

# Effect of material hardness, counter-face hardness and load on the tribological properties of virgin and glass filled PTFE using Taguchi Approach

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**Abstract.** The present paper aims at evaluating the tribological performance of virgin and glass fiber filled PTFE against different steel counterfaces to co-relate the effect of material and counterface hardness on friction and wear performance. The influence of load on friction and wear of virgin and glass fiber filled PTFE is also studied. The experiments were designed according to Taguchi's L18 orthogonal array and conducted on a pin on disc reciprocating tribometer. Analysis of variance was used to determine the effect of various parameters on coefficient of friction and wear rate. The results revealed that the counterface hardness is the dominant factor affecting the COF and the material hardness is the dominant factor influencing the wear rate. Regression analysis was carried out to predict the outcomes of the experiments. The predicted and measured values show a good degree of proximity. Further, confirmation tests were also conducted with the random parameter combinations for validation of the regression equations. Furthermore, contour plot analysis has also been carried out to ascertain the ranges of COF and wear rate for different settings of control factors.

## 1. Introduction

PTFE is a valuable polymer based engineering material. It is used as a self-lubricating material, exhibiting very low coefficient of friction. It has been extensively used in bearings and seals applications [1, 2]. However, it shows poor wear resistance, which restricts its application [3]. For a good bearing material, properties like coefficient of friction and wear rate should be low but these two are practically conflicting requirement in case of PTFE. Addition of different fillers improves the wear resistance of PTFE as reported by different researchers. Khedkar et al. [4] investigated the wear properties of PTFE and composites with different fillers viz., MoS<sub>2</sub>, PPDY fibers, graphite, glass fibers and carbon and observed that the addition of fillers improves the hardness and wear resistance of PTFE. Lancaster et al. [5] reported that high aspect ratio fillers like carbon fibers and glass fibers can improve the wear resistance of PTFE due to better load supporting action by fibers. Moreover, the size, shape and type of filler materials also influences the tribological properties [6].

Taguchi techniques have been used in the recent past, in tribological investigations of polymers, to optimize the wear process based on various control factors like load, hardness, sliding distance, sliding velocity etc. [7-11]. Mudassar Pasha et al. [7] studied the wear properties of Polytetrafluoroethylene composites with glass and bronze as fillers using Taguchi technique and observed that load and sliding distance are the most significant factors affecting wear. Pattanaik et al. [11] studied the tribo-behaviour of fly ash filled epoxy composite using Taguchi technique and found that normal load is the most

