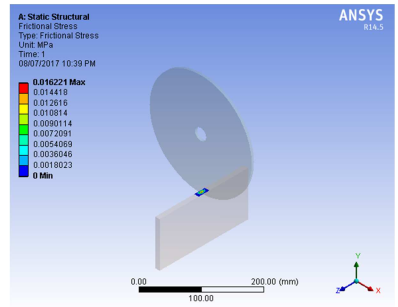


Frictional stress

Grinding Wheel: Tungsten Carbide, Work piece: Steel and Co-efficient of friction: 0.6

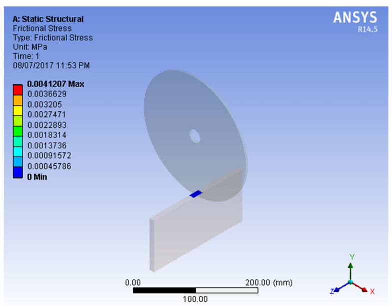


Contact pressure

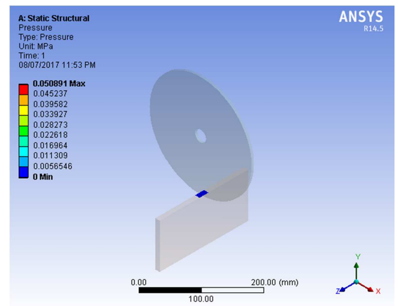


Frictional stress

Grinding Wheel: Tungsten Carbide, Work piece: Steel and Co-efficient of friction: 0.15



Contact pressure



Frictional stress

Sl. No.	Work piece	Grinding Wheel	Co-efficient of friction	Frictional Stress [Mpa]	Contact pressure [Mpa]
1	Iron	Tungsten Carbide	0.7	0.017082	0.054998
2	Iron	Tungsten Carbide	0.8	0.017795	0.054998
3	Steel	Tungsten Carbide	0.6	0.016221	0.054998
4	Steel	Tungsten Carbide	0.15	0.0041207	0.0504891

7. CONCLUSION

Surface texture of a component place an important role in most of the cases. It directly influences the other parameters, such as frictional resistance, aesthetic etc. considerable efforts are to be made to achieve the required surface finish. Grinding is one of the finishing process which can employed to observe the require surface finish. During the process of grinding due to the contact between the grinding wheel and the work piece the contact pressure develops and the material gets induced with the frictional stresses. These stresses may accumulate into the material in the form of residual stresses and partially may become the cause of failure during its survival.

During the study, the results obtained from the static analysis conclude that the contact pressure and frictional stresses are highly influenced by the contact friction. The stresses induced are 0.17795 Mpa when the co efficient of friction was 0.8 and it has reduced to 0.0041207 Mpa when the co efficient of friction was brought to 0.15. the coefficient of friction is mainly to be dependent on the roughness or smoothness of surface. Type of materials the only option to reduce the co efficient of friction is by employing the proper and suitable lubrication, so the material can be safe from excess frictional stresses.

REFERENCES

[1] Malkin, S., Grinding Technology: Theory and Application of Machining with Abrasives, Ellis Harwood Publication, UK, 1990.
[2] Bhattacharyya, A. Metal Cutting Theory and Practice; Central Book Publishers, Kolkata, 1984.
[3] Das, S., Improving grinding performance through appropriate grinding fluid application, Proceedings of the National Conference on Investment Casting, Durgapur, India, 2003, 97-103.

[4] Das, S.; Sharma, A.O.; Singh, S.S.; Nahate, S.V. Grinding performance through effective application of grinding fluid, Proceedings of the International Conference on Manufacturing, Dhaka, Bangladesh, 2000, 231-239.
[5] Putatunda, S., Bandyopadhyay, A.K., Bose, T., Sarkar S. and Das, S., On the Effectiveness of applying grinding fluid in surface grinding, Proceedings of the National Seminar on Emerging Trends in Manufacturing, XVI National Convention of Production Engineers, Varanasi, India, pp.182-187, 2002.
[6] Chattopadhyay, A. B., Lecture note delivered at Tata Bearing, 24.10.1992.
[7] Palhade, R.D.; Tungikar, V.B.; Dhole, G.M.; Application of Different Environments in Grinding of Titanium Alloys (Ti-6Al-4V): Investigations on Precision Brazed Type Monolayered Cubic Boron Nitride (CBN), Grinding Wheel, Institution of Engineers (India), Production Engineering Division, 2009, 90, 9-13.
[8] Yang, C.T.; Shaw, M.C. The Grinding of Titanium Alloy. Transactions of the ASME, 1955, 77, 645-660.