



# Analysis for A mathematical to predict the abrasive wear

Md. Ali Anshari

University of Baghdad, Baghdad, Iraq

## ABSTRACT

*In this study, a mathematical model has been developed to predict the abrasive wear behavior of pulp fiber strengthened compound composite. The experiments are conducted victimisation full factorial style within the style of experiments (DOE) on pin-on-disc sort wear testing machine, against four hundred grit size of paper. In the second order polynomial model has been developed for the prediction of wear and tear loss. The model was developed by response surface technique (RSM). Analysis of variance technique at ninety fifth confidence level was applied to ascertain the validity of model. Result of volume proportion of reinforcement, applied load and slippy speed on abrasive wear behavior was analysed intimately. To judge the potency and skill of the model, comparison of expected and experimental response values outside the look conditions was applied. The result shows, sensible correspondence, implying that, the empirical models derived from response surfaces approach will be accustomed describe the tribological behavior of the on top of composite.*

**Keywords:** DOE, RSM, Full factorial design, bagasse fiber.

## 1. INTRODUCTION

In the recent years, natural fibre bolstered with polymer matrix have attracted the eye as a result of of their low price, light-weight, renewability, low density, high specific strength, non-abrasivity, combustibility, non-toxicity, low price and biodegradability. the provision of natural fibres and simple producing have tempted researchers to try domestically accessible cheap fibres and to review their practicability of reinforcement functions and to what extent they satisfy the desired specifications of good bolstered compound composite for tribological applications. In tropical and equatorial countries, fibrous plants like banana, oil palm, bamboo, sugarcane, etc. square measure accessible in abundance [3] and fibres like sugarcane [6] seem to possess a considerable interest as reinforcement in compound matrices for cheap composites. they're wide used in the assembly of bearing elements employed in automobile industries like gears, wheels, bushes, etc. [8] within which friction and wear square measure essential issues. The importance of tribological properties convinced several researchers to review the friction and wear behavior and to boost the wear and tear resistance of polymeric composites.

Little info regarding the tribological performance of fiber bolstered composite material [14] has been according. Basavarajappa et al. [15] studied the dry slippy wear behavior of graphite crammed glass epoxy composites and finished that Addition of C in glass-epoxy composite exhibits lower weight loss, whose worth drops because the percentage of C will increase within the composite.

U.K.Dwivedi et al. [16] investigated on the influence of MA-g-PP on abrasive wear behavior of shredded sisal fiber bolstered polypropelene composites. They concluded that the addition of MA-g-PP couplingagent has considerably influenced the wear and tear resistance of sisal fibre bolstered PP composites. Besides experimental work on natural fibre primarily based composite, researchers have worked on completely different mathematical models to predict the fabric properties. Most of those researchers have worked on Metal Matrix composite (MMCs). Sahin and Ozdin [17] investigated the abrasive wear behaviour of aluminium primarily based composites victimisation pin on disc kind of machine and developed in terms of the applied load, slippy distance and particle size victimisation factorial design. N.S.M. El-Tayeb et al.[18] Studied the cryogenic impact on resistance behaviour of atomic number 22 alloy slippy against W inorganic compound victimisation response surface methodology (RSM) approach and expressed the relation between the friction constant (response) and freelance variables like speed, load, and slippy distance. Farias et al. [19] studied the slippy wear of primary solid solution unsullied steels. They adopted to get associate degree empirical model of damage rate as a perform of applied load and slippy rate victimization RSM. From these discussions it's



clear that tho' lot of labor has been done on MMCs, as per the information of author no work has been done on the use of RSM technique to predict the tribological performance of natural fibre composite.

Therefore within the gift work an endeavor has been made to analyze the abrasive wear behaviour of bagasse fiber bolstered epoxy composite beneath various testing conditions. RSM was adopted to obtain associate degree empirical model of damage loss (response) as a perform of quantity of reinforcement, applied load and slipperly rate (input factors).

## 2. METHOD & STRATEGIES

### Fabrication of composites

The type of epoxy glue utilized in the current investigation is LY 556 and hardener HY951 supplied by Ciba- Geigy of Asian nation restricted. Epoxy is mixed with hardener within the quantitative relation 10:1 by weight. Different volume fraction of shredded pulp fibers (10, fifteen and 20%) were more on an individual basis within the higher than epoxy combine and stirred for ten min by a glass rod to obtain uniform dispersion. the ultimate resultant mixture of chopped pulp fiber and organic compound was poured into cylindrical mould [Fig.1] and stuck properly.

$$X \times Y = d_0 2Y + d_1 2^2 Y + d_2 2^4 Y + \dots + d_{N/2-1} 2^{N-2} Y.$$

$$Z = \sum_{i=0}^{N-1} z_i 2^i + \sum_{i=N}^{2N-1} z_i 2^i$$

During fixing a number of the chemical compound combine squeezed out. Care was being taken for this within the experiment to create composite pins of length thirty five milli metre and diameter of ten mm. The samples were unbroken within the moulds for solidification at temperature (29 0C) for twenty-four hour. Cured samples were then far from the moulds and used for different measurements.

### Response surface methodology (RSM)

Response surface methodology (RSM) is sensible, economical and comparatively straightforward to use. RSM is a collection of mathematical and applied mathematics techniques that are helpful for the modeling and analysis of problems within which output or response is influenced by many input-variables and objective is to search out the correlation between the response and therefore the input variables. It compares: planning a group of experiments, determinant a mathematical model and determining the best worth of the response to better understanding of the general system behavior [2]. A polynomial model of second order sort was proposed to represent the connection between wear loss and tribo take a look at freelance variables. The performance of the model depends on an oversized variety of factors that may act and move during a complicated manner. within the gift work, the input variables are wt. capitalize on reinforcement (R) or fiber concentration, Sliding rate (V), and traditional applied load (L) and the output (response) is wear loss (w).

### Pin-on-disc wear check

Wear tests were disbursed by employing a pin-on-disc wear tester equipped by wine bottle, Bangalore. Abrasive paper of four hundred grade (grit-23 μm) was glued on a rotating disc (EN thirty one Steel disc) of 120mm diameter victimisation double-sided tape. The sample pin was mounted during a holder and was skinned under totally different applied hundreds (5N, 7.5N and 10N).

Each set of check was disbursed six times for a amount of 15 minutes run. When every fifteen minutes run the check items were aloof from the machine and weighted accurately to work out the loss in weight.

## 3. ANALYSIS OF WORK

Analysis of variance (ANOVA) and therefore the F-ratio take a look at have been performed to examine the adequacy of the model furthermore because the significance of the individual model coefficients. The analysis of variance was applied on the model for a confidence level of ninety fifth. The results of analysis of variance tables for wear loss square measure listed in Table. Table two presents the analysis of variance table for the second order model propose for wear loss given in equation. It are often appreciated that the P-value is a smaller amount than 0.05 which implies that the

model is important at ninety fifth confidence level. what is more, the importance of each constant within the full model was examined by the t-values and P-values and therefore the results square measure listed in Table 3. The larger values of t-test and smaller values of ‘‘P’’ indicates that the corresponding constant is

**Residual Plots for wear loss**

The regression model is employed for determinative the residuals of every individual experimental run. The difference between the measured values and foretold values ar known as residuals. The residuals are calculated and ranked in ascending order. The conventional chances of residuals ar shown in Fig. 1. the conventional chance plot is used to vary the normality assumption. As shown in Fig. 1, the info are unfold roughly on the line. Hence it are often ended that the info are unremarkably distributed [2].

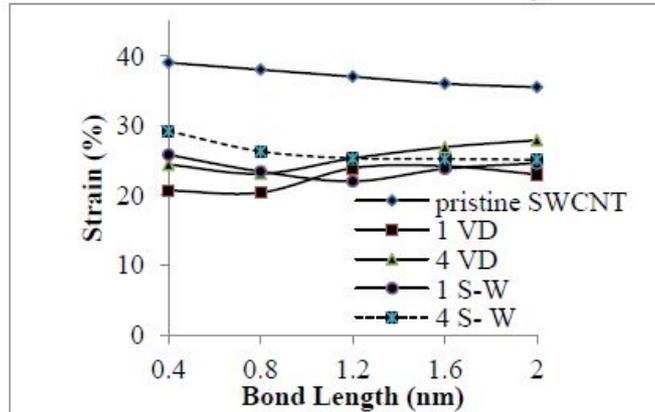


Fig 1

Figure two is employed to point out the correlation between the residuals and from this, it's stressed that a tendency to possess runs of positive and negative residuals indicates the existence of a particular correlation. Also the plot shows that the residuals are distributed equally in each positive and negative on the run. Thence the info are often said to be freelance.

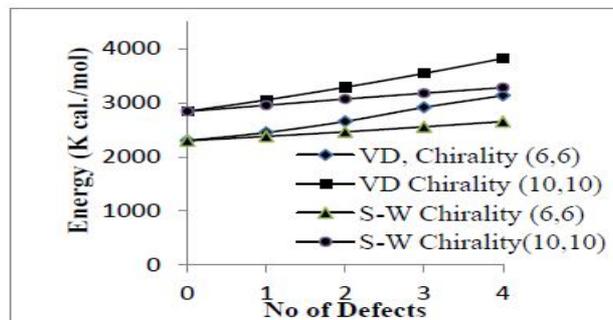


Fig 2

Figure three indicates the residuals versus fitted values, which shows solely the most variation of-0.5 to 0.5 mm in wear loss between the measured and therefore the fitted values. This plot doesn't reveal any obvious pattern and hence the fitted model is ample.

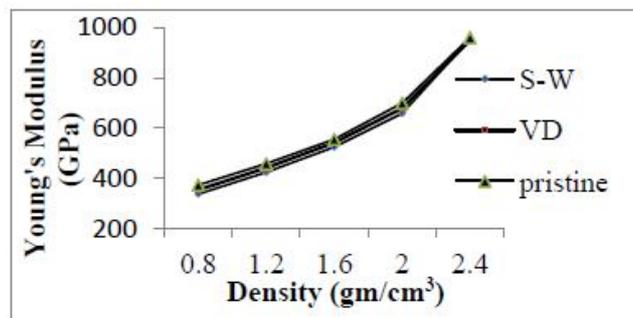


Fig. 3



Checking Adequacy of Mathematical Models The goodness of match of the mathematical models was conjointly tested by constant of determination ( $R^2$ ) and adjusted constant of determination ( $R^2$  adj). The  $R^2$  is that the proportion of the variation within the variable explained by the regression model. On the opposite hand,  $R^2$  adj is the coefficient of determination adjusted for the amount of freelance variables within the regression model.

Unlike  $R^2$ , the  $R^2$  adj could decrease if the variables square measure entered within the model that doesn't add considerably to the model match. The  $R^2$  and  $R^2$  adj values of mathematical models square measure found zero.929 and 0.907 severally that clearly indicate the superb correlation between the experimental and also the foretold values of the responses.

Validity of the Models The performance of the developed model was tested victimisation 5 experimental knowledge that were ne'er used in the modeling method. The results foretold by the developed model were compared with the measured values and conjointly average proportion deviation ( $\phi$ ) was calculated and conferred within the Table six. The results indicate that the model foretold wear loss has smart validity with acceptable proportion deviation.

#### 4. CONCLUSION

In this study, full factorial style of experiments has been used to develop a second-order polynomial equation for describing abrasive wear behaviour of bagasse fiber bolstered Epoxy composites. The relationship of abrasive wear loss with fiber concentration, applied load and slippery speed has been with success obtained by victimisation RSM at ninety fifth confidence level. This model is valid at intervals the ranges of selected experimental parameters of fiber concentration, applied load and slippery speed. The accuracy of the RS model was verified with 3 sets of experimental knowledge that were ne'er utilized in modeling and average proportion deviation calculated as 7.542%.

#### REFERENCE

- [1.] Leach, M. P., & Liu, A. H. (2003). investigating interrelationships among sales training evaluation methods.pdf. *Journal of Personal Selling Sales Management*.
- [2.] Leach, M. P., Liu, A. H., & Johnston, W. J. (2006). The Role Of Self-Regulation Training In Developing The Motivation Management Capabilities Of Salespeople. *Industrial Marketing*, 25(3), 269–281.
- [3.] Lilly, B., Porter, T. W., & Meo, A. W. (2003). How Good Are Managers At Evaluating Sales Problems? *Journal of Personal Selling & Sales Management*.
- [4.] Little, B. (2012). Identifying key trends in sales – from a training perspective. *Industrial and Commercial Training*, 44(2), 103–108. doi:10.1108/00197851211202948
- [5.] Mark. (2003). ST evaluation.pdf. *Journal of Personal Selling & Sales Management*.
- [6.] Menguc, B., & Kim, Y. C. (2011). Salespeople ' S Knowledge-Sharing Behaviors with Coworkers outside the Sales unit. *Journal of Personal Selling Sales Management*, XXXI(2), 103–122.
- [7.] Meyer, H. H., & Raich, M. S. (1983). An Objective Evaluation Of A Behavior Modeling Training Program. *Personnel Psychology*, (page 49), 755–762.
- [8.] Miao, C. F., Lund, D. J., & Evans, K. R. (2009). Reexamining The Influence Of Career Stages On Salesperson Motivation: A Cognitive And Affective Perspective. *Journal of Personal Selling Sales Management*, XXIX(3), 243–255. doi:10.2753/PSS0885-3134290303
- [9.] Michaels, R. E., Marshall, G. W., Laforge, B., Dubinsky, A., Jolson, M., Cron, B., Dalrymple, D., et al. (1999). Marketing education in the 21st century perspectives on selling and sales management education. *Management Science*, 12(2).
- [10.]Morrow, C. C., Jarrett, M. Q., & Rupinski, M. T. (1997). Investigation of the Effect and Economic Utility of Corporate-Wide Training. *Personnel Psychology*, 50(1), 91–117. doi:10.1111/j.1744-6570.1997.tb00902.x
- [11.]Krishnan A, Duajardin E, Ebbesen TW, Yianilos PN, Treacy MMJ. Young's Modulus of Single-Walled nanotubes, *Phys. Rev. B*, 58(1998) 14013-14019.
- [12.]Thostenson ET, Li C, Chou TW. Nano composites in context, *Comp. sci. and tech.* 65(2005) 491-516.
- [13.]Belytschko T, Xiao SP, Schatz GC, Ruoff R. Atomistic simulations of nanotube fracture, *Phys Rev B* 65(2002) 1–8.
- [14.]Zhang P, Lamert PE, Crespi VH. Plastic deformations of carbon nanotubes, *Phys Rev Lett*, vol. 81, pp.5346-5355, 1998.