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STUDY AND ANALYSIS OF ABRASIVE WEAR PROPERTIES OF 60Cu40Zn

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Abstract: *Wear is very important phenomena which play a vital role while designing any component. It directly affects the life of the component. Abrasive wear phenomena are simply caused by the passage of relatively hard particles or asperities over a surface. Abrasive wear simply includes division of two surface parts by abrasion of other mating surface that is situated between the friction areas. This abrasion is mainly depends upon several factor like on loading condition, slide-way length and hardness. A Brass mainly considered as the important copper alloy. In particular, up to date brass alloys have been extensively used in automotive, electronic, energy, construction and marine application by virtue of their corrosive resistance in non acidic environment, good mechanical properties and fabricability, high thermal and electrical conductivity. So, in this paper a study of abrasive wear of brass with different loading condition were given to analyze the possibility of wear. A review of abrasive wear properties of 60Cu40Zn using different wear rate measuring technique has been discussed in this paper. Mainly focus on the varying wear condition during varying loading conditions. As we all know that wear is very important parameter which directly affects the life of a component. And that can be control using several parameters on which it depends. The result of the study indicates several measuring wear rate technique till date.*

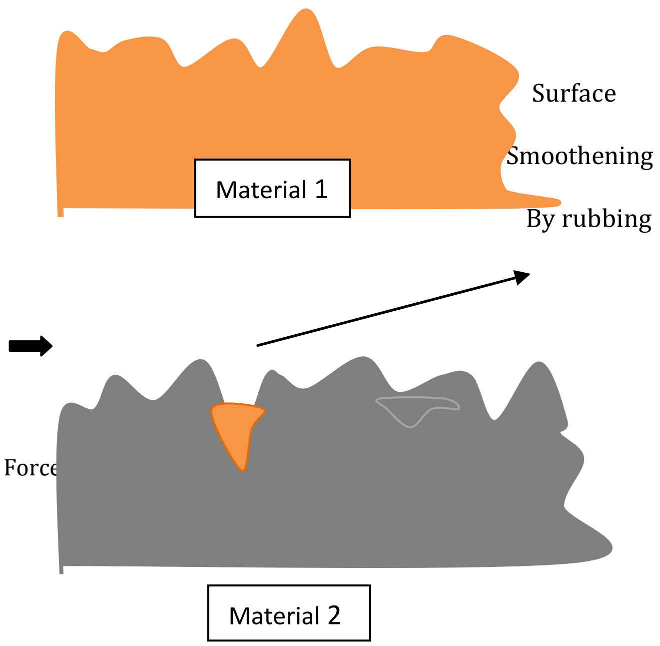
Keyword- Abrasive Wear, Copper Alloy, Brass 60:40, Wear resistance, Normal load, Orientation

1. INTRODUCTION:

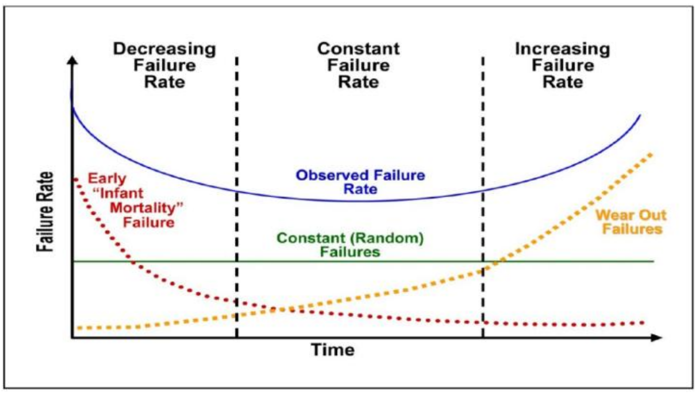
Interaction of the base body and counter body arises in the absence of lubrication film thickness or the presence of too small lubrication film thickness. Wear is very important phenomena than friction and lubrication play a very hypothetical role in reducing friction. Lubrication is providing to reduce a wear, because wear is much more dominant compare to friction. A good design can simply reduce this problem of wear. Hence wear factor is directly depend upon the design of the component. A good design reduces 100000 times that is more dominating factor. In short, we simply define wear as an undesirable removal of material from operating solid surface. Here the word undesirable simply signifies that there are two definitions; one is known as a 'zero wear' and other one is 'measurable wear'. Zero wear is simply tells that there is a wear, but that is not going to cause as much. In fact it may increase the performance and it is for betterment, so that it is not undesirable. However in case of measurable wear where the undesirable wear occur or undesirable removal of material takes place.

We simply take one example to study the chance of occurrence of wear in any material i.e. 'Zero wear'. We considering two materials; material '1' and material '2' rub each other. After short interval of time there some asperity detachment from material '1' as well as some material detachment from material '2'. This is simply a zero wear condition. Analyse the zero wear using 'bath tub curve'. It simply consists of three stages:

- Infant Mortality failure(decreasing failure rate)
- Constant Failure rate(indicating useful failure rate)
- Wear out failure(increasing failure rate, 'shows end of life)



Rubbing of the surfaces of two materials



Bath Tub Curve

Fig-01: rubbing of the surfaces of two materials and Bath tub curve to show change of failure rate with respect to time [1].

If we considering measurable wear condition, then there is a formation of pit on the surface of the material. For the deep study of the measurable wear condition, we are considering four figure ‘a’, ‘b’, ‘c’ and‘d’ . Now considering cyclic loading condition, there is a possibility of formation of cracks within the surface. If there are too many cracks they will agglomerate, they will make a one big crack and may be after certain duration, and this whole attachment will get detached. This situation is undesirable which simply shows measurable wear condition. In this wear condition, discontinuity is arises. There is a possibility of converting rolling motion is converted into sliding motion. This is the main reason to study the wear and wear mechanism.

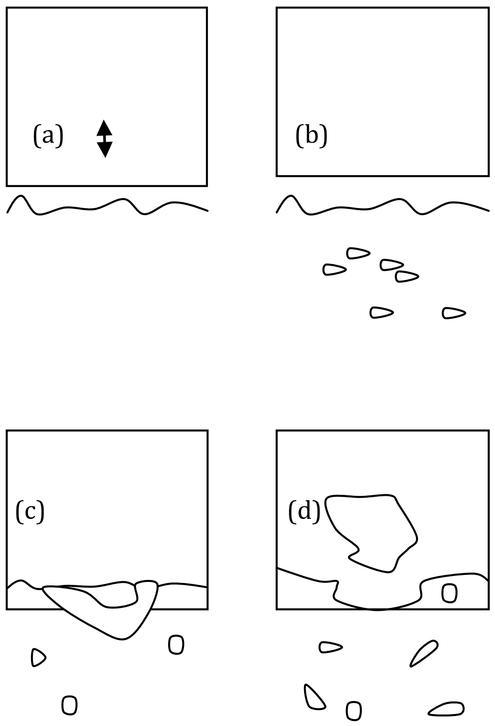


Fig-02: Formation of pit on the surface of material [1]

Wear occur in material through several mechanism like adhesive, abrasive, surface fatigue, fretting and corrosion wear.

Table-01: Typical wear mechanism [2]

Wear Mechanism	Wear Phenomenon
Adhesion	Scuffing or galling areas, holes, plastic shearing, material transfer
Abrasion	Scratches, Grooves, ripples
Cavitation	Interaction with fluid
Corrosive wear	Chemical nature
Surface fatigue	Cracks, pitting
Erosive wear	High velocity particle or liquid
Fretting wear	Micro motion

The chance of occurrence of abrasive wear is more than that of adhesive wear. When a hard surface or hard particle simply slides on the surface of material then this is known as 'Abrasive wear'. It is approximately 10^6 times more than the adhesive wear. Several materials that are used under abrasive wear condition mainly require different desired property like flexibility, resistance to corrosion and good process ability [3, 4]. In summarized way this simply indicates that it is very important to measure the abrasive wear because here the chance of failure of material takes place at each and every cycle.

Kloss *et al*. focused on the various tools like equipment used for wear measurement, mathematical modelling, tribo meters and simulations mainly play an important role for measuring the wear resistance. It is summarized by several author[5-16] that the wear rate and friction conditions directly effect by so many constraint like normal loading condition, geometry, relative surface roughness, relative humidity and lubrication, temperature and vibration[17].

1.1 Abrasive Wear:

Abrasive wear phenomena are simply caused by the passage of relatively hard particles or asperities over a surface. Four mechanisms which will give the physics of abrasive wear and depend upon whether material is ductile or brittle, mechanism will change. This type of wear occurs in most of the machine very frequently and it present up-to 80% of overall volume. Four types of mechanism used in abrasive wear are as follows:

- Micro-cutting: Sharp particle or hard asperity cuts the softer surface and the cut material is removed as debris.
- Micro-fracture: The material which is abraded is brittle, example ceramic. Fracture of worn surface occurs due to merging of the number of smaller cracks.
- Micro-fatigue: When a ductile material is abraded by a blunt particle or asperity then the cutting is unlikely and the worn surface is repeatedly loaded and unloaded.
- Removal of material grains: It generally happens in material (i.e. ceramic) having relatively weak grain boundary.

It can also originate from other wear types in the course of which the free particles are being formed. Free particle are stiffer than parent material. Several condition are arises due to the occurrence of plastic deformation or we can say that air oxygen oxidation. By following way we simply reduce the abrasive wear:

- By reducing loading condition
- Acceptance of hardening process[18]

Abrasive wear simply includes division of two surface parts by abrasion of other mating surface that is situated between the friction areas. This abrasion is mainly depends upon several factor like on loading condition, slide-way length and hardness. Apart from these, it also depends upon particle size, shape and interactive number [19].

During running process, several undesirable condition of wear are arises. This undesirable wear conditions are measurable. Therefore, we are trying to reduce the effect of undesirable effect to enhance the life of the components. By which we can easily increase the technical life of the components. Surfacing presents one of these possibilities. Due to formations of pits during measurable wear process, the surface of the machine elements has led to be effected. This causes the development of newer surfaces for the betterment of the sub assembly of machine parts. In modern days, we totally focus on increasing the safety and extending the technical life of machine and devices. For the proper fulfillment of all these conditions we require a maintenance process which is very simple and less time consuming. The process, which we considering always reduce the chance of occurrence of wear and enhance the life of the product [20].

1.2 Modes of Abrasive wear:

Abrasive wear is commonly classified into two parts based on whether their asperity verses asperity or particle verses asperity exists. If asperity verses asperity interaction occur then this phenomena is simply known as 'Two-body abrasion' where a particle verses asperity interaction happens then we simply call this as 'Three-body abrasion'. Assuming particle loses as a third body then we already have two surfaces. One is the soft surface and other is the harder surface. Some particle also exits in between them. The division of these two modes simply depends upon the contact area and the environment at the time of contact. Following are considered as basic modes of abrasive wear:

- Two-body wear:[Fig 03]

  -Two interacting asperities physical contact occurs in between them and one of them is harder than other [21].

  -Normal load causes penetration of harder asperities into softer surface thus producing plastic deformation.

  -To slide, the material is displaced or removed from the softer surface by combined action of micro-ploughing and micro-cutting.

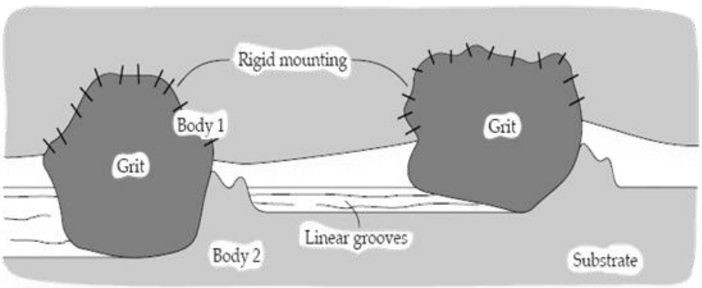
- Three-body wear:

  -It occurs when the abrasive particles are trapped loosely between surfaces to roll and slide down the surface [Fig 03] [21].

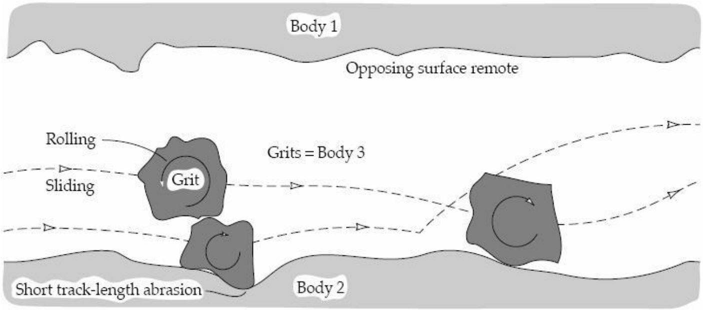
  -Material removal from the softer surface by hard loose particles [21].

  -Generally located by oxidation or wear-out [21].

  -Clearance larger than particle size and filtration reduce chances.



Two body mode



Three body mode

Fig-03: Two body and three body mode of abrasive wear [22]

1.3 Quantitative Law use for the measurement of Two body and three abrasive wear mode

1.3.1 Rabinowicz's Quantitative law for two body abrasion:

For studying the two body abrasion we simply assume a conical asperities indenting soft surface during transverse motion. We simply assume that all material displaced by the cone is lost as wear debries. The whole assumes is based on micro-cutting, it means whole material can easily be removed. Conical asperity [Fig 4] we are assuming having radius 'a' that means diameter is '2a'. Hence area of this asperity is 'πa^2'. But we are considering half of this area and multiply this with hardness because we are assuming plastic deformation [23].

Load carried by n^{th} asperity

$w_n = H(0.5 * \pi a^2)$

Volume swept by penetrated asperity (wear rate)

$\Delta v = a.x.L$
or $\Delta v = a.a/\tan \alpha.L$
or, $w_n/(0.5H\pi.\tan \alpha).L$

where x=depth of penetration
L= distance travelled
a= radius of the cone at the contact surface
α= cone angle

There is need to calculate the total wear because here number of asperities are present on the surface. Total wear is the sum of the wear caused by individual asperity. If we are considering 'n' number of asperities (n= 1000, 100, 10.......) then,[23]

Total wear,

$$L\sum_{i=1}^{n} w_n$$

$$V = \frac{\quad}{0.5H\pi.\tan\alpha}$$

$$V = \frac{LW}{0.5H\pi.\tan\alpha}$$

Volume per unit length can also be calculated then

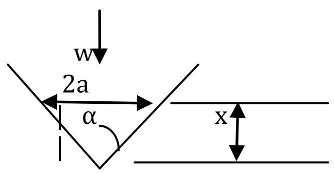
$$Q = \frac{V}{L} = \frac{2}{\pi.\tan\alpha}\frac{W}{H}$$

Here, $K = \frac{2}{\pi.\tan\alpha}$ is constant

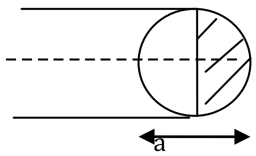
$$Q = K\frac{V}{L}$$

The value of this constant is depending upon various parameters:

-chemical nature of material
-property of material
-hardness property of the material



Conical asperity



Half portion of the asperitiy

Fig-04: Conical asperity and half portion of that conical asperity which we are considering [23]

1.3.2 Quantities measurement of three body abrasion

Three body abrasions are less harmful than two body abrasion. Particle is detached from the surface, if it does not have any rigidity, if we allow the movement of the particle, there is a possibility sliding as well as rolling. And rolling because of it has lesser coefficient of friction, rolling will be more dominant.

For the same force, rolling will be more dominant compared to
sliding if the shape is proper. Of course, if the shape is very irregular and one dimensional shape, then sliding will be more. But if the particle has a more like spherical shape, there will be more and more rolling. So, at the end we can say that for loose particle, even though the hardness is very high, there will be overall lesser sliding distance, because there is more rolling distance. And if that is a case, wear rate will be reduced. It will be much lesser, most of the energy is been absorbed in the rolling action. This is the reason if we compare three body and two body abrasion then possibility of wear rate is reduced in three body abrasions [23].

If we are assuming the value of K in both the cases then

$K_{2B} = 5*10^{-3}$ to $50*10^{-3}$; $K_{3B} = 5*10^{-4}$ to $50*10^{-4}$

Hence in three body abrasion wear rate is reduced by 10 times.

1.4 Abrasive Wear Stages

During several operating condition, the possibility of wear arises in the material. Due to this loading condition, property of the material change. This simply generates different stages of wear arises, these are as follows:-[24]

- Initial or early stage or run-in period- In this stage the rate of change is high.
- Mid-stage process or secondary stage- life of any component or design can easily be judge by this stage.
- Failure Stage or last stage- Rate of aging leads to end of the life of product.

1.5 Factor affecting wear rate

There are number of factors by which wear rate is affected.

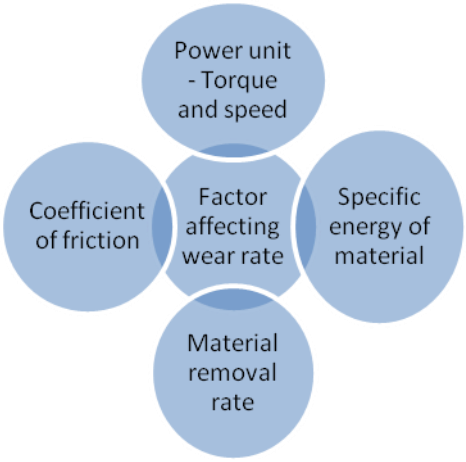


Fig-05: Factor affecting wear rate

2. COPPER ALLOY :BRASS 60:40

Cu-Zn alloys are simply known as brass. The copper end alloys have reddish color. Brass and bronze are most common used alloy of Cu. Brass is an alloy with Zn. Bronzes contains tin, aluminum, silicon or beryllium. Other copper alloy families include copper-nickels and nickel silvers. More than 400 copper-base alloys are recognized.

Table-02: Family of Copper Alloy [25]

Alloy	Alloying element	UNS Number
Brass	Zinc(Zn)	C1xxxx–C4xxxx,C66400–C69800
Phosphor bronze	Tin (Sn)	C5xxxx
Aluminium bronzes	Aluminium (Al)	C60600–C64200
Silicon bronzes	Silicon (Si)	C64700–C66100
Copper nickel, nickel silvers	Nickel (Ni)	C7xxxx

2.1 Properties of brass:

The single phase alloys are known as alpha brass. They are good corrosion resistance & ductile. They can easily be cold worked. 70-30 (70%Cu 30% Zn) and 60-40 (60%Cu 40% Zn) are the two most common grades of brass. The former is a single phase alloy. It belongs to the class of alpha brass. As against this 60Cu40Zn two phase alloy. It consists of two phases α &β. It is yellow in color. It has good machinability but it never cold worked. It is also known as αβ brass. 70/30 brass has the highest ductility. Beta brass has the highest strength. Gamma brass is very brittle. It is of little use.

Table-03: Properties of brass [26]

Elements	Cu	Zn	Fe	Tensile strength	Shear modulus
Wt%	60%	39.65%	0.35%	370 MPa	37 GPa

Elements	Melting Point	Density	Modulus of elasticity(E)	Possion's Ratio
Wt%	885^{o}C-900^o C	8.49 gm/cm^3	97 GPa	0.31

Due to such ample use of the 60Cu40Zn, it is important to analyze the whole problem step by step taking properties of material on top. Now days this material plays a very important role and acquire large part of the market. Presently we use them in manufacturing of several types of gear, ball bearings, locks etc. A construction and transportation industry impinges the advent use of brass for enhancing the mechanical as well as electrical property of the material. It simply increases the tensile strength and hardness of the material.

2.2 Analytical technique use to produce brass:

In the present investigation we simply focus on the production of brass and we apply the analytical technique to produce a brass under varying loading condition. 60Cu40Zn were simply produce by several methods like by traditional way and by alternate way.

- In traditional method of making alloys, first we heat up the component so that it simply converted into liquid stage and mix them together gently, and then allow them to cool. This solution is simply known as 'solid solution', which is generally made up of by mixing solid in water.

- Second alternate way of making an alloy is to turn the components into powder form, mix them together, and then fuse them. The temperature of this mixture is very high. This technique is called **powder metallurgy**.

- Third method of making alloys is an **Ion implantation technique**. In this method, we simply fire the beam of electron on the surface of layer of metal piece. This method is very accurate and precise for producing brass.

2.3 Composite Production:

For ease in fabrication brass is more essential than bronze. It has relatively low melting point approximately 900 to 940°C or 1652 to 1724°C. It simply consist of varying percentage of copper and Zinc. Due to this it has different properties which make it to allow for varying application. Brass can available in hard and soft structure. Density of brass is about 0.303 lb/cubic inch, 8.4 to 8.73 grams per cubic centimetre [15]. Now a day, approximate 90% of every type all brass alloys can easily be recycled [16]. If we talk about different magnetic properties than we can say, brass is a non ferromagnetic material. By passing it through powerful magnet the scrap of brass can easily be removed from ferrous scrap.

2.3.1 Method use for producing metal from their sulphides

For producing any of the metal we simply used the sulphides as the base metal. There are several standard methods which are generally used to produce metals. These are as follows-

- Thermal decomposition method
- Roasting and subsequent reduction method
- Controlled roasting method
- Flash smelting method
- Metallothermic reduction of sulphide
- Hydrometallurgical processing
- Chlorination
- Electrolytic refining of matte to pure metal

Copper is simply extracted from low grade copper. Flotation is a process, low grade copper ores to produce a concentrate that will have much higher concentrate of copper. Flotation is a technique where we have very fine ores is ground very fine. Then we simply make froth, we have that fine suspended, in a medium where there is froth and when the bubbles come out, the sulphide particles attach themselves to the bubbles, they float to the surface. The gangue minerals like silica and other oxides which do not attach themselves to the bubbles, they stay behind. So, from the top we can scheme out a layer which will be very rich in the sulphide particles. So, starting with an ore which may contain only one to two percent copper, one can after grinding and flotation, one can produce a concentrate which will have 13 to 35% copper, depending on circumstances. And the gangue and the other sulphides which have not been floated will be taken out. There is a way of doing differential flotation also where we float one sulphide, not the other sulphide, with another state float the other sulphide. So, here we are doing differential flotation, only to get the copper sulphide mineral floating out of other sulphides and there are other sulphides are not floated. So, the conditions are so maintained. So, we will start now with a concentrated, which contain sulphide from 15 to 35% copper. This is the starting material.

Now, there are several ways which are similar but they evolved over time. The conventional or traditional are two routes. The concentrate goes for reverberatory or electric furnace smelting, or it can go from hearth or fluid bed roasting, calcinations and then go for a reverberatory or electric furnace smelting. Now, in the smelting process, we simply produce a matte. Matte is a mixture of copper sulphide and iron sulphide, which means that copper sulphide which was in the concentrate, is left practically untouched. Only the iron sulphide part is oxidized that too in completely, so that only it goes to the FeO state. That FeO state is slagged out and the rest of the iron sulphide and copper sulphide solution called Matte, which can have 35 to 60% copper, the rest will be iron as iron sulphide. So, all the oxygen has been eliminated from the system and the slag that comes out, which has most of the iron, slagged out FeO with silica, limestone, quartz etc in a slag. It will also take out a small amount of copper, obviously, that we cannot ensure. But, basically oxygen is eliminated, from the system. But what we get is matte, a mixture of iron sulphide and copper sulphide. Then this goes through a process called converting. Converting a process of oxidation, where as we oxidize iron sulphide and copper sulphide matte, a stage comes where suddenly copper comes out of the system and there is some slag also. The slag will be put back to the reverberatory furnace because it may contain some iron. The copper that has come out goes for refining. Now, a newer route is that which will eliminate reverberatory furnace smelting. We should have and there steps everything is combined into one step called flash smelting, means everything is smelted. It produces a matte, it goes straight for converting, there are newer processes, where everything is combined, all steps are combined into one continues smelting process. And it can straight away produce the copper called blister copper. The slag that contains some copper will go for slag cleaning, for copper recovery. After we have produced improve copper called blister copper, which is 98.50% copper. In the refining process we will produce cathode copper. But we will also get whole lot of valuable by products in slime.

3. TECHNIQUE USED TO MEASURE WEAR RATE OF BRASS:

3.1 Design of experiment based on Taguchi technique

In Taguchi method we simply plan for an experiment by considering an objective for acquiring data in a very controlled manner. After controlling of all the data execution process is takes place. To execute the whole process, we simply analyze the available data. The whole process is generally carried out to obtain the information about the behavior of given process. The concept of orthogonal array is simply use by this process to define the exact experimental plans. Whole analysis is based on whole analysis is based on the analysis average and the analysis of variance (ANOVA) [27].

Khaled Elleuch et al, were carried out "Sliding wear transition for the CW614 brass alloy". He simply performs a dry sliding wear tests on a CW614 brass alloy with the help of pin-on-ring configuration. Input parameters which are consider during the experiment like load range of 20-80 Newton and the sliding velocity is approx 1 to 7 meter per second. Scanning electron microscope (SEM) and energy dispersive X-ray spectrometer (EDS) techniques are use for measurement of chemical composition. Severe wear and mild wear are two main wear regimes. At the contact surface existence of friction coefficient and temperature rise takes place. So, there exists a strong correlation between friction coefficient and temperature rise [28].

An experiment is conducted on Pin on disc. This test is basically conducted on M2 quality high speed tool steel and Al_2O_3 abrasive paper. For the completion of experiment we simply use quality balls. For the successful investigation of the synchronizer rings we establish a correlation in between hardness, microstructure and wear resistance. At the end result, he simply found that increased value of the α-phase can easily get through decrease the hardness and increase the wear resistance property. The percentage increase in α-phase is by 8 to 23% and the reduction in the value of hardness is by 281 to 250 Hardness Value. The type of assembly or we can say the set up arrangement for wear test and counterface directly affect the wear resistance property of the material. The value of wear rate is simply increase by percentage of 15 to 80% [29]. By adopting the surface burnishing process, we can simply improve the surface roughness and hardness of brass component. This whole concept is simply given by Hassan and Al-Dhifi. In addition we also observe that by adopting this process we can also enhance the wear resistance property of the material by studied the burnishing effect which includes force and velocity on the wear characteristics of the same alloy [30].

On more experiment is carried out by Satpal kundu et al to study the behavior of aluminium. The name of his paper is "study of dry sliding wear behavior of aluminium/SiC/Al2O3/graphite hybride metal matrix composite using taguchi technique". We simply use the stir casting process. For this he made a pin of AL6061T6/10%Sic/10% Al2O3/5% Graphite MMC. The specimen used having specification 12 mm diameters and 30 mm length. Input parameter while consideration several parameters like loading, sliding speed and sliding distance. And output parameter is weight loss of pin which can easily be measure by weighing machine. In their experiment, he simply use EN32 steel disk having hardness of about 65HRC. Taguchi method simply analyzes the wear condition and formulates the problem and gives best result about wear behavior of hybrid composite. ANOVA is used to judge the parameters which directly affect the wear rate. The end results which he has taken out are:

- Loading condition, sliding speed and sliding distance directly affect the wear rate (term which is consider is Load*Speed.
- Similarly frictional coefficient was directly affected by different loading condition, sliding speed and sliding distance (term which is consider is Load*distance) [31].

Sanjeev Sharma and Jayashree Bijwe, conduct an experiment on sliding a pin of composite. They use an abrasive paper which is made up off SiC. The whole analysis is totally based on single – pass linera motion with fixed speed. The complete examination is done at different loading condition. After the detail analysis of the process, the end result what we get is that inclusion of SiC enhance wear resistance property (approximately 15%).

Mohd S. Khan, Zahir Hasan and S. M. Farhan, also do one other experiment to simulate the result which we get from the previous work. Their work is mainly focus on wear rate measurement or the loss of weight due to wear by the effect of orientation and normal loading condition on brass (60Cu40Zn). Normal loading condition is varies from 5-20 Newton and speed approximately 2000 revolution per minute [32] [33].

Full factorial design of experiment (Anand Kumar, M.M. Mahapatra n, P.K. Jha 2013) based abrasive wear modeling of in-situ Al–4.5%Cu/x TiC (where x¼5%,7%and10%(wt%)) metal matrix composites. Applied load , sliding distance and weight reinforcement considered as a input variable and weight loss and coefficient of friction as responses (Belete Sirahbizu Yigezu and M.M. Mahapatra, 2013).

3.2 Analysis of variance:

S. Basavarajappa et al, were carried out "Application of Taguchi techniques to study dry sliding wear behaviour of metal matrix composites". In this study Aluminium metal matrix composites reinforced with SiC (Al 2219/Sic 15% weight) and graphite (Gr) (Al2219/SiC 15% weight + Gr3% weight) particles was prepared by stir casting process. Dry sliding wear behaviour of the composite was tested and compared with Al/SiCp composite. Experiment was done on pin on disk wear testing machine, where EN32 steel, hardness 65HRc disk was used. Output parameter was weight loss of pin. A plan of experiments based on Taguchi technique was used to acquire the data in a controlled way. An orthogonal array and analysis of variance was employed to investigate the influence of wear parameters like as normal load, sliding speed and sliding distance on dry sliding wear of the composites. After experiment they conclude that (1) adding of graphite partical in aluminium increase wear resistance of aluminium. (2) in SiCp composite sliding distance 57.57%, load 24.34% and sliding speed 6.8% effect on wear.(3) in SiCp-Gr composite sliding distance 57.24%, load 22.58% and sliding speed 9.66% effect on wear[31].

Sakip Koksal et al. were carried out "Experimental optimization of dry sliding wear behavior of in situ AlB2/Al composite based on Taguchi‟s method". A wear rate prediction model for aluminum based composites reinforced with 10 and 30 weight.% in situ aluminum diboride (AlB2) flakes was developed using Taguchi‟s method by considering the parameters of sliding velocity, normal load, sliding distance and reinforcement ratio. Having produced the in situ reinforced bulk of composite, the final shape of the test samples was given through stir casting process. The wear behavior of the specimen was investigated using pin-on-disk. where the pin sliding against a steel disk (AISI 4140 steel) under different conditions. The orthogonal array, signal-to-noise ratio (S/N) and analysis of variance (ANOVA) were employed to study the optimal testing parameters on composite samples. The experimental results demonstrate that (1) the applied load generated the highest influence on the wear rate while sliding distance was of no significant effect. (2) The specific wear rate was influenced primarily by applied load (58.2%), the amount of reinforcement phase (32.40%), and sliding speed (7.44%). (3)The higher the rate of reinforcement, the better is the ability of the samples to resist wear [34].

3.3 Artificial neural network on MATLAB

Artificial neural network is an important feature of MATLAB, which is use for analysing the wear of the material influencing under several factor. Several steps are generally while developing a neural network model. These are as follows:

- Selection of the material
- Processing
- Testing
- ANN(Artificial neural network) datasets
- ANN architecture
- Training
- Optimization

To know that which weight is to be consider or not, we simply use a diverse approaches (or pruning algorithms) to optimize the ANN architecture.

4. CONCLUDING REMARK:

In the present work, we simply analyze that wear rate directly affect the life of any component. So, it is very essential to study in detail, various parameters affecting the life of the product. For the accurate measurement of the value of wear rate, we develop a polynomial equation. On the basis of literature review, it is observe that several mathematical and simulation techniques are used under loading condition in between 5 to 20 Newton [32]. So, in order to achieve further development in this field, it is essential to exceed this limit. To examine whether the result comes under these analysis are worthwhile or not, whole process is analyzed by using MATLAB. So main objectives of research proposal are:

- To investigate or examine the various factor which directly affect the friction and wear rate.
- Formulation and modification of several regression equations with the help of various old research papers.
- Formulation of new equation, with new parameters and coefficients, with the help of

MATLAB and compare this with the previous research's equations.

- To develop the MATLAB code for a mathematical equation.
- Validate the result by exceeding the value of load beyond 20 Newton.

5. REFERENCES:

[1] http://allthingsnuclear.org/dlochbaum/the-bathtub-curve-nuclear-safety-and-run-to-failure

[2] Gesellschaft für Tribologie e.V.: GfT Arbeitsblatt 7: Tribologie - Verschleiß, Reibung, Definitionen, Begriffe, Prüfung (GfT, Moers 2002), in German.

[3] K.Tanaka, "Wear of polymer based composites, Sen'i Gakkaishi", vol. 31, 1975, pp. 234–241, http://dx.doi.org/10.2115/fiber.31.8_P234 (in Japanese).

[4] N.E. Bekhet, "Tribological behavior of drawn Polypropylene,Wear", vol. 236, 1999, pp. 55–61.

[5] J. F. Archard, "Wear Theory and Mechanisms," In: M. B. Peterson and W. O. Winer, Eds., Wear Control Handbook, ASME, New York, 1980, pp. 35-80.

[6] D. Tabor, "Friction and Wear—Developments over the Last 50 Years, Keynote Address," In: Proceedings of In- ternational Conference on Tribology—Friction, Lubrica-tion and Wear, 50 Years On, Institution of Mechanical Engineers, London, 1987, pp. 157-172.

[7] S. T. Oktay and N. P. Suh, "Wear Debris Formation and Agglomeration," ASME Journal of Tribology, Vol. 114, No. 2, 1992, pp. 379-393.

[8] N. Saka, M. J. Liou and N. P. Suh, "The Role of Tribol-ogy in Electrical Contact Phenomena," *Wear*, Vol. 100, No. 1-3, 1984, pp. 77-105.

[9] N. P. Suh and H. C. Sin, "On the Genesis of Friction and Its Effect on Wear," In: H. S. Cheng and L. M. Keer, Eds., Solid Contact and Lubrication, AMD-Vol. 39, ASME, New York, 1980, pp. 167-183.

[10] V. Aronov, A. F. D'Souza, S. Kalpakjian and I. Shareef, "Experimental Investigation of the Effect of System Ri-gidity on Wear and Friction-Induced Vibrations," ASME Journal of Lubrication Technology, Vol. 105, No. 2, 1983, pp. 206-211.

[11] V. Aronov, A. F. D'Souza, S. Kalpakjian and I. Shareef, "Interactions among Friction, Wear, and System Stiff-ness—Part 1: Effect of Normal Load and System Stiff-ness," ASME Journal of Tribology, Vol. 106, No. 1, 1984, pp. 54-58.

[12] V. Aronov, A. F. D'Souza, S. Kalpakjian and I. Shareef, "Interactions among Friction, Wear, and System Stiff-ness—Part 2: Vibrations Induced by Dry Friction," ASME Journal of Tribology, Vol. 106, No. 1, 1984, pp. 59-64.

[13] V. Aronov, A. F. D'Souza, S. Kalpakjian and I. Shareef, "Interactions among Friction, Wear, and System Stiffness—Part 3: Wear Model," ASME Journal of Tribology, Vol. 106, No. 1, 1984, pp. 65-69.

[14] J. W. Lin and M. D. Bryant, "Reduction in Wear Rate of Carbon Samples Sliding against Wavy Copper Surfaces," ASME Journal of Tribology, Vol. 118, No. 1, 1996, pp. 116-124. http://dx.doi.org/10.1115/1.2837065

[15] M. A. Chowdhury, M. K. Khalil, D. M. Nuruzzaman and M. L. Rahaman, "The Effect of Sliding Speed and Nor-mal Load on Friction and Wear Property of Aluminum," International Journal of Mechanical & Mechatronics En-gineering IJMME-IJENS, Vol. 11, No. 1, 2011, pp. 45-49.

[16] Walker, Roger. "Mass, Weight, Density or Specific Gravity of Different Metals". Density of Materials. United Kingdom: SImetric.co.uk. Retrieved 2009-01-09. brass – casting, 8400–8700... brass – rolled and drawn, 8430–8730.

[17] M. F. Ashby; Kara Johnson. "Materials and design: the art and science of material selection in product design." Butterworth-Heinemann. Dec 2002, pp. 223–. ISBN 978-0-7506-5554-5. Retrieved 12 May 2011.

[18] Jozef Balla, Professor, PhD. – Slovak University of Agriculture in Nitra Pavel Kovačócy, Assoc. Professor, PhD. - Department of Welding , Institute of Production Technologies, Faculty of Materials Science and Technology in Trnava, Slovak University of Technology Bratislava.

[19] Ahmad S.N., Hashim J. and Ghazali M.T., "The effect of porosity on MechanicalProperties of Cast Discontinuous Reinforced.", Vol. 3, No. 2, July-December 201, pp. 43-54.

[20] A.Wang,H.J.Rack, A statistical model for sliding wear of metal sinmetal/ composite systems, Act a Metallurgicaet Materialia 40(9)(1992)2301–2305.

[21] Modeling theabrasivewearcharacteristicsof in-situ synthesized Al–4.5%Cu/TiC composites Anand Kumar,M.M.Mahapatra n, P.K.Jha Department of Mechanical and Industrial Engineering, Indian Institute of Technology, Roorkee247667,Uttrakhand,India

[22] Blanchett, t.a., Kennedy, f.e., "The Development of Transfer Films in Ultra- High Molecular Weight Polyethylene/Stainless Steel Oscillatory Sliding, *Tribology Transactions",* Vol. 32, 1989, pp. 371-379.

[23] http://nptel.ac.in/courses/112102014/6

[24] Chattopadhayay (2001) surface wear analysis treatment and prevention 04 OSA.ASM international

[25] http://nptel.ac.in/courses/113106032/16%20-%20Properties%20and%20Applications%20of%20Matrials.pdf

[26] Effect of Orientation and Applied Load on Abrasive Wear Property of Brass 60:40 Mohd Shadab Khan1, Zahir Hasan2, Syed Mohd Farhan3

[27] J.Paulo Davim,"An experimental study of the tribological behaviour of the brass/steel pair", Journal of Materials Processing Technology, vol 100, 2000, pp. 273-277.

[28] Khaled Elleuch,"Sliding wear transition for the CW614 brass alloy", Tribology International, vol 39, 2006, pp. 290–296.

[29] H. Mindivan, "Microstructures and wear properties of brass synchroniser rings", Wear, vol 254, 2003, pp. 532– 537.

[30] Al-Dhifi SZS,"Improvement in the wear resistance of brass components by the ball burnishing process",Journal of Materials Processing Technology, vol 96, 1999, pp. 73– 80.

[31] Satpal Kundu, Dr. B.K. Roy, Ashok Kr Mishra, "study of dry sliding wear behavior of aluminium/SiC/Al2O3/graphite hybride metal metrix composite using taguchi technique", International Journal of Scientific and Research Publications, Vol. 3, Issue 8, August 2013, pp. 2250-3153.

[32] Mohd S. Khan, Zahir Hasan and S.M. Farhan, "Effect and Orientation and applied Load on Abrasive wear propertyof Brass 60:40", Journal of Minerals and Material Characterization and engineering (JMMCE), Vol 2, NO.

4, 2014, pp. 49-53.

[33] M. S. Khan and Z. Hasan, "Effect of orientation and applied load on Abrasive Wear Property of Aluminum Alloy-Al6061," International Journal of Mechanical Engineering & Technology (IJMET), vol 4, No, 4, 2013, pp. 80-87.

[34] Sakip Koksal, Ferit Ficici, Ramazan Kayikci, Omer Savas, "Experimental optimization of dry sliding wear behavior of in situ AlB2/Al composite based on Taguchi‟s method", Materials and Design, vol. 42, 2012, pp. 124–130.