2. 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. 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 % Al_2O_3p, 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.

Zhang et al. [46] 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.

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.

Aluminum alloy coating of compositions, aluminum 98.76%, magnesium 0.81%, and manganese 0.41% was successfully prepared by two wire arc sprays on the graphite substrate. There are different thermal spray process such as combustion flame spray, high velocity oxy- fuel spray, plasma spraying , vacuum plasma spraying and cold sprays. But the coating produced by two wire arc spray having less porosity (1-2% only) and the process is easy to control. The graphite substrate was used because the coating after solidification does not adhered over the graphite substrate. After solidification it was removed from the graphite substrate. The coating was cut in the form of circular disc of diameter 5 cm and pasted on a sheet of diameter 17 cm with the help of araldite. There are different wear test such as scratch test, slurry abrasion test, erosion test and pin on the disc test. The selection of the wear test depends on the material of the coating and its applications. For marine applications of the coating slurry erosion and corrosion test are commonly perform. But in case of dry applications of the coating the pin on disc and scratch test are commonly perform. For the present study two variables were selected for wear test that was load (29.4, 44.1 and 58.8 N) and sliding speed (150, 200 and 250 rpm). To find the significant variables which affect the wear rate and coefficient of friction of the coating ANOVA was designed. Wear test of the coating was conducted on pin on disc machine under dry conditions. The wear rate was calculated by mass loss methods. The wear disc was weigh before and after the wear test on an electronic balance having least count 0.0001g. The coefficient of friction was found with LVDT which give the frictional force during wear test. The surfaces morphology of worn surfaces of the coating was analysed with scanning electron microscope. The XRD of the worn surfaces was done to determine the change in intermolecular spacing of the worn surfaces of the coating. The wear rate of the coating was found to be increased with increased in load as well as sliding speed. The co-efficient of friction of the coating was found to be decreased with increased load and sliding speed. The d-spacing of the coating molecules on the wear track was found to be decreased with increased in load during the wear test. The microstructure of the worn surfaces of the coating was also examined with optical microscope and no change in microstructure of the coating due to frictional heat was observed. The micro hardness at the cross section of the coating at the wear track was found to be decreased away from the wear track. The main wear mechanism examined by scanning electron was adhesion, deformation and microcutting.