## LITERATURE REVIEW -

## As the aluminum is the lighter material so it is use for making much industrial and household equipment. As the aluminum the aluminum is soft and ductile so some alloying materials are added such as magnesium, manganese, copper, zinc etc [2]. By the addition of these alloying elements there is loss of the ductility of the aluminum but they provide strength to the alloy. The wear behavior of the aluminum has been studied at various compositions of the alloying elements.

**Robinson**[60] had found the wear of the anodised layers obeyed the generally accepted laws of abrasion; wear was proportional to load and sliding distance, and was independent of speed and of the apparent contact area. Apart from a slight increase just below the surface, the wear resistance was essentially constant through the depth of the anodizing and did not depend on the initial thickness of the layer. Four of the anodised coatings wore at about the same rate. Their wear resistance was greater than that of the underlying aluminium alloy in the same ratio as has previously been found for solid alumina.

**Fernandes** [61] had found A novel borate/boric/sulphuric acid anodising process is studied. The results show that the physical structure of the films is influenced not only by the bath used, but also and mainly by the substrate, i.e., Al 2024-T3 or Al. The corrosion resistance of the anodised specimens is satisfactory for practical applications and the fatigue resistance is not significantly different from that obtained with the traditional chromic acid anodising.

# Gangling [62] had found The thickness, chemical composition and microstructure of anodised coatings formed on magnesium alloy AZ91D at various anodising current densities were measured. It was found that all these parameters could be affected by anodising current density, and hence the coatings formed at different anodising current densities had different corrosion resistances. This suggests that the corrosion performance of an anodised coating could be improved if a properly designed current waveform is used for anodising. In addition, based on the experimental results, some physical, chemical and electrochemical reactions involved in theanodising process were proposed to explain the anodising behaviour in this paper.

## Zhang et al. [63] Examined the extent of plastic deformation that occurred below the contact surfaces as a result of dry sliding wear in an Al-7Si alloy. In this study, profiles of both the shear strain and micro hardness distributions were determined in the worn region. For dry sliding, it was found that the magnitude of the plastic strains and the depth of the heavily deformed subsurface zone increased with both sliding distance and applied load. The wear process was observed to follow Suh’s delamination wear theory. Delamination cracks were formed by the growth and coalescence of voids at a critical depth (10-20 µm) below the wearing surface

In a review paper concerning topographical features of worn Al-Si alloys in dry sliding, Clarke and Sarkar’ made the following statements:

The mutual transfer of material between the wearing Al-Si and the steel counterface appears to be a feature of all wear regimes and becomes more significant as load Increases.

The transition from mild to severe (metallic) wear is associated with the existence of a Delamination wear process. Although Pramila **Bai and Biswas** reported that Si additions (4-24%Si) improved wear resistance of aluminium, no relationship between wear rate as a function of Si content was found. Wear rate increased linearly with applied pressure but was independent of sliding velocity. The value of the friction coefficient was found to be insensitive to applied pressure, Si content and sliding velocity. The fact that no transition in wear mechanism was observed with increased pressure, as reported by **Sarkar,** could be due to the narrow range explored (0.105-1.733 MPa). These findings were contradicted in a study published by **Clarke and Sarkar,** where it was reported that the wear resistance of Al-Si alloys improved with Si content up to a near-eutectic composition. Furthermore it was indicated that Si additions improved seizure resistance, with the optimum Si content corresponding to the near-eutectic value

Work on the dry sliding of an Al-17Si alloy by **Krishna Kanth** et a1.69 confirmed the existence of a transition in wear rate related to applied pressure. The applied pressure range investigated was l-30 MPa.

**Shivanath** et al.‘” classified the two wear mechanisms in the dry sliding of Al-Si alloys as oxidative and metallic wear:

Oxidative wear occurred at low applied loads. In this wear process an aluminium oxide layer lo-80 pm) formed on both the wearing Al-Si surface and the counter face. Wear occurred firstly by oxidation of the asperities and then secondly by fracture and compaction of the oxidized wear debris into this film. The wear rate was low, due to the amount of metal removed being confined to the thickness of this oxide formation. Some localized deformation of the substrate and fracture of the Si particles was observed. Oxidative wear was considered to be generally independent of the Si content or Si particle size. Metallic wear became the predominant wear process at higher applied loads. The Al-Si wear surface was characterized by plastic deformation and fracture, significant transfer of material between the sliding surfaces and wear debris formation. The amount of plastic deformation and the higher wear rate prevented the formation of an oxide layer. A higher Si content was reported to increase the load at which this wear regime was active

**Haque & Tuti** [68] studies show the increase in wear with an increase in input weight, rotational speed and sliding distance is observed for both the as-cast and heat-treated specimens of aluminum-silicon eutectic alloy. The wear is more pronounced in the as-cast samples compared to the heat-treated ones due to some inherent characteristics obtained during different heat treatment cycles. The volumetric and specific wear rates are also increased with the increase of rotational speed, but with the increase of input weight and sliding distance both wear rates show towards decreasing trend. The contacting surfaces of the materials become work-hardened due to sliding with higher load, which results slower wear rate.

**Honda & yoneda** [64] finding says about Sliding wear tests of high tensile strength aluminium alloys were conducted using extruded AI -Zn-Mg alloy (7004-T6) and AI--Cu-Mg alloy (2024-T4). The following results were obtained.

. In paraffin oil, the wear rates were about 1 / 10 those under dry conditions. The wear rate of T00 gT6 was greater than that of 2024-T4, but the difference became smaller with increasing contact load. 7004-T6 showed a lower friction coefficient compared with 2024-T4 at every contact load. When the wear rates were compared at the same friction force, that of 7004-T6 was greater than the 2024-1"4 value at every friction force. this result was due to the difference in wear particles. Namely, for 7004-T6 wear cracks which would propagate in the sliding direction occurred and large and elongated wear particles were detached. 2024-T4 produced many small wear cracks, resulting in detachment of small wear particles, The wear behaviour seems to be affected by the material characteristics which are responsible for the differences in fatigue behaviour rather than tensile strength or hardness.

According to **karacan & durmus** [65] It was determined that AA 2024 alloys had higher hardness values than AA 6063 alloys. It was determined by hardness measurement that the hardness value of the heat treated aged sample of AA 2024 and AA 6063 alloys was higher than the samples which are not aged. It was also determined that the temperature and period of aging decreased the resistance of the material and its hardness value after a certain level. It was speciﬁed that reason of this could be the decrease of hardness value of the material in the course of time as a result of the fact that precipitations formed in the structure increased to the amount that cannot prevent the dislocation movement. It was also determined in wear tests that by increasing sliding velocity, sliding distance and load, the amount of wear also increased. The amount of mass loss was observed to increase with increasing the load, and the amount of the maximum wear loss was determined to be in 30 N load. The amount of wear loss was determined to change in parallel with the hardness value depending on the temperature and period of aging.

By **yang** [66] Pin-on-disc experiments were carried out with Duralcan 284 MMC with two nominal specimen contact areas, 6 ×6 mm² and 10 × 10 mm² and tested with loads of 74 and 98 N, and speeds of 200 and 275 m/min. It was found that the wear coefficient values obtained for the specimens with a smaller nominal contact area were lower, by about 12 to 32% based on the measured and predicted values, respectively, as the wear asperity volume available is smaller. This observation also agrees well with the adhesive wear theory. Furthermore, the results obtained from this work has also provided a good explanation to the variation of wear coefficient values of tungsten carbide encountered in the previous studies.

**Dwivedi** [67]foundWear rate of both the binary and multi-component hypereutectic Al–17%Si alloys initially decreases with increase in sliding speed up to a critical speed, it then increases. Load at which wear rate increases with increasing sliding speed was found higher for multi- component alloy than the binary Al–Si alloy. Wear rate of binary alloy was somewhat higher than multi-component alloy under identical sliding condition. The presence of alloying elements increases the wear and seizure resistance. Friction coeﬃcient decreases with the increase in sliding speed for both the alloys used in this experiment. Higher friction coeﬃcient was found higher for binary Al–Si alloy than the multi-component alloy.

. Alpas et al. [20,43-44] investigated the effect of silicon particle reinforcement on the dry sliding wear of an A356 alloy under different applied load (0.9-150N) in this study of the wear behavior of an A356 alloy. Three different regimes are identified as summarized below:

Regime I (< 10): in this wear regime the composites exhibited a low wear rate then the unreinforced alloy. The wearing composite surface also possessed an iron rich transferred layer (5-10µm) that indicated a material transferred process was active. Wear proceed by the spalling of iron rich layer. The silicon particle acted as a load bearing phase. The addition of SIC phase impended the transition of the regime II.

Regime II (10-95 N): wear rate of both materials is similar in this regime with surface morphologies characterize by the severe plastic deformation. The applied load produced stresses higher than fracture strength of the SIC phase, therefore the matrix was in direct contact with steel counter face and large plastic strains resulted in the formation of tribolayer. Delimitations wear was the predominant wear mechanism. In the case of the composite, sub-surface crack occurred via decohesion at the SIC matrix interface and for the A356 alloy, sub surface nucleation was associated with the Si particle. The wear rate was generally independent of the size of volume fraction of Si particles.

Regime III (>98): at these high applied loads the wear rate of the A356 alloy was about two orders of magnitude greater than regime II. Severe wear was associated with adhesion of the aluminum to the steel counter face and the occurrence of the thick irregular plate like wear debris particle (200-500µm). Plastically deformed zone penetrated to depth of 300-400 µm. the silicon phase appeared to be responsible for the improving wear resistance of this alloy.

Alpas et al. [45] reported Sliding wear studies of an Al 6061 alloy containing 20 % Al2O3p, performed at elevated temperatures (25-500˚C), have been published recently. Their research shows that iron from the counter face oxidised and was then deposited on the composite surface. It was proposed that this resulted in an improvement in wear resistance in the mild wear regime (ring-on-disc, sliding speed 0-2 m/ s, applied load 1-50 N). This reduction in wear rate due to the formation of the iron oxide phase on both sliding surfaces was attributed to the fact that iron oxides can act as solid lubricants.

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Koji Kato et al. [30] observed the friction and wear are responses of a tribo-system. Coefficients of friction and wear are parameters describing the state of contact of bodies in a tribo-system, and they are not material constants of the bodies in contact. They may be treated as material properties for technical conveniences with an engineering sense only in some special states of contact. Friction and wear, as two kinds of responses from one tribo-system, must be exactly related with each other in each state of contact in the system, although a comprehensive simple relationship should not be expected. Technical senses of past iridologists, on the other hand, have already introduced successful methods of controlling wear without asking details of wear mechanisms. They are soft or hard film coating, multi-phase alloying and composite structuring in addition to traditional method of lubrication. It would be helpful for the understanding of wear mechanisms to confirm the tribo-characters of materials by those methods, in the viewpoints of wear and friction, by describing the tribo-phenomena with the representative terms of ‘‘roughness, hardness, ductility, oxide film, reaction layer and adhesive transfer’’ When adherence between coating and substrate plays the major role in wear of the coating.