THE REPUBLIC OF TURKEY
BAHCESEHIR UNIVERSITY

ELECTRIC CONDUCTIVITY AND RESISTIVITY OF ALUMINUM ALLOYS FOR THE APPLICATION OF ELECTRIC COUNTERS

Master's Thesis

İPEK YAZICIOĞLU

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THE REPUBLIC OF TURKEY

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DEDICATION

I dedicate my thesis work to my family, my friends and my thesis supervisor. A special thank to my adoring parents Özlen and İsmail Yazıcıoğlu. Thank you for your unconditional support with my studies and giving me the opportunity to prove and improve myself through all my walks of my life. I am honored to own you as my parents. My best friends Derya Ertaş, Sevcan Lena Lutzke and Nazlı Bilici have never left my side during my studies for my thesis.

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ABSTRACT

ELECTRIC CONDUCTIVITY AND RESISTIVITY OF ALUMINUM ALLOYS FOR THE APPLICATION OF ELECTRIC COUNTERS

İpek Yazıcıoğlu

MECHATRONIC ENGINEERING

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The energy lost in electric meter is an important issue to minimize. Due to the resistance of materials used in material deformation occurs in the electric meter and is energy loss. One of the reasons that are not fully tightened the screw terminals and is also used for relaxation over time.

In the first part, properties and deformation of the aluminium (aluminium) alloy was examined. According to the kinds of aluminum alloys it has been found that these characteristics be different.

In the second part, copper plating of the selected 1000 series aluminum alloy have been made. Immersed in the aluminum alloy is copper-coated copper bath at different times depending on the time on the wires of different thickness.

In the third part, and 1000 series aluminum wire, but features aluminum alloy coated type constant current through resistance over copper wires of different thickness were measured. At the same time the constant current is passed through the terminal screw tightening torque and wires of different measured resistances were compared.

The results of keeping constant the current flowing through the wire, which vary depending on the torque of the change in resistance was observed torque increases resistance decreases. It is also important number of torque with the wire of the materials used in electricity meters and clamps no screws and have observed that, the more bored wire that extends the contact area and the fall of the junction of resistance and power transmission.

Keywords: Aluminum Alloys, Electrical Conductivity, Electrical Resistivity, Electric Counters, Tightening Torque

ÖZET

ELECTRIC CONDUCTIVITY AND RESISTIVITY OF ALUMINUM ALLOYS FOR THE APPLICATION OF ELECTRIC COUNTERS

İpek Yazıcıoğlu

Mekatronik Mühendisliği

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Elektrik sayaçlarında kaybolan enerjiyi en aza indirmek önemli bir konudur. Elektrik sayaçlarında kullanılan malzemelerin direnci nedeniyle malzemelerde deformasyon meydana gelmekte ve enerji kaybı olmaktadır. Bunun sebeplerinden biri de kullanılan klemens vidalarının tam sıkılmaması ve zaman içinde gevşemesidir.

Birinci Bölümde, alüminyum alaşımların özellikleri ve deformasyonları incelenmiştir. Alüminyum alaşımların çeşitlerine göre bu özelliklerin farklı olduğu tespit edilmiştir.

İkinci Bölümde, seçilen 1000 serisi alüminyum alaşımın bakır kaplaması yapılmıştır. Farklı sürelerde bakır banyo içinde bekletilen alüminyum alaşımlı tellerin üzerine süreye bağlı olarak farklı kalınlıkta bakır kaplanmıştır.

Üçüncü Bölümde, 1000 serisi alüminyum tel ile, aynı özelliklere sahip alüminyum alaşımlı telin farklı kalınlıklarda bakır kaplanmış türleri üzerinden sabit akım geçirilerek dirençleri ölçülmüştür. Aynı zamanda klemens vidaları farklı torklarda sıkılarak teller üzerinden sabit akım geçirilmiş ve ölçülen dirençler mukayese edilmiştir.

Araştırma sonucunda teller üzerinden geçen akımın sabit tutularak, direncindeki değişimlerin torka bağlı olarak değiştiği, tork arttıkça direncin düştüğü gözlemlenmiştir. Elektrik sayaçlarında kullanılan tellerin malzemesi ile birlikte tork sayısının da önemli olduğu ve klamens vidaları ile daha fazla sıkılan telin temas alanının genişlediği ve birleşme yerindeki direncinin düştüğü ve elektrik iletiminin iyileştiği gözlemlenmiştir.

Anahtar Kelimeler: Alüminyum Alaşımlar, Elektrik İletkenliği, Elektrik Direnci, Elektrik Sayaçları, Sıkıştırma Torku

CONTENTS

TABLES

FIGURES

ABBREVIATIONS

Al : Aluminum

Cu : Copper

Mg : Magnesium

Mn : Mangan

Nm : Newtonmeter

Si : Silisium

Zn : Zinc

1. INTRODUCTION

Aluminium metal is today the most widespread usage because of the advantages of mechanical properties after the steel alloy. Aluminum is ideal and the beginning of the most important features that make economical material; Besides having the appropriate mechanical properties, low weight, is recyclable, and can be formatted easy workability, high electrical and thermal conductivity, such as lack of use due to its magnetic properties were widespread.

Aluminum, although the third most abundant element on earth after oxygen and silicon, industrial-scale production has been realized with the introduction of the electrolysis process used in 1886.

In 1886, Werner von Siemens In dynamo discovery and in 1892 KJ Bayer's production of industrial-scale aluminum with finding the Bayer process, enabling the resulting alumina from bauxite is very easy and this young metal, after iron and steel was second metal most used in the world.

Be of good casting properties and is easily adapted to many casting process, mechanical properties of the various metallurgical processes as a result of the development, have good corrosion properties, the extent of use of aluminum are the most important reason for the prevalence.

Parallel to the increase in world consumption of aluminum consumption is growing rapidly in Turkey. One of the biggest share in the process of forming an aluminum extrusion technology. The driving force behind the developments in Turkey for aluminum extrusion sector in the field of architecture. With the advances in this sector usage share is predicted to increase in the automotive sector.

The use of aluminum and its alloys in recent years have increased at a great pace, aluminum and its alloys has entered into every branch of industry. Such rapidly gained importance to accelerate the work done on aluminum and its alloys, aluminum alloys are made and new features are being developed those made earlier. One of those aims is applied method in heat treatments, alloys are given to the implementation of these versatile features.

Most existing metals aluminum takes second place in the world ranking. Various alloying of aluminum metal and has been able to achieve very different physical and mechanical properties with different heat treatment requirement. Close to four hundred in number of aluminum alloy has been developed for industrial application purposes. Low density aluminum alloys, can be easily shaped, high corrosion resistance, possess improved physical and mechanical properties that increase the field of use of these alloys.

Aluminium has a density of about 2.7 g / cm^3 is steel (7.83 g / cm^3), and copper (8,93g / cm^3) is approximately one third of the density. Although the low strength of steel, equivalent strength steel is achieved by increasing the cross-section. In many constructions the use of aluminum alloy for making a reduction in weight is advantageous. The modulus of elasticity of steel, but aluminum is about one-third.

Therefore, the compressive stress of running an aluminum-based components can be very critical situations. However, aluminum shock (pulse-shaped) it has a higher resistance to cargo. Instead of using aluminum-alloy steel, the weight of construction on a building design is done correctly provides relief of over 50 percent. Although the electrical conductivity of copper is less than twice the weight of copper in the same enable more electric current. Sectional area of the wire in co weight aluminum wire, aluminum wire was higher than for more electrically conducting copper wire.

Aluminum and aluminum alloys; light weight, high strength, good corrosion resistance, easy formability and have a material widely used in the engineering process in terms of resource availability with multiple sources. Specific weight of the aluminum; steel about 1/3 as is. In addition, aluminum and alloys; air, in water, in contact with oil and has a very good corrosion resistance to many chemicals.

The heat treatment generally consists of heating and cooling process is applied to modify the mechanical properties of metallic materials. For this purpose, the aluminum alloy to annealing to get the solution and aging heat treatment are applied.

Solvus curve with aging, but in alloy phase diagrams and solid solution composition can only occur in the limits of the solvus curve. Therefore, some of the aluminum alloy can be aged. Heat treatment of 2XXX and 7XXX series alloys of aluminum alloy important technological aspects of aging.

In this study, general characteristics of aluminum and aluminum alloys in the first part was examined. In the literature section, which aim to introduce the materials used prior to the experiment examining the general characteristics of aluminum alloys are given.

The second part of the electrical properties of copper and aluminum alloys have been introduced and electrical conductivity of these materials was examined. Electricity and heat transfer known as aluminum and copper are frequently preferred materials. The best of these products between the conductive material is preferred in terms of cost-effectiveness.

The third part is the last part of the relevant literature contains descriptions of the information and uses the material in the first two chapters. Good conductivity, which uses a large number of these substances are therefore. Aluminum alloys are generally preferred in the automotive and energy sectors.

Try to look as 1000 series aluminum alloy wire covered with wires and electrical resistance measurements were carried out by performing some operations. These alloys were measured conductivity and resistance to compression terminals. Congestion of terminals has been determined as a variable.

2. GENERAL INFORMATION

2.1. GENERAL FEATURES OF ALUMINUM

It has low weight aluminum, low density, high corrosion resistance, excellent surface properties, is used in many different areas of difficulty were towards the high mechanical and physical properties and processing ease (ASM, 1990).

Aluminum metal density (2.7 g / cm^3); steel (7.83 g / cm^3), copper (8.93 g / cm^3) or brass (8.53 g / cm^3) it is about 1/3 the density. Aluminum metal, atmosphere, brine, has an excellent corrosion resistance in many petrochemical or chemical systems (ASM, 1990).

Aluminum has a high reflectivity surface. Electromagnetic waves, caused by heat and radiation, visible radiation, or energy radiation is reflected from the surface effectively. Outside the reflectivity of the surface material Anodized aluminum has the absorption feature. Since having superior reflectivity of aluminum makes it possible in particular to use in decorative applications in many different areas (ASM, 1990).

Aluminum metal having excellent electrical and thermal conductivity properties. With this high-owned property; high-torque electric motors, steel core reinforced aluminum transmission cables in high voltage applications, the heat exchanger device, the evaporator, electric heating devices are used in the aluminum alloy cylinder heads and radiators in cars (ASM, 1990).

In the nineteenth century, it increased use of aluminum metal engineering applications. These events have the biggest factor in that aluminum is a versatile features. Ability of property due to hot or cold formed aluminum and decoration properties; In the machinery industry, metal industry, construction industry, chemical industry, food industry, transportation industry, in the electrical - electronics industry, are used in the aerospace industry and many other industries (ASM, 1990 and nautilus.fis.uc.pt).

2.2. HISTORY OF ALUMINUM AND ALUMINUM IN THE WORLD

Aluminum, as a versatile material in the world markets recently a little over a century of history has established itself. World unlike steel basic steps in the development of the overall market, disposable aluminum during the industrial revolution, has gained importance in this century (Robert, 2001; Conserva et al., 1992).

Aluminum for the first time in 1825 and obtained by Orsted produced in very low amounts in the years 1850-1860. Industrialization of aluminum has been completely after 1880. In 1880 America Hall and Héroult in France as almost simultaneously, more reliable and can then be re-named with names, industrial-scale production processes discovered and described. As well as aluminum production in a short time than a century has shown a remarkable development in terms of operation and has now taken second place after the steel industry in terms of importance for the present. Indeed, while in 1920 the annual production of 200,000 tons of primary aluminum, climbs toward 18 million tons today (Robert, 2001; Conserva et al., 1992).

2.3. ALUMINUM ALLOYS

In practice, other metals of high purity aluminum (weight ratio 0.05 percent "to be less than) does not include. The ratio of other metals in aluminum alloys containing high levels of 1 percent (Surtec Techical Letter, 2008).

Due to many different applications can not have the desired strength level of the high purity aluminum material, the aluminum is alloyed be needed. Aluminum is generally Mg, Si, Mn, Cu or Zn alloyed elements. Strength of the material increases with increasing alloying elements (Surtec Techical Letter, 2008).

Table 2.1: Classification of aluminum alloys

Symbol	Basic Element Alloy
1XXX	99 percent and above Al
2XXX	Cu
3XXX	Mn
4XXX	Si
5XXX	Mg
6XXX	Mg and Si
7XXX	Zn
8XXX	other elements
9XXX	unused series

Source: ASM, 1990, p.765

1. 1000 Series Aluminum Alloys

Is aluminum alloy containing by weight 99 percent aluminum. Very little is also called aluminum alloy that contains alloying elements. Cold working is suitable (ASM, 1990).

2. 2000 Series Aluminum Alloys

From then aluminum is aluminum alloy with a maximum amount of copper element by weight. In this type of steel alloy which can be hardened by precipitation hardening strength values can be obtained which can compete. Previously, spacecraft applications are preferred because of their sensitivity to stress corrosion cracking place in this area today has given way to quality 7000 aluminum alloy. Weight within 2024 quality aluminum alloy is given in Table 2 of element ratios (ASM, 1990).

Table 2.2: Chemical composition range of quality aluminum alloy 2024

2024	Zn	Mg	Cu	Cr	Mn	Fe	Si	Ti	Al
Chemical Composition Range	< 0.25	1.2 - 1.8	3.8 - 4.9	< 0.1	0.3 - 0.9	< 0.5	0.7 - 1.3	< 0.15	Remaining

Source: www.alcoa.com

3. 3000 Series Aluminum Alloys

From then aluminum is aluminum alloy with a maximum amount of manganese element by weight. Cold working is a suitable aluminum alloy (ASM, 1990).

4. 4000 Series Aluminum Alloys

From then aluminum is aluminum alloy with a maximum amount of silicon element by weight (ASM, 1990).

5. 5000 Series Aluminum Alloys

Is an aluminum alloy containing aluminum, then the maximum amount of magnesium element by weight. Strength by cold process values can be removed to very high values. In cryogenic applications where a low temperature process is preferred (ASM, 1990).

6. 6000 Series Aluminum Alloys

After the maximum amount of magnesium aluminum and aluminum alloys containing silicon elements by weight. Resistance value can be increased by precipitation hardening method. Not provided hardness of aluminum alloy grade 2000, 7000 grade aluminum alloy hardness close to the hardness range can be provided (ASM, 1990). Weight within 6082 quality aluminum alloy is given in Table 3 of element ratios.

Table 2.3: Chemical composition range of quality aluminum alloy 6082

6082	Zn	Mg	Cu	Cr	Mn	Fe	Si	Ti	Al
Chemical Composition Range	< 0.2	0.6 - 1.2	< 1	< 0.25	0.4 - 1	< 0.5	0.7 - 1.3	< 0.1	Remaining

Source: www.fairdene.com

7. 7000 Series Aluminum Alloys

Is an aluminum alloy containing aluminum, then the maximum amount of zinc element by weight. The highest hardness values between 6 applied to precipitation hardening aluminum alloys can be caught. Weight in the 7075 aluminum alloy is given in Table 4 of element ratios (ASM, 1990).

Table 2.4: Chemical composition ranges of aluminum alloy 7075

6082	Zn	Mg	Cu	Cr	Mn	Fe	Si	Ti	Al
Chemical Composition Range	5.1 - 5.6	2.1 - 2.9	1.2 - 2	0.18 - 0.28	< 0.3	< 0.5	< 0.4	< 0.2	Remaining

Source: www.alcoa.com

2.4. CLASSIFICATION OF ALUMINUM ALLOYS

Aluminum-based materials are usually divided into two groups as shown below;

a. Casting alloys: for the production of castings,

b. Processing alloys: rolling, extrusion and forging products for manufacturing.

The other classification alloy according to the independent metallurgical hardening characteristic, thermal processing sensitive alloys are separate from the others. This distinction is based on product and hardening method. These two separation characteristic of commercial purity aluminum, depends mainly on the chemical composition depending on the types and proportions of the alloying elements in the alloy.

These fundamental factors are used in calcification of primary aluminum alloy and classifying their relevant national and international standards and the status.

There are two basic naming criteria for defining the composition of an aluminum alloy. This standard is used in one or other of the criteria:

a. Numerical classification

b. Alpha numeric classification

Alloy compositions according to the first criterion is defined with significantly regulated figure. The most important coding systems; National Standards Institute (ANSI) adopted by the American Aluminum Association (AA), British Standards Institute (BSI) and the German Standards Institute (DIN) were classified according to the calcification of the method (Conserva et al., 1992; Singh, 2000).

In the alpha numerical composition of each alloy system consisting of groups of letters and numbers and is defined by the split Nutation code. The first letter shows the basic metal alloys generally indicates the next type. The letter indicates the ratio of the group of the second group of the main alloying elements and alloys.

There are still many coding system is used to determine the heat treatment history and metallurgical condition of the material. However, current developments and uncertain serial numbers and leave the definition of the basic method of using abbreviations heat treatment operations of letters and numbers that are developing in favor of systems containing certain combinations (Conserva et al., 1992; Singh, 2000).

2.5 TEMPER DEFINITIONS

Quenched and tempered various codes to precisely define the physical characteristics of any alloy is very important to know better. For a complete identification, the applied manufacturing process and application expressing temper definitions are used. This identification system and process temp alloys are used in both cast alloys.

Basic temper are indicated by the letter notation. One or more of a combination of alphanumeric designation is used to complete the nutation. These numbers are used to indicate the complex flow of basic operations affecting product quality (Hatch, 1984; Singh, 2000).

2.5.1 Basic Temper Definitions

F: This letter indicates that the material is produced in tempera. This display of temper temper any possible situation to ensure that the material is indicated that only controlling the thermal shaping and implementation of manufacturing processes. It also indicates whether a control of work hardening in any case within the impression material.

F nutation of product hardness, tensile and yield strength, surface hardness and so on. It does not show its features.

O: that of re-crystallized and with all the strength of this alloy temper indication means that the process down to a certain level. % Elongation in material wherein the operations performed thereby providing increased formability. This feature allows for convenient access to a state, especially for deep drawing of the products. Annealing also provide dimensional stability to the product.

This temper display process, as well as alloys, cast aluminum and cast aluminum alloys also apply to.

H: "H" is used for processing the alloy can be hardened only by deformation. Subsequently allowing the hardening process to improve the condition may include a thermal treatment step. It always followed by two or more digits of the display.

W: "W" is used in alloys, heat treatment can be applied to unstable temper practice. Aging treatment after the alloy is rapidly cooled to room temperature to get a solution heat treatment is very fast. For a complete description letter "W" followed by length of time in minutes.

T: "T" shows stagnant temper condition. This group defines the condition rendered malleable material with a thermal process. In order to fully define the status of special temper letter "T" is followed by two or three digits.

2.5.2. Process Alloys

"Transaction" alloy identification; plates, foils, sheets, tubes, forgings, rod and wire are defining figure given as the main aluminum alloys. Applied deformation and thermal processes and products are characteristic of the alloy cast structure; fiberleş have a structure that fully crystallized into a building, seen through mechanical operations translates into a structure. The obtained structure material; strength will change the corrosion resistance and other properties (Hatch, 1984).

The effect of alloying elements on the properties of aluminum not only on the amount and type of alloying elements in combination with aluminum and also depends on the interaction with the microstructure.

2.6. TRANSMISSION OF ELECTRICITY AND STRENGTH ALUMINUM ALLOYS

2.6.1. Transmission of Electricity

Unlike most metals, aluminum usage sites, aluminum alloys is concerned. This is the case with energy in the time domain, for example, less than 2 percent of the total eligible pure aluminum alloy metal again be used as a suitable heat treatment as a result of the electricity transmission conductor bar is moved to 6101T6 form. The value of this material conductivity of pure aluminum by 61 IACS just 57 IACS value of yield strength value, fell 17.0 kg / mm2 increase of 25.0 kg / mm2 is to go up.

The compositions of some of the most important aluminum and alloys used for various purposes in energy transmission are given in Table 5 below (Gümüş, 2004).

Table 2.5: The composition of the aluminum and alloys used in the electrical field

	I.C-AL	5005	6201	b1O1
Cu	0,01	0,20	0,10	0,10
Fe	0,15-0,20	0,70	0,50	0,50
Si	0,07	0,40	0,50-0,90	0,30-0,70
Mg	0,005	0,50-1,1	0,60-0,90	0,35-0,80
Zr	0,02		0,03	0,03
I	-	-	0,60	-
Ti	0,003	-	-	-

Source: Gümüş, 2004, p.86

Although despite the not use in energy production, containing a total of approximately 10 percent as alloy element 7075 T6 alloy of 51.0 kg / mm^2 limit and 58.0 kg / mm^2 up to remember where n is the breaking strength of the metal it is interesting in terms of showing the alloying capability (Gümüş, 2004).

The aging process in which material hardening heat treatment capability, you need to consider the necessity of cold deformation in others. Aluminum conductor wires used in the manufacture of strong heat treatment if necessary is applied with a cold deformation aging (Gümüş, 2004).

Pure aluminum conductivity value of 65 IACS is. However EC of aluminum commonly employed in power transmission, this value ranges between 61 62 IACS (Gümüş, 2004).

2.6.2. Resistance Welding of Aluminum Alloys

Resistance welding processes (spot, seam and flash-to-flash-butt welding) is applied to the ordinarily made of aluminum alloy. These processes are particularly useful in joining high strength alloys can be subjected to heat treatment. These are combined with melting power supply with correspondingly resistance welding process which can be combined without losing strength as practical (Oğuz, 1990).

Aluminum pulls substantially in the transition from a liquid to a solid. This feature in high-strength alloys such as 2024 and 7075 is the most obvious and accepting the heat treatment can lead to cracking. Accepting heat treatment to 6000 series alloys are less prone to crack due to this shrinkage (Oğuz, 1990).

The natural oxide coating on aluminum having relatively high and variable electrical resistance. To obtain high and uniform spot and seam welding strength and the reduction of these coatings are often required before welding (Oğuz, 1990).

Although all Al alloys can be done to spot and seam welding, alloy or some combination of alloy, they are more prone to other sources. Generally, high-strength alloys as mentioned above in 2024 and 7075 can also be easy to weld cracking and porosity, lower-strength greater inclination would supply according to the alloy. In fact, quite the little cracks in the weld metal tensile alloy containing copper or zinc (such as 2024 and 7075) is unique (Oğuz, 1990).

It sees alloy hardness process also affects the weld ability. In certain alloys, it annealed 0-0 treated material is more rigid than more processing power. Generally milder processing are offering greater difference in resistance welding is more inclined to leave excess volatility and hair. This not change during connects to change shape so that a greater source of resources under the current force and pressure distribution leads to violence (Oğuz, 1990).

2.7. DEFORMATION OF ALUMINUM ALLOYS

Low specific gravity, a good conductor of electricity and heat Ability, mechanical strength may be sufficient numbers and good ability with the plastic shaped aluminum can be used in different deformation conditions.

Aluminum deformation resistance arises in coating the surface of the protective and tight oxide layer.

Especially deformation strength is sought, the aluminum purity is necessary to be under 99.5 percent. However, since the alloying is usually done to improve the mechanical properties of aluminum, the deformation resistance of the aluminum alloy is lower than that of pure aluminum (Topbaş, 1993).

The resistance to deformation environment many aluminum alloys, formed on the surface depending on the current conditions is due to the amorphous or crystalline aluminum oxide layer. The surface film in the atmosphere is more amorphous, in water and the water vapor is more crystalline structure to the surface film is formed. How homogeneous the resulting sheet creep resistance under the same conditions is also better.

Ambient air or in aqueous solution, easily, formed on the surface of this layer, it protects the oxidation of part of the continuation; aluminum containers and transport of oxidizing chemical protection also possible with a more stable protective layer formation. The protective layer is usually in the form of deterioration in mechanical loading, immediately renewed the usage environment.

This very thin layer of natural oxide (10-5 mm), for the continued protection of the deformation is kept away from mechanical stress, and even strengthened; tightening and thickening layer. High deformation resistance than other materials as pure aluminum, Al-Mn, Al-Mg, Al-Mg-Mn alloy supply would need to use the chemical and food industries.

Deformation resistance next, especially in the food industry toxin absence of these alloys, beverage cans in the packaging industry with good deformation capability, wrapping leaves (films) production, strength, and in the building and ship construction with decorative appearance and moves to use in the forefront of other constructions.

Al-Mg alloys are more resistant against deformations than pure aluminum medium containing alkali and salt. But this is not true in all cases. With increasing magnesium content is increased tendency to intercrystalline fracture deformation and tension deformation. In particular, 5 percent more than Mg containing alloy can be formed in this case, the upper limit of 5.5 percent magnesium alloys used in the technical today (AlMg 5) up. The cause of intercrystalline deformation is grain boundary precipitation (ß-phase).

In this case, the reduced amount of magnesium, manganese (1 percent or so) can be compensated by addition.

AlMg 4.5Mn as alloys, primarily used in shipbuilding and particularly for roofing. As a result of the addition of manganese chloride increases deformation resistance to media containing ion. The aluminum-manganese alloys, aluminum, material of natural rigidity. Creep resistance and workability of the alloy containing 0.8 to 1.5 percent manganese, it is as pure aluminum. But they have a higher mechanical strength.

The precipitated with one of the alloys Al-Cu-Mg alloys curable (2.8 to 4.8 percent C and 0.4 to 1.8 percent Mg), used in construction vehicles and airplanes because of their high strength. Deformation resistance is lower than in many aluminum alloys. Resistance to sea water can’t be guaranteed. The homogenization temperature is cooled very quickly (at least 400 ° C / s speed) and then deformation resistance can be increased if aging is done. Slow cooling and sedimentation occurring when the aging structures, cause the intercrystalline deformation and stress cracks deformation.

Al-Zn-Mg alloys are resistant construction materials and which can be cured with moderate precipitation. Al-Cu-Mg alloys with good creep resistance than lower values, but the deformation resistance of Al-Mg and Al-Mg-Si alloy compared to less than. Atmospheric conditions, the black coating layer is formed which protects the alloy. In contrast, the water vapor causes severe deformation AlZn-Mg alloy. Furthermore, the deformation has a tendency of stress cracks. Deformation susceptibility increases with rising Mg and Zn. In general, to prevent the deformation stress cracking, should not exceed 5 percent of the total amount 6 alloy. Higher amounts of the alloy, 0.1 to 0.15 percent chromium addition, reducing the deformation stress fracture.

2.8. HEAT TREATMENT OF ALUMINUM ALLOYS

Of heating and cooling results in the parts applied on the piece casting heat treatment causes a change in the physical and mechanical properties. This basically annealing heating and cooling, making the solution, comprises the steps of processes such as aging and cold, varies according to the chemical composition of the alloy and to gain the required final properties (Askeland, 1990).

Aluminum alloys are generally applied in the assessment procedures according to the aging process and mechanical properties not only plays a decisive role in the electrical conductivity and corrosion properties. The aging process of aluminum alloys are given in Table 6, below applicability (Askeland, 1990)

Table 2.6: Aging suitability of aluminum alloys

Classification	**Basic Element Alloy**	**Heat treatment**
1XXX	99 percent Al	OK
2XXX	Cu	OK
3XXX	Si, Mg, Cu	Partially
4XXX	Si	Impossible
5XXX	Mg	Impossible
6XXX	Unavailable	-
7XXX	Zn	OK
8XXX	Sn	OK
9XXX	Unavailable	Impossible

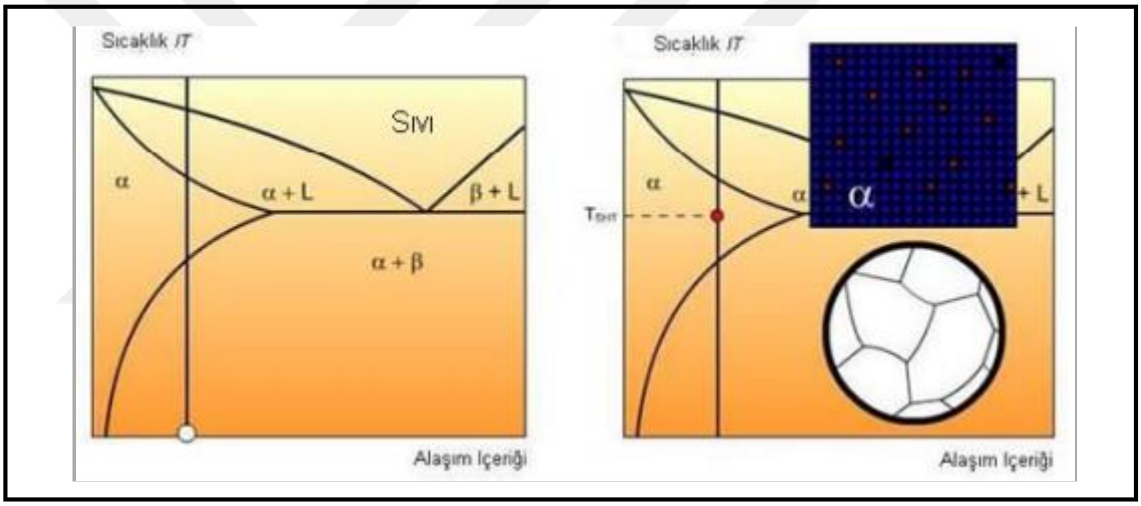
Source: Askeland, 1990, p. 423

The three stages to occur as the basis for the heat treatment are available, they respectively; take the solution, quenching and precipitation (aging) process. The composition of the supersaturated solid phase precipitates in very fine phase structure upon aging process is the basic rule for improving the mechanical properties. This precipitation of the phase can be made artificially as can be naturally occurring. Generally, however, a very effective change in mechanical properties can't be obtained by natural aging of aluminum alloys.

2.8.1 Commissioning Process Solutions

The purpose of the solution treatment, is to obtain single-phase solid solution. B and α phase at the first temperature and not in equilibrium. Alloy temperature above the solves curve β phase at this temperature is removed and subjected to dissolve completely processed in α phase. After transformation into the α phase completely all of the structure is cooled abruptly. Taking the solution temperature should be selected so as not to cause melting of the alloy. Because the melting temperature of aluminum to be around 560 ° C processing temperature 525 - 545 ° C must be between. This temperature is expressed by TSHT in Fig.1. TSHT temperature for all components in a single phase solid solution.

Figure 2.1: Operation receiving solution



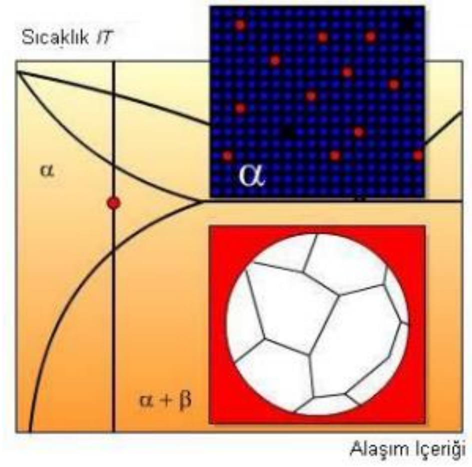
Source: aluminium.matter.org.uk

Receiving solution temperature and duration of the micro structure, the thickness of the part and oven capacity / load varies according to the. This time sheet, statements while the minutes are indicated by the slice thickness increases watches.

2.8.2 Quenching Process

The purpose of quenching solution to get in to form a supersaturated solution of the alloying element in the aluminum into one phase and the solution is cooled quickly to take the temperature of the alloy. This process is stated manner.

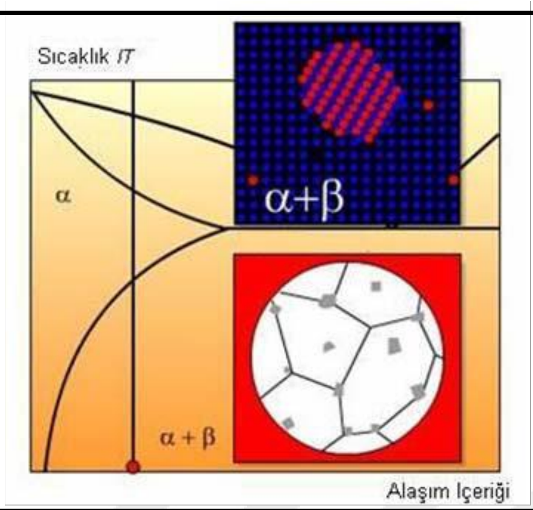
Figure 2.2: Solid solution in the form of a single phase as a result of the process of getting the solution



Source: aluminium.matter.org.uk

If the alloy itself (if slow cooling) allowed to cool, occur and shaped core Beta phase precipitates to form a heterogeneous phase equilibrium α + β (Fig.3). Beta does not allow precipitation of the α phase in rapid cooling and therefore no more solid equilibrium α phase (supersaturated) are included.

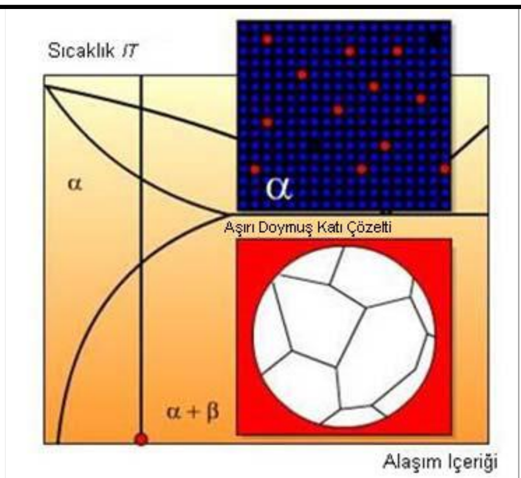
Figure 2.3: Alloy case of heterogeneous nucleation occurs spontaneously cool



Source: aluminium.matter.org.uk

In addition, as quenching reduces the diffusion time and non-equilibrium structure alpha phase "freeze" allows. Because alpha phase includes more solid that in equilibrium. This is referred to as supersaturated solid solution. (Figure 4).

Figure 2.4: Supersaturated solid solution



Source: aluminium.matter.org.uk

Often it used water quenching. However, addition of water, glycol as the quenching medium - water mixtures, water-soluble polymeric oils or mineral oils are used. Due to the high thermal conductivity of aluminum alloy, the thin and thick portions of the same piece cooling characteristics can be seen from deformation because it is different. Therefore, to avoid such deformation, quenching medium, the temperature of the environment must be carefully chosen if necessary or quenching media should be moved in mixed or piece of media.

2.8.3 Aging Process

Aging process is used for to provide better strength of Al. alloys. The following brief information will be useful to deal with aluminum usage. Being dissolved in solid solution supersaturated beta phase, as shown in equation temperature and precipitated as a stable phase with the effects of time.

Alloy few days at room temperature (natural aging) or 10 to 24 hours at elevated temperature (artificial aging) are kept. During the aging process, supersaturated solid solution separated. This strengthens the alloy. Where the separation of solid was dissolved in a uniform lattice in the order of copper atoms occurs in several stages depending on the aging temperature and duration. Natural (20 ° C) or artificially low temperature (100 to less than 150 ° C) does not appear in dating phase decomposition of the dissolved solid with more precipitation. Copper atoms at these temperatures, α solid melts the crystal lattice in only move short distances on the extraordinary and Guinier-Preston zones (GP-I) formation is similar to the two-dimensional sheet called or are brought in by plane into discs. GP-l of a few dozen angstroms (30 to 60) into the spread and possess a thickness of 10 to 5; they are much less uniformly distributed within the boundaries of each crystal. The copper content of the cual2 until the GP-l (54 percent) less.

After natural aging rapidly alloys 230-270 ° C (regardless of a few seconds or minutes) to be heated and cooled quickly, which derive strength from aging disappear completely and alloy returns to the condition immediately after being cured. This phenomenon is called reinstatement. Softening reversion, GP-l region at these temperatures is due to stable absence and melting of the solid solution copper atoms again, more or less uniform, as erectile be immediately after each solid solution in the crystalline volume limits, are distributed. Then again, if the alloy is kept at room temperature, GPU-line regions are formed and strengthened alloys. However, the corrosion properties of the alloy deteriorates after reinstatement aging has followed. This circumstance makes it unusable for any practical purpose of this reversion.

Structure as a result of the supersaturated solution phase tends to return to the equilibrium structure. Structure shown on the left in Fig.4, a result of quenching (Al) in the supersaturated B (Mg-Si) represents the solid solution phase (Askeland, 1990). During the aging process willingly go diffusion result of B atoms in the lattice creates regional concentration on the specific plane (structure shown on the right in Figure 4). This region GP (Guinier - Preston) are called zones. In some systems, the GPU of the disk can be spherical or rod-shaped.

2.9 ALLOY ELEMENTS AND EFFECTS

It can be easily confused with many metal liquid aluminum. The solid solubility in aluminium metal is only worth a few percent. Many compounds are formed from metal alloys and significantly affect the properties of the alloy. No elemental aluminum in the solid state fully (100 percent) insoluble. Intermetallic compounds consisting of the aforesaid metals are much higher alloy contributions. They are very hard and brittle they negatively affect the mechanical properties. Often times my total does not exceed 15 percent of alloying elements. The most important and common ones include alloys 2XXX, 3XXX, 4XXX, 5xxx and interests of the 7XXX series.

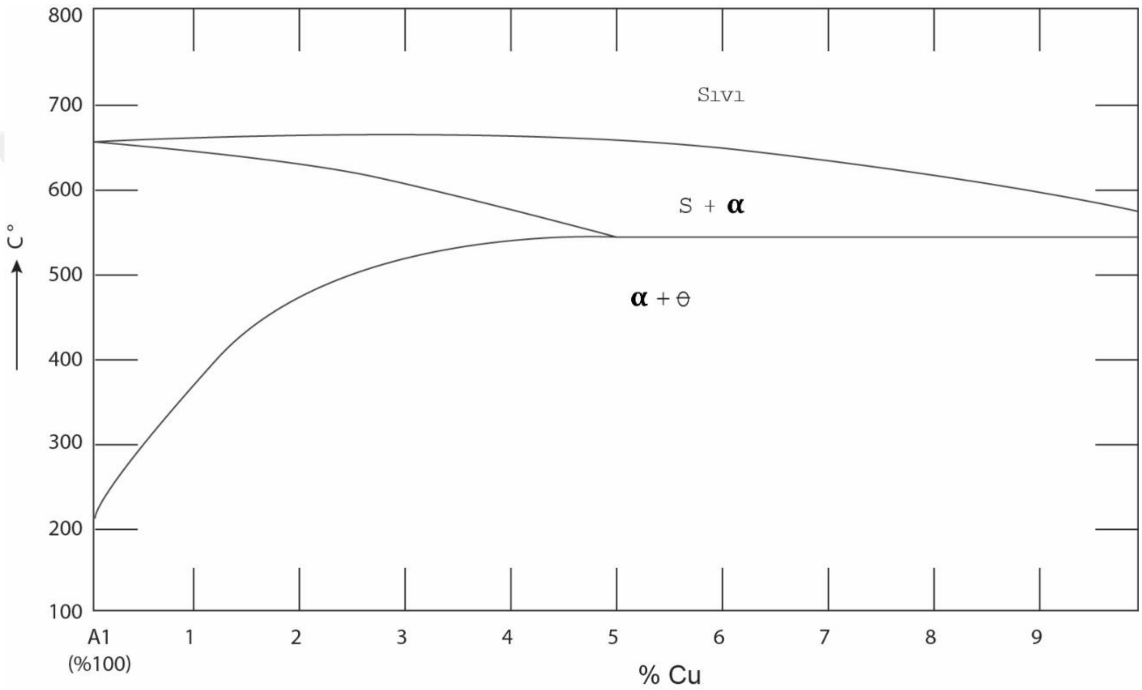
There is so much difference in value between high and room temperatures resolution leads to precipitation hardening of alloys of these elements. This is the underlying cause of the aging process (Deschams et al., 2001) (Durmuş et al., 2009).

2.9.1. Effect of Aluminium Copper

Values up to 12 percent of the copper in aluminium increases resistance. More than 12 percent thereby providing work embrittlement. Usually it increases workability and high temperature properties.

The solubility of copper in aluminium is about 5.65 percent. Precipitation aging are applied to contain at most 2.5 percent of Cu. θ phase is a solid solution of cual2 compounds. To the α phase of the alloy is heated and cooled for precipitation aging in water. After leaving natural aging or artificial aging is applied. Most well-known of Al-Cu alloys containing 4 percent Cu Duralumin (2017) (Deschams et al., 2001).

Figure 2.5: Aluminium-copper phase diagram



Source: Deschams et al., 2001, p.165

Al-Cu alloys small amounts of Si, Mn, Fe, Mg, Zn, may also contain other alloying elements such as Cr. For example; when an alloy containing 4.5 percent C, 1.5 percent Mg added strength will increase. (Deschams et al., 2001)

2.9.2. Effect of Aluminium Silisium

Silisium increases the fluidity in aluminium reduces the hot cracking tendency correspondingly. Processing of alloys containing more than 3 percent silicon is very difficult. It also improves the corrosion resistance of the silisium alloy. (Deschams et al., 2001)

2.9.3. Effect of Manganese Aluminium

Manganese is used in alloys with iron to increase the pourability. It also alters the functionality of metal intermetallic compounds. Structures play a role in reducing the pulling direction. It increases the ductility and toughness properties of alloys. (Deschams et al., 2001)

2.9.4. Effects of Zinc Aluminium

It corresponds to the increase in manganese alloy castability of zinc castability decreases. Likewise money to reduce the cracking tendency of high silicon zinc alloys give rise to cool the hot cracking and shrinkage. Higher than 10 percent Zn alloys response to stress cracking if my new show with no other alloying elements increase strength too. A significant impact on binary aluminium alloy containing less than 3 percent Zn zinc invisible. (Deschams et al., 2001)

2.9.5. Aluminium Effect of Iron

Naturally present in the ore in the iron aluminium. Rigidity of certain alloys in small amounts and increase their strength. In the direction of reducing the tendency of hot cracking cast plays a role. (Deschams et al., 2001)

2.9.6. Effect of Aluminium on Transition Metals

As is known, the transition metals chromium, aluminium, zirconium, titanium. The strength of the solid solution of transition metals, zinc and magnesium in solid solution in magnesium, zinc and aluminium are significantly lowered.

For example; increasing the presence of zirconium in the examination with an electron microscope showed the strength of the solid solution of zinc and magnesium in aluminium decreased significantly. In addition, transition metals in the solid solution reduce the solubility of the main alloying elements in aluminium balanced.

Therefore transition metals should increase the strength of the solid solution. Meanwhile, melt the aluminium in the solid transition metal that strengthens bonds and reduce the movement of atomic diffusion of atoms are in the opinion advocating. Transition metals should increase the strength of the melt in this view.

However, the aluminium solid solution of zinc and magnesium alloyed with transition metals resistance experiments indicate that the fall. Advocating the increase resolution in this case is to go first sight more accurate. Chromium can be said about the same thing over and zirconium. (Deschams et al., 2001)

2.10. GROUPS OF ALUMINIUM ALLOYS

2.10.1. Forged Aluminium Alloys

Wrought alloys are alloys that can be formed by plastic deformation. After casting alloy can be formed into final products are hot or cold process. They are classified according to the main alloying elements they contain. The structure of product strength, corrosion resistance and affects various many ways. Wrought alloys that can be made among themselves, such as heat treatment and casting alloys are divided into alloys can't be heat treated. Strength aluminium alloy heat treatment can't be process is achieved by solid solution hardening of hardenings or deformation. Owned alloys is due to the main alloying elements in this group are found in many feature structures. A four-figure mark alloy used to describe the process. The first digit indicates the alloy group with specific alloying elements. The second number indicates the changes made to the initial or impurity limits alloy (Demiral, 2015).

Semi-solid shaped AA2024, AA2014 and AA7075 as wrought aluminium alloys, aluminium casting alloys because of its superior mechanical properties compared to aviation and the opportunity to find wider application in the automobile industry. Al alloy forged forging, rolling and extruding and so on. By plastic deformation processes it can only be used in shaping the simple geometry parts. Machining methods are limiting in terms of the geometric part of the production cost and increase production significantly. In contrast, wrought aluminium alloys may be formed in series with YKM forming methods. The biggest problem with conventional casting methods for producing the forged aluminium alloy hot tears and fluency. In recent years, therefore the forged aluminium alloys YKM which is formed by forming methods and REO lyxo-cast-iron. Studies on the method of wrought aluminium alloys are formed by YKM focused on lyxo-casting. Lyxo for pre-cast material is the most widely used method of preparation of SIMA (Akar & Mutlu, 2010).

2.10.1.1. Forged Al - Cu Alloys (2XXX Series)

Precipitation heat treatment is applied to the optimal properties of these alloys with copper basic alloying elements. Al-Cu alloy during aging changes despite the complex has been studied in more detail than other systems. Where required good processing properties, where relatively high tensile strength at room temperature with good creep strength at increased temperatures and at very low temperatures required having high rigidity, are used extensively. Corrosion resistance is not as good as other groups and weld ability of the alloy is limited. Usually in vehicles and aircraft wheel, the suspension part of the vehicle, and is used in airframe parts requiring strength at temperatures up to 150 ° C (Kumru, 2007).

2.10.1.2. Forged Al - Mn Alloys (3XXX Series)

3XXX series alloys generally moderate softness and high durability with excellent corrosion resistance are required. 3003 series is presented in the form of leaf used as 0yayg. This group of alloys drink cans, kitchen utensils, heat exchangers, storage tanks, furniture, highway signs, roof and sides with coatings are used in other architectural applications (Kumru, 2007).

2.10.1.3. Forged Al - Si Alloys (4XXX Series)

The main alloying elements are silicium 4XXX series for Al alloys. Silicium aluminium in sufficient quantities (up to 12 percent) was added and crispening without causing a decrease in alloy melting temperature. Therefore, the Al - Si alloy as a brazing alloy melting at lower temperatures than the melting temperature of aluminum base metal joining and welding wire used. Most of the heat treatment of alloys in this group is applicable. 4032 alloy has a low thermal expansion coefficient and high wear resistance and is therefore suitable for the production of this alloy forged pistons (Kumru, 2007).

2.10.1.4. Forged Al - Mg Alloys (5xxx Series)

Mg ratio of Al is used in proportions up to 5 percent from 0.8 percent. Untempered state resistance values of (Mg containing 0.8 percent for 5005) 40 MPa and 125 MPa tensile and yield (for 5456) varies between 160 MPa and 310 MPa tensile yields. Elongation is higher in relative and will usually be 25 percent. The risk of stress corrosion cracking in corrosive environments stretch and deformation hardened alloy may be problems with softening is known as aging. Al - Mg alloys are widely used in applications. Dump truck bodies, oil, milk and cereal to move large tanks and pressure tanks are the main areas in particular that require storage at low temperatures (Kumru, 2007).

2.10.1.5. Forged Al - Mg - Si Alloys (6XXX Series)

Al - Mg - Si alloys are good sources as well as being able to moderately resistant, widely used because they are resistant to corrosion and stress corrosion cracking resistance. Architectural applications, transportation industry, bridges and welded structures are applications of this alloy (Kumru, 2007).

2.10.1.6. Forged Al - Zn Alloys (7XXX Series)

Al alloy in the zinc alloy is an important element in 7XXX groups between 1-8 percent. When used with high strength magnesium alloy is obtained which can be heat treated. Often other elements such as copper and chromium are also added in small amounts. 7XXX alloys in the fuselage structure is used under high stress in the working parts (Kumru, 2007).

2.10.2. Aluminum Casting Alloys

Casting alloys, the final product; sand mold casting, permanent mold casting or casting methods such as metal injection are used in the production of aluminium alloy. Generally they have a good fluidity of the cast alloys, low melting temperature, short of solid state transition time and therefore less cycle time, during cooling hot tearing and after avoid cracking and cast as part of the physical and chemical expected to be stable. Casting alloys, depending on the casting method, complex parts having shaped design are used to produce without any additional processing. These alloys; on behalf of the casting process suitability and castability contain the silicium element in large quantities (Övündür, 2014).

Shaped by casting aluminium alloys have been classified by a three-digit number by the AIU. Alloy forged alloy as the first digit refers to the elements of the group. 1xx series aluminium alloy consisting of 99.0 percent minimum. In the 3xx series is the main alloying element silicon. There are also the alloying elements, such as alloys of copper and magnesium. Subject to three digits after the point and point-digit indicates whether or number of ingot casting followed. "0" The number of dump "1 or 2 refers to the ingot. For instance, refers to sand or die 356.0 spilled ingots of 356.2 and 356.1, while part of the expression. Cast aluminium alloys are classified in the following manner (Alan, 2013):

1XX.X: pure aluminium.

2XX.X: Main alloying elements are copper.

3XX.X: Main alloying elements are silicium. Other alloying elements such as copper and magnesium may also be present. 90 percent of the cast alloy used in industry 3XX.X series.

4XX.X: Main alloying elements are silicon.

5XX.X: main alloying element is magnesium.

6XX.X: This serial number is not used.

7XX.X: Main alloying element zinc.

8XX.X: main alloying element is tin.

2.10.3. Heat Treatment Is Applied To Aluminium and Alloys

Aluminium and aluminium alloys and light metal alloys because of their improved mechanical properties as a result of heat treatment. Machining of aluminium alloy is often used in manufacturing. Due to the use of pure aluminium is quite weak and ductile materials are limited. Properties of Al and alloys significantly depends on how subjected to a pre-treatment. The heat treatment or a heat treatment process that improves desired properties to metals are known as a chain. In other words, the metals and chemical compounds cases require heating and cooling without any changes can only be described as the process by which the mechanical properties as desired. The addition of certain alloying elements such as aluminium alloys and the alloying elements added result of the application of heat treatments strength is increased to hinder heat treatment. For this reason, according to their sensitivity to heat treatment forged or cast aluminium alloy, heat treated or heat treatment can be divided into two groups as unworkable alloy. Elements that may be present in the heat treatment alloy, to have substantially solid melting properties at high temperatures; the characteristics are limited to be able to melt the solid state at low temperatures (Erkal, 2011).

2.10.3.1. Casting Alloys Are Subjected To Heat Treatment Not Kept

The main alloys in this group, kneaded-hardened state, are expected to have sufficient strength and stiffness and good corrosion resistance with them. These alloys are widely used in the manufacture of road vehicles. The desired mechanical properties, is formed by cold kneading degree is applied in the final cold process and alloys as usual "soft", "3/4 hard", "1/2 hard", "3/4 hard" and "full hard" to use is supplied. Here the main drawback, only after the final size and shape of the material (except softening and annealing) can’t be played on the mechanical properties. In However, precipitation hardening should alloys, qualifications, within certain limits, can be changed by heat treatment. The main outside Al-Si alloys, these alloys many have the structure entirely composed of solid solution. This evidently their high ductility and high corrosion resistance helps (Oğuz, 1990).

2.10.3.2. Casting Alloys Are Subjected To Heat Treatment Can Not Be Held

This alloy group as a general purpose material in sand and permanent mold casting includes widely used ones. These alloys are mainly rigidity, are used where it is more important than the tensile strength and corrosion resistance of cast fluency. Without a doubt, the most widely used in this class of alloys include those containing copper in silicium and in some cases a small amount between 9.0 percent to 13.0. These alloys are extremely suitable for die casting will be narrower freezing areas are about eutectic in composition. In this process, small amounts of molten alloy immediately before casting it consists in adding sodium. The effect of normal eutectic temperature is reached and to delay the precipitation of silicium is to shift the equilibrium diagram but also to the right of the eutectic composition (Oğuz, 1990).

3. ALUMINUM ALLOYS WITH GOOD CONDUCTIVE AND COPPER CLAD ALUMINUM ALLOYS

3.1. ELECTRICAL CONDUCTIVITY OF ALUMINIUM ALLOYS WITH GOOD

The most commonly used aluminium and aluminium alloys after the steel industry today; they are light weight, good thermal and electrical conductivity, strength properties of expandable and today is an important material for engineers and designers because of their resistance to corrosion. Especially in recent years, energy conservation-oriented activities, less fuel-efficient lightweight and economical vehicle production agenda to bring aluminium alloys, in cars, buses, trains, watercraft has been prioritized as a preferred material in construction. In fact, these alloys are materials which are used in the aerospace industry for many years and have come into use in enhanced strength and impact properties through the defence industry (Başer, 2012).

Aluminium conductor manufacturing industry, starting from the first year in which the manufacture of aluminium conductors are generally the most preferred raw materials EC-99.7 percent purity. Most of the published standards in this area, according to the time of conception, showed a constantly changing according to the change of technology. When defining the amount of raw material for production of aluminium metal in many catalogues and documents belonging to the firms examined, purity aluminium conductors used in the construction of the EC-some seen as being down to the level of 99.5 percent. But today, existing in many international standards, that without mentioning much respect to aluminium modified already, this is outside of their subject, it must demand mainly built on conductivity are to refer to the use of raw materials in high-purity quality. 1000 series mentioned EC of 99.5 percent, 99.6 percent and 99.7 percent purity of the combination as well as the 6000 series of A-6101, A-6063, A-6201kombinasyon are used for electrical conductors. These as well as 5000 series 5005 alloy and AA cited in the 8000 series-8017, A-8030, A-8076, A-8130, A-8176 and A-8177 are combinations used for the same purpose. These aluminium alloys in the manufacturing of many different types of conductive species was carried out according to need and purpose. All the realization of this new type of manufacturing is carried out through various changes so naturally pre-alloys with metallurgical structure of the material means and methods of vaccination. To name the most important pre-alloy aluminium conductors used in industrial production AlB2, AlB12, AlZr, considered as AlTiB (Karabay & Yılmaz, 1996).

Unlike most metals, aluminium usage sites, aluminium alloys is concerned. This is the case with energy in the time domain, for example, less than 2 percent of the total eligible pure aluminium alloy metal again be used as a suitable heat treatment as a result of the electricity transmission conductor bar is moved to 6101T6 form. The value of this material conductivity of pure aluminium by 61 IACS just 57 IACS value of yield strength value, fell 17.0 kg / mm2 increase of 25.0 kg / mm2 is to go up (Gümüş, 2004).

Although the conductivity of aluminium is very well known effects of alloying elements it can be summarized as follows. Fe, Ni, Zn affect the conductivity and decrease, Cu, Si, Mg, V the effect is greater. The worst effect of Cr, Ti, Mn elements shows (Gümüş, 2004).

3.1.1. 1350 Aluminium Alloy

In the past 80 years to the present energy structure with composite aluminium-steel combinations are used in the transmission lines. In this design, steel extracts are used which are readily bent in the centre to carry the load resulting from an external impact. Steel wire tensile strength of 140-160 N / mm2. The tensile strength of aluminium wire 16-18 N / mm2, which varies. Despite the high tensile strength difference between steel and aluminium wires composite structure showed resistance to external load, a small proportion of the load is borne by the aluminium wires. This is called composite steel-cored conductors ACSR conductors and called on international manufacturing and trade. These conductors conductivity duty steel beaker on self packed solid in different directions and are made with minimum purity 99.6 percent Al-1350 wire (Karabay et al., 2005).

Al-1350, when used in ACSR conductor with conductive current carrying capacity equivalent to 50 percent of the dead weight savings can be made (Karabay et al., 2005).

Moreover, Al-1350 ACS is the equivalent diameter of the current carrying value of Al-Zr conductor will be smaller than the capacity between 20 and 30 percent. That is, the use of smaller and lighter material in addition to the line is re-construction means (Karabay et al., 2005).

If any part of the transmission line completely re-done the equivalent of Al-1350 ACSR by conducting "Al-Zr" carrier poles of conductors will also be spent on poles because they will be designed according to less weight-bearing material costs will further decrease (Karabay et al., 2005).

AISI 1040, AISI 1350 and AISI 4140 steels are widely used in machinery manufacturing industry. For example; AISI 4140 steel, machinery manufacturing, machining industry are used in approximately 10 percent and steel with high harden ability because of alloying elements it contains. Also be applied to steel heat treatments and the heating rate are important determining factors in determining the process ability characteristics in manufacturing (Doğan, 2011).

3.2. COPPER

The most commonly used alloying elements in aluminium alloys. Cu containing 8 percent in the year it is used as an alloy in aluminium casting industry, "Al -C" alloy was used. This sand mold casting alloys made with aluminium to copper added in the commercial purity to be used despite the difficulty of many years castability. Later, the amount of copper was reduced to 5 percent and silicium is added in this way easy to cast, has good fluidity and it was improved alloy can be hardened by heat treatment and also found broad utility (Şafak, 2011).

Copper is one of the most widely used electrical conductive materials. Pure find use with alloys as well as the use (www.elektrikport.com).

Copper, compliance cost in the electrical industry and is the most widely used conductive properties caused by the material. The importance of copper is due to three main reasons (www.elektrikport.com).

In almost all regions of the world due to the presence of large scale production can be done,

a. After silver in all other electricity-conducting metals to be the best metal,

b. The high industrial importance, rice is making alloys like bronze.

The development towards the end of the 19th century electrical engineering, electrical conductive pure copper is very well needs to have increasingly heard. On the other hand, this type of electrolytic refining of copper more, because that is obtained by means of electrical energy, electrical and copper production are enhanced by supporting each other (Eker, 2008).

Industrial copper as a material, alongside the high level of ability to give shape to the height of the electrical and thermal conductivity of plastics has always maintained its position at the forefront. Copper stemming from these features; Giftware production because of its ability to manufacture processed in cable electrical conductivity due to thermal conductivity due to the heating / cooling systems are used widely (Eker, 2008).

In times past in the softness of copper, or benefiting from strength to be processed it is known to use in various places. If more time in areas that use is based on copper subsequently learned features. This is the most important characteristics of copper transmission of heat and electricity very well. Copper, silver and is the best conductor of heat and electricity after gold. Therefore, copper is the most dominant electrical and electro-technical support to metal have been many new developments in this area (Yazan et al., 2011).

Copper crystallizes in a cubic system, and then silver is the best thermal and electrical conductor, especially the second conductivity trace amounts of impurities, even if the presence is significantly reduced. Purity sometimes major elements Fe, Ni, As, Sb, Pb, Ag, Au is the oxygen which has the largest share between them. This element has the form of a sub-oxide Cu2O. Copper melts at 1083 ° C and this temperature is partly due to the metal of the residual melt during solidification porosity of the gases that are gases (www.oerlikon.com.tr).

3.2.1. Electrical Conductivity of Copper

Copper is a very important advantage of the current location. Properties that are used in a pure copper industry;

a. Best electrical conductivity between Industrial metals; electric cables and wires used in the production of electrical equipment.
b. Very good thermal conductivity; boilers, retort, cooking utensils where copper is utilized as heat exchangers and the like.
c. Sufficient resistance to atmospheric corrosion; used in places such as sewer and roof plate.

Pure copper is used mainly in the electrical industry, but to shoot some properties, fatigue resistance, hardness, small amounts of certain elements are taken into copper to bring the processing ease of making better: 0.5 percent arsenic or 0.1 percent silver and 0.8 percent cadmium or 0.5 percent of tellurium, selenium or sulfur (www.teknolojikarastirmalar.com).

Copper conductor used in power cables is usually manufactured according to the IEC 60228 standard or the standard reference prepared according to national standards (Özdemir, 2014).

For the purpose conductors;

Class 1: solid conductors,

Class 2: Stranded conductors,

Class 5: Flexible conductors,

Class 6: Class flexibility in the form of more than 5 conductors are divided into 4 categories (Özdemir, 2014).

Energy production as it is known, the strain of damage to the environment and natural resources is carried out by methods that have been developed at all costs. Efficient use of the generated energy and the reduction of losses, it is important to the development of environmentally sound technologies and much more efficient energy production. One of the important parameters of the factors that lead to energy loss are conductive electrical resistance value at the point of contact. For example, the copper bars used in industrial power transmission system usually provides cut in short lengths and connecting with each other bolts. This practice brings the contact resistance at the attachment points are welded losses. Therefore, the contact surface roughness, surface space and their location, corrosion resistance and oxidation tendency of the material, electrical characteristics of the effect of pressure on each other, they form contact surface is important (Harput, 2008).

As you know, especially when exposed to high current transformers, electrical panels, high-current transmission, the base station and switching, electrolytic copper materials are used because of the advantages of the properties. In this reason, it is important to reduce electrical conductors ensure a good connection and contact losses. The electrical resistance of the system in which they are exposed in particularly vulnerable areas is increasing conductor port. This situation results in causing brings about energy losses. In recent years, it is seen that the present until several studies and publications of the studies examined affecting productivity and those ports that cause energy losses has been proven through various models and theoretical explanations and conductive contact surfaces involved in the work on improvement (Harput, 2008).

3.2.2. Copper Clad Aluminium Alloys

In addition to its limited capability like solid solution Cu and Al alloyed they are created from a series of phase brittle metals. Get avoiding aggregation of these phase and C flash welding, soldering, brazing, welding pressure, can be done with ultrasonic welding or adhesive connection. Silver-copper solders or by the addition of pre-coated metals, aluminium oxy-acetylene and arc welding it is possible to combine with and brazing (Oğuz, 1990).

Copper, aluminium hardness, strength, castability and gives the ability to be processed. 33 percent copper eutectic aluminium ratio gives compound. Aluminium melts in 0.5 to 5.7 percent. Heat treatment applied to the copper aluminium alloy. Al_2Cu is precipitated in the heat treatment. $CuAl_2$ intermetallic phase of technological importance contain 53.2-53.9 percent Cu (Bayram, 1994).

Melt decomposes and which at least in the form eutectic structure component "Al_2Cu" search phase for causing material embrittlement, in terms of casting techniques should be close to the eutectic composition "Al-Cu" prohibits the practice of the alloy. On the other hand considering the cooling structure due to the width of the solidification range extreme technical "Al-Cu" The amount of copper in the composition of the alloy, even for lagging behind the 5.7 percent value of the start of eutectic horizontal it is limited to about 4.5 percent (Çavuş, 2010).

The best feature preferred composition containing 4.5 percent Cu in terms of "Al-Cu" is the alloy. If you have a high proportion of tin in the alloy reduces the hardness, corrosion resistance decreases. High amounts of iron and silicon acts in bad way mechanical properties. In general, copper, aluminium, hardness, strength, feature adds features such as casting and machining facilities. Al 33 to 50 percent Cu is added in the form of pre-alloy copper alloy preparation (Çavuş, 2010).

In general, copper, aluminium, hardness, strength, good casting properties and adds features such as ease of workability. Copper wrought alloys are used in between 3 percent and 5 percent. If more than 5 percent using mechanical processing difficulties arise. Further, electric conductivity and corrosion resistance is reduced. Wrought copper alloy can be used in up to 12 percent (Doğan, 2006).

Copper Al-Si alloy while increasing the mechanical strength of the alloy while seawater will reduce the resistance against weak acids and poor atmospheric conditions. Also Al-Si alloy with a low expansion coefficient can be obtained by adding copper (Doğan, 2006).

4145 type fillers, such as 2XXX 2014 and 2618 series aluminium alloys, Al-Cu and Al-Si-Cu resource type cast aluminium alloys exhibit low sensitivity to cracking. 7XXX series alloys having high crack sensitivity that varies depending on the amount of copper they contain. 7004, copper alloys such as 7005 and 7039 with low rates of 5356, 5183 or 5556 type can be welded with filler materials. The higher proportion of the aluminium alloy containing copper as 7075 or 7178 using the arc welding method is not suitable (Odabaş, 2007).

4. ALUMINUM ALLOYS IN DIFFERENT AREAS IN TURKEY

Aluminium and alloys today in almost all branches of the manufacturing industry, agriculture, energy, are used in an increasing amount of transport and construction sectors. Particularly iron and copper in place of aluminium; In manufacturing, various constructions, electrical industry, in the manufacture of conductors and vehicles has led to significant reduction of weight. Therefore, aluminium and alloys has found application in various branches of the construction industry to the automotive and electrical industries. Aluminium demand usually sectors that drive the automotive, aerospace industries are the aircraft. Especially aluminium and flat steel products are high-level needs of this sector. For this reason, balance supply and demand has changed in recent years (Şafak, 2011).

As previously briefly mentioned, aluminium and aluminium alloys which are used with many advantages in almost all branches of the manufacturing industry. In particular, steel and copper, instead of using aluminium and its alloys (in the machine manufacturing industry, in the manufacture of various constructions and vehicles), there is provided a substantial reduction of the weight. Therefore, aluminium and alloys to the automotive industry, the construction sector has complied area is found in the various branches of the industry and has become an indispensable basic input status (Yıldırım, 2002).

4.1. APPLICATIONS IN THE PACKAGING SECTOR

As time progresses, aluminium foil production and consumption is increasing. Foil used in packaging and candy wrappers jobs in the first year, and later expanded areas. Aluminium foil is used in the drug case. Seydişehir has the capacity to do business in aluminium foil 3000 tons per year should be good. There is also still made of standard aluminium foil production facility in the private sector. Population growth has developed canning jars are made of aluminium and history to the forefront. They provide better properties and lower cost than other materials. This is an important advantage for the used cans discarded (Zeren, 2012).

Aluminium is one of the most convenient packaging. Aluminium, container and manufacturing of a wide range of packaging applications gives the perfect answer to the drug box. It is not toxic and is used in many different ways in the packaging materials that reduce the proliferation of bacteria in the food and pharmaceutical industries. Toothpaste from a tube in the bathroom, wrapped in foil and store in countless products in the kitchen refrigerator, oven dishes and cold drinks up to, and aluminium wraps and protects many products. Homogeneous structure of the aluminium can be produced in the form of thin films; air tightness can be easily shaped and makes it an ideal packaging material (Şafak, 2011).

4.2. APPLICATIONS IN THE TRANSPORT SECTOR

Aluminium alloys are widely used in the automotive industry due to the low specific weight and high mechanical properties. 25-30 percent of the weight of the car represents the aluminium alloys. The amount of aluminium used in automobiles shows an increase of 10 percent each year. Car carburettors, pistons, rods and connectors are used in components such as moving arms (Zeren, 2012).

The improved production process although there was discovered in aluminium was realized in the year 1800. 1870. Nevertheless, aluminium is produced in volume more than the sum of other non-ferrous metals every year. Aluminium is the third most abundant element on earth. The aluminium which is 8 percent declining resources in our world day by day, taking into account the structural features are used widely in aluminium alloys. Aluminium and automotive industry, the most common light metal, have a common history of use in vehicles. As a result of this common history of an average car today contains a wide variety of aluminium parts (Düzce University, 2013).

Corrosion resistance and gained hafif1ik car for the construction, trucks, and trains, marine vessels such as transport vehicles in both cast and wrought alloys are used. Use of aluminium is approximately 25 percent of vehicle production tools. The lighter vehicles require less energy to move through the senses. Nowadays, about 50 kg of aluminium used in cars. Thus, approximately 100 kg of iron, steel and copper materials saving is made. The results of the accounts and experiences of aluminium used in a car, compared to a sufficiently aluminium used car, it was understood that spent 1500 litres less fuel over the economic life. Sea vehicles, particularly boats in aluminium superstructure systems, is drawn down more centre of gravity and so is the boat's stability is increased and is provided more user-generated content, 70 percent by weight of an airplane is made of aluminium, lightweight aluminium alloys as well as the stability of the aircraft and therefore the aviation sector. He has made the greatest contribution to development. Duraluminium (aluminium and copper) in the future will be the most important aircraft aluminium-lithium alloy material after the alloy, and aluminium-lithium alloys, 15 percent of the air relief is possible (Şafak, 2011).

Aluminium and its alloys has entered the aircraft industry in 1908 with the discovery of aging hardening. Duralumin type aluminium alloys used in the aircraft industry today. Today, many of the body of the plane is made of aluminium alloy. Today, nearly 50 years ago with aluminium alloys resistant to the corrosive effect of the sea it is made. These alloys with small amounts of 2.5-6 percent Mg Mn, Cr, B and Ti existence contained. High tensile strength, ductility and workability of this alloy is difficult to cast the best ones. Small research ships, yachts, sailboats and ferries such as aluminium alloys in the construction of large and small vessels are used. Passenger ships and preferred aluminium alloys because they are light in freighters, large military ship, a further advantage is achieved through low magnetic permeability. Aluminium and aluminium alloys are less expensive operating costs although it is used in a corrosion-resistant and due to the light rail vehicle. In recent years, wagons, trailers, aluminium alloys have been used in locomotive production (Zeren, 2012).

4.3. APPLICATIONS IN CONSTRUCTION SECTOR

Developments occurring in the architectural style and construction techniques in recent years in favour of aluminium alloys. Surface structures of these developments, external and internal parts, such as door and frame. Excessive use of aluminium and its alloys low cost of course, is because of the good-looking and fast construction (Zeren, 2012).

The construction sector, 1.2 million tons per year in Europe, 1.05 million tons in the US uses 915,000 tons of aluminium in Japan. Aluminium, roofing and cladding of buildings, doors and windows, stairs, the roof structure is used in large quantities in the production of scaffolding and greenhouses. Besides the decorative appearance as it is the strength aluminium, anodized (anodic oxidation) is immortalized in a way to finish. Both natural and colored anodised coating, both the lacquer coating (powder or liquid painting) with aluminium; it offers rich options for architects and engineers in construction. In the construction sector; aluminium extrusions, castings and flat-products and door / window frames, wall / roof used in the manufacture of coatings and accessories. 6XXX series (AlMgSi) alloy in architecture - the most widely used in the construction sector, 6060 and 6063 (and the new TS EN notation) and almgsi0.5 (DIN notation and former TSA) are alloys. Their chemical composition is basically the same, they show the nuances of differences in the lower and upper limits. EN AW / AE 6005, 6005 and 6082 aluminium alloys are preferred mechanical properties for engineering applications with higher value as desired (Düzce University, 2013).

Aluminium; building the roof, in the cladding, doors and windows, stairs, the roof frame, the scaffolding and greenhouses, bridges, towers, storage tanks, etc., used in large quantities in the production. Although expensive than aluminium steel structure in architectural design, light weight, aluminium is preferred in cases where the advantages of corrosion resistance. For the construction sector, 1.2 million tons in Europe, the United States 1.05 million tons, 0.92 million tons of aluminium use in Japan. Besides the decorative appearance as it is the strength aluminium, anodized (anodic oxidation) is immortalized in a way to finish. Both natural and colored anodised coating, both the lacquer (powder or liquid) aluminium with painting; it offers rich options for architects and engineers in construction (Şafak, 2011).

4.4. APPLICATIONS IN THE ELECTRICAL AND ELECTRONICS INDUSTRY

An aluminium conductor is lighter than copper conductor because of its low density. Therefore, it is used in power transmission lines since 1930. In our country, 'Turkey's electricity agency' in the domestic power transmission and aluminium cables are used (Zeren, 2012).

Both in the electricity transmission engine, generator, aluminium is used in various parts of the equipment, such as transformers. Aluminium is a highly conductive metal. Therefore, 10 percent of all aluminium use in Europe, the USA 9 percent and 7 percent in Japan is used in electrical and electronic industry. Aluminium is the most widely used in this area, electricity transmission lines. Steel reinforced aluminium conductors, has been the preferred material for high-voltage electric transmission lines only. Aluminium, in underground cable, are widely used in the electrical conduit and the motor winding. Electronics, aluminum usage between, sachets, chip, transistors coolers, there are crates of data recording discs and electronic equipment (Şafak, 2011).

Aluminium is highly conductive material. Therefore, 10 percent of all aluminium use in Europe, the USA 9 percent and 7 percent of the electrical and electronic industries in Japan. Steel reinforced aluminium conductors, has been the preferred material for high-voltage electric transmission lines only. Underground cables, electrical conduits are used aluminium in the motor winding. In the electronics sector, with chassis, cooler transistor chips are used in the coffers of data recording discs and electronic equipment (TKB, 2006).

Aluminium is the most widely used in this area, electricity transmission lines. Aluminium underground cable is also widely preferred in the electric motor winding pipe and with the technological advances made between the years 1950-1986, the amount of energy used for aluminium production decreased by 30 percent. Aluminium, where used, that saves more than time and again when the energy consumption is obtained and can be reused indefinitely "energy bank" in their roofs (Kılıç, 2003).

Aluminium is a light metal with properties including aircraft and space vehicles and all vehicles in the construction sector; in the production of electric and electronic instruments with conductivity (electrical wiring, electrical transmission lines, etc.) it is preferred. The bright and stylish image utilizing aluminium is used for making ornaments and decorative household items. High strength / weight ratio is preferred due to the cladding. In particular, transport, construction and packaging industries, including the use of new technologies to the growing influence of aluminium is considered to be the metal of the 21st century (Felekoğlu, 2004).

4.5. ENGINEERING APPLICATIONS

Oil, rubber, textiles, paper, belonging to the industrial sector such as aluminium is widely used in coal mine machinery and equipment. Machine elements applications, high strength / weight ratio, corrosion resistance and ease of processing is superior properties of aluminium. Because of its lightness, and it is possible manipulation of large single pieces. Thanks to precise tolerances ease of processing, it is possible to make large parts of the standard unit. Production of complex parts in cross-section, aluminium extrusion provides great advantages. Gear boxes, engine blocks and cylinder heads made of aluminium casting with ease. The use of aluminium in the final application in the crankshaft bearings has enabled the longevity of these parts (Şafak, 2011).

4.6. APPLICATIONS IN HIGH-VOLTAGE LINES

Aluminium is the third most abundant element on earth after oxygen and silicium. Today, in many countries power transmission lines from aluminium, copper instead of aluminium for all elements of the transmission and distribution system, there are many reasons to be regarded as the main conductive material. Aluminium is lighter than copper, the density of aluminium is approximately 30 percent copper. In particular, the lightness of the air line is a very important pillar structure; because heavy conductors, shows the need for heavy post structure. In addition, the transportation of aluminium conductors, processing and assembly is easier than heavy copper conductors. Aluminium is lightweight, offers many advantages compared to the heavy copper conductors (www.butunsinavlar.com).

Such conductors; specific diameter aluminium wire if the wire tow or all-in-one twisting or bending is manufactured composite structures of two different materials together. They can be classified as being produced and shaped by those not formed (Yılmaz & Karabay, 1996).

1. Fully AAC aluminium conductors.

2. ACSR steel reinforced aluminium conductors.

3. Full aluminium alloy AAAC conductors.

4. ACR aluminium alloy reinforced aluminium conductors

5. TACSR heat-resistant (Al alloy Zr), steel reinforced aluminium conductors.

6. TACSR/AS heat-resistant aluminium (Al, which is alloyed with Zr) and aluminium-clad steel core of the wires.

7. KTACSR/AS High-strength aluminium and alloyed with Zr to the core temperature strength and the steel wires coated with aluminium.

8. ZTACIR very high strength thermal resistant aluminium conductor Inverters steel alloyed with concise and Zr.

9. TAL was alloyed with aluminium Zr, heat steel conductor.

10. ACSR / AS conductor wires of aluminium composite coated steel core.

High voltage overhead lines in Turkey enter the ACSR type within this group. This Canadian CSA-C / 49.1-1975 standards has been designed and are conducting according to the given names of wild animals with birds (Yılmaz & Karabay, 1996).

5. 1000 SERIES COATING OF ALUMINUM ALLOY COPPER

1000 series aluminium alloys in 8 separate step for the copper plating bath is made of the process.

Bathroom process was performed to prepare test cleaned aluminium alloy. Cleaning is important for the coating of aluminium alloy. Because the electrical resistance measurements in experiments which will be coated should be positively influenced happen to be made from any material. Thus aluminium alloy is subjected to the bathroom preparing to test eight different step process. During this process, the process of bathrooms process is very important. To get the best results should be thoroughly cleaned of aluminium alloy. Applied to its eight different operations are as follows:

1. Ultrasonic Hot Degreaser

2. Rinse Bath

3. Electric Cleaning

4. Rinse Bath

5. Zincates Bath

6. Rinse Bath

7. Cyanide Copper Bath.

Step 1: Ultrasonic Hot Degreaser

Aluminium alloy of the surface cleaning is done with hot chemicals. This applies for the removal of the oil layer formed on aluminum. 10 minutes in the pool where the hot wire chemical is suspended.

Degreasing surface treatment is the first and most important stage of the process. Oil, which is used to cut the metal reacts with air. The oil of the tasks is to prevent corrosion of metal cut out of contact with atmospheric oxygen. The same oil, makes it impossible to make the phosphatizing and chromating process. That's why oil supplies should be made free of dirt and rust.

Degreasing process can vary in terms of both chemical applications. Acidic, alkaline and neutral degreasing chemicals used. Spraying, dipping, and ultrasonic methods, such as manually deleting main types of applications. Which methods and is determined by the metal, the nature and operating conditions to which chemical is used. Iron phosphate, zinc phosphate coating, manganese phosphate and chromate coatings prior to use bath is suitable.

Ultrasonic degreasing works with sound vibration. By moving parts of the oil and chemical cleaning it enables more comfortable with the sound vibration. Important parameters to be considered in the degreasing bath temperature, duration, total alkalinity, total acid, concentration and pressure.

Figure 5.1: Ultrasonic Hot Degreasing Bath

The figure shows an ultrasonic hot degreasing. Through transactions performed in this step are cleaned oil layer on the surface of aluminum alloy. Hot chemicals are used during the transaction. Thus it was released from surface cleaning made of aluminum alloy layer of oil.

Step 2: Rinse Bath

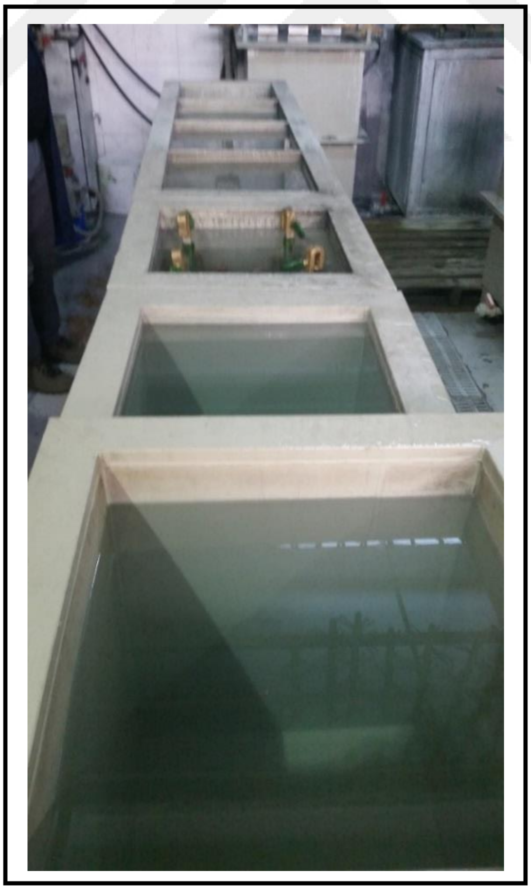
After ultrasonic hot degreasing aluminum alloy wires cleaned by removing immersed in the bath where the pure water. This process is made of aluminum alloy in order to keep any chemical substance on the wire.

Rinsing for cleaning the surface of the alloy hot chemicals used in the ultrasonic receiving hot oil is carried. Thus, the remains of the cleaning is not done in the first step with this rinse.

The rinsing will be carried out after each step. Thus, the ruins will be destroyed after each transaction.

Fat layers on aluminum alloy was cleaned thereby cleaning the used chemicals. Which is inserted into a vacuum cleaning alloys rested ready for the next step.

Figure 5.2: Rinsing Baths



Step 3: Electric Cleaning

Alcali metals such as alkaline degreasing cleaning solutions are the basic solution used in the cleaning power. Of course, the solution composition is not exactly the same. Electric current through the solution using a piece to be cleaned is passed through the anode or cathode.

Cathodic or even cleaning the cleaning part will be used as the cathode in an alkaline solution. Consequently, a significant amount of hydrogen gas into small bubbles in its surface is formed. This helps to clean by scrubbing and bubbles on the surface of the mixing effect. On the part used as the cathode is little or no corrosion. If the solution is coated onto the track cleaned metallic contamination exists. This cathodic reason this type of cleaner should be kept very clean and the bathroom should be renewed on a regular basis if there is a possibility of dissolution of foreign metals. Pollutants metal is coated onto the parts to be cleaned and cause stains or discoloration makes it useless as the effect of cleaning. Meanwhile, the cathode cleaning may sometimes stick to the tool loading electricity even non-metallic particles.

The cleaning is carried out with anodic anode part or the reverse flow to be cleaned. Here the surface of a certain percentage of mixing a gas composition (oxygen) are but formed the amount of gas is lower (the water content is in the form of H 2 O 2 contains hydrogen for 1 oxygen, so hydrogen releasing oxygen half). This gas will be direct chemical effect on the metal surfaces are cleaned with the formation behaving like that because part of the anode and cathode from the anode previously coated metal dissolves as you learn. In this film electrochemical metal surface useful in some cases such effects are present. This kind of cleaning aids in removal of the film layer. On the other hand sensitive metals such as brass cleaner it is cleaned in the most adverse and tingling occur because of poor staining. Similarly, the nickel as a metal that can easily be passivated anodic cleaning should not be applied.

Second cleaning process is applied to the surfaces of aluminum alloy by an electric current. Aluminum alloy wires are held in this bath for 10 minutes.

Figure 5.3: Electric Cleaning Bath

Bubbles with electric current on the surface of the aluminum alloy used in the experiment with the scrubbing is done by creating vacuum cleaning. Thus, cleaning of the alloy surface is occurred a second time. This process is achieved by performing cleaning for 10 minutes.

Step 4: Rinse Bath

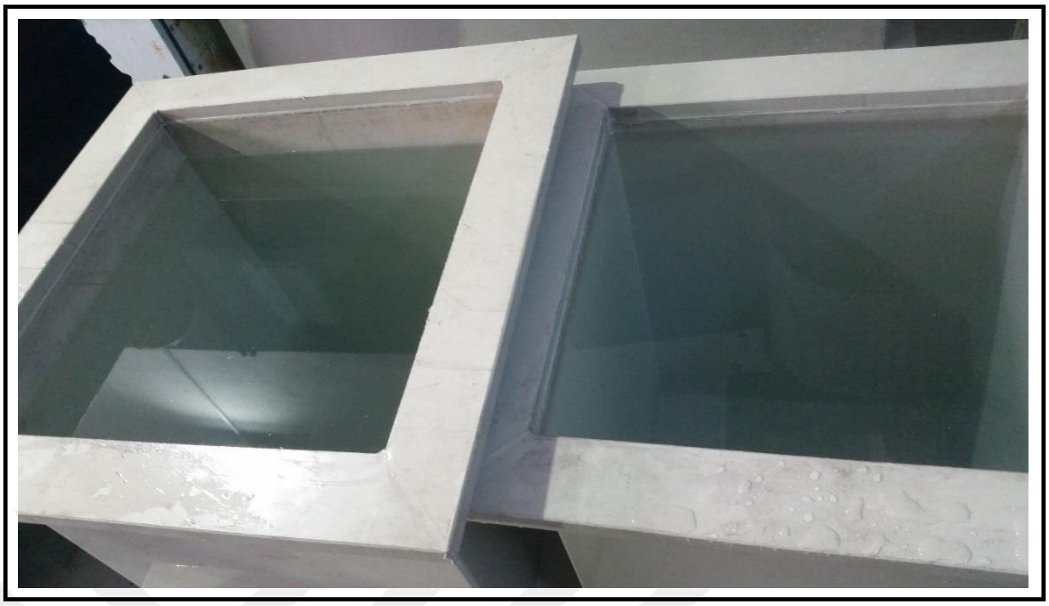
Electric cleaning bath is then passed through the aluminum alloy wires baths.

Electric residue formed during cleaning are cleaned by the rinsing process. Thus it is reached the vacuum cleaning purposes. Alloy cleanliness is important, as initially called. Thus each step is reinforced by rinsing bath.

Step 5: Zincates Bath

Copper plating process before the surface of the aluminum alloy wire, zincate bath is used to prepare the coating. This process results in bright aluminum alloy becomes uneven surface of the wire is broken. Rough surface coating clings becoming better.

Figure 5.4: Zincate Bath



Step 6: Rinse Bath

This rinsing step is repeated 2 times. Zincates bath of the aluminium alloy wires in through the rinse bath of 2 times prepared to copper plating.

Step 7: Cyanide Copper Bath

Extremely smooth copper coatings which have a uniform fine grain texture may be performed in a cyanide-based bath. High current density. Depth distribution is high. After the coating suffers from discoloration made to react with oxygen in the air are oxidized to copper metal coated with a protective layer of lacquer to prevent it.

Electrical current is contained in the copper bath in the anode cathode plate method is carried out by coating. This bath should be 35 degrees.

Wires for copper plating bath is maintained at different times in different thicknesses. Copper wire prepared for the experiment 5, 10, 15 and is maintained in bath 20 minutes.

Figure 5.5: Cyanide Copper Bath and Electric Current that Temperature and Time Set

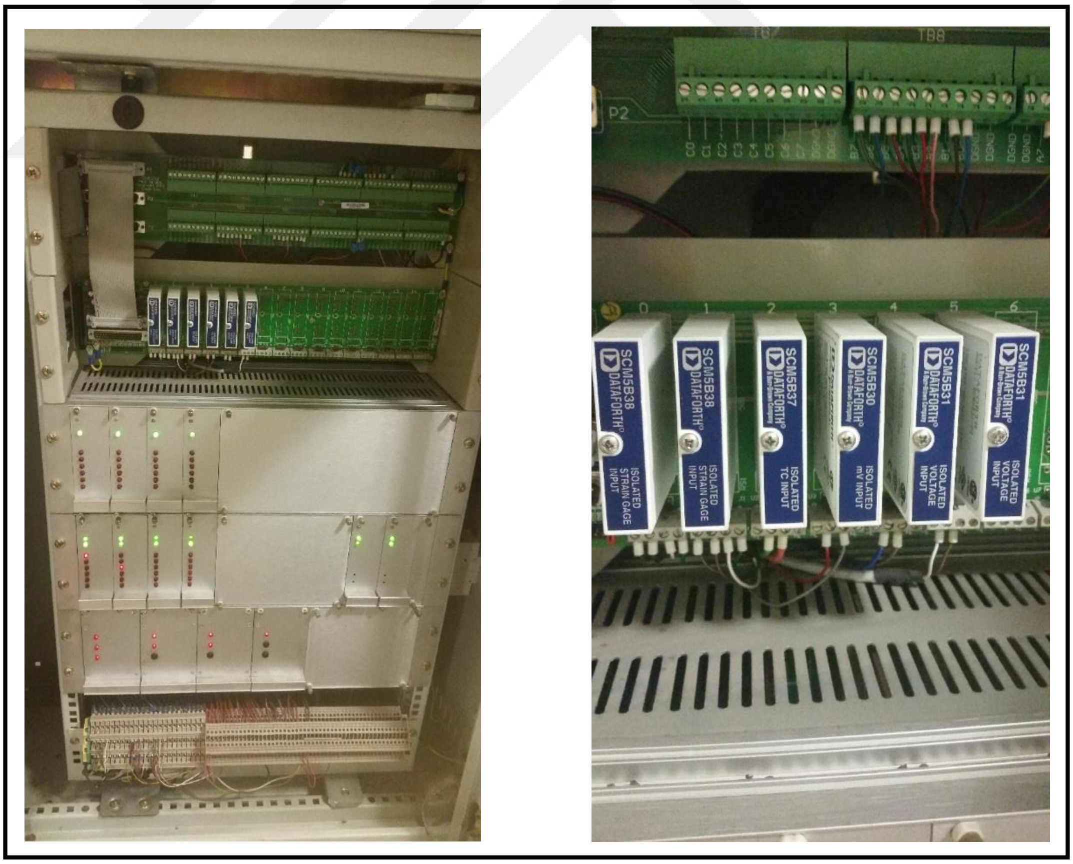
In this way it is made ready for the second part of the test coated alloy. Measuring terminals for making coated copper alloy to be compressed iles the cleaning process has ended.

6. 1000 SERIES ALUMINUM ALLOY COATED COPPER WIRE AND ALUMINUM ALLOY DIFFERENT THICKNESSES OF ELECTRIC CURRENT AND VOLTAGE WIRE TORQUE MEASUREMENT AND TESTS

1000 series aluminum alloy wires coated with copper wires and contact surfaces enhanced resistance testing with current and voltage of Tallinn measurement is made.

Test Setup: The prototype consists of terminals and wire holder, electrical supply, data acquisition machine, 1000 series Al alloy wire, copper clad 1000 series Al alloy wire, brass terminals

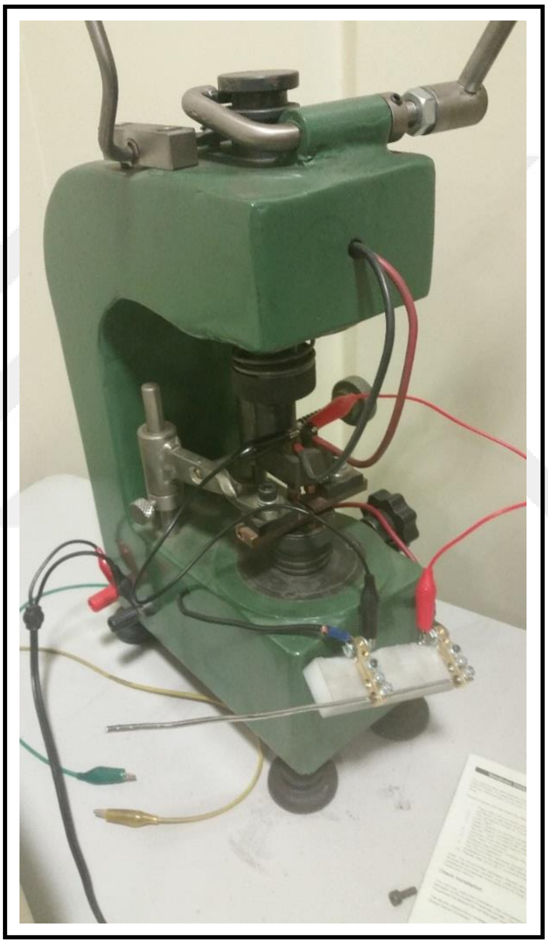
Figure 6.1: Data Retrieval Machines



Data acquisition machine, Dasylab data acquisition program installed is connected to the computer. This computer is also connected to the power source.

Prototype placed wires attached to the holder terminals and 3.8 Amp current passing through the resistance is measured. Then the same process is performed for copper wires.

Figure 6.2: Fitted with Terminals 1000 series Aluminum Alloy Wire

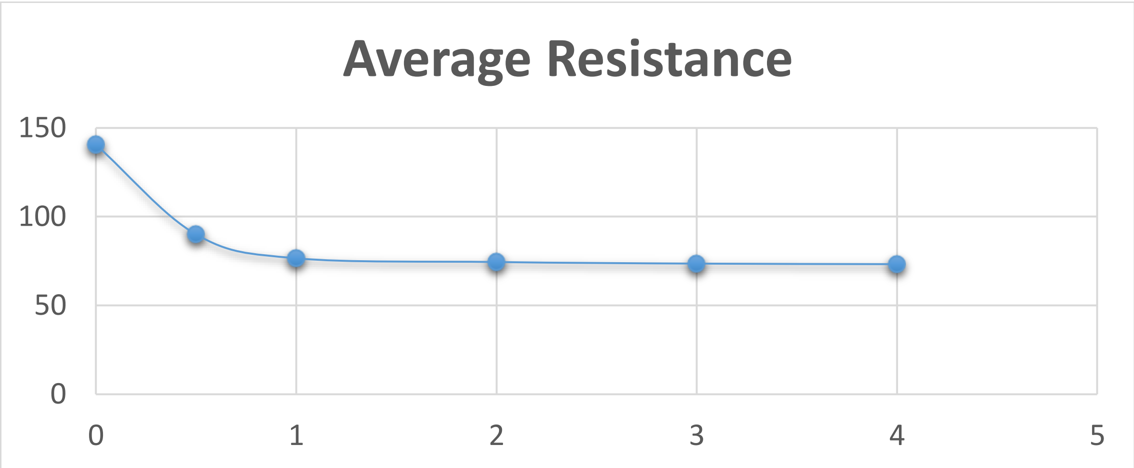


Test method: The aluminum alloy wire resistance measurement by measuring current and voltage.

Table 6.1: Data of experiment for aluminium alloys coated copper

	1000 Series Al Alloy	Al alloy coated copper bath for 5 minutes on hold	Al alloy coated copper held for 10 minutes in the bathroom	Al alloy coated copper bath for 15 minutes on hold	Al alloy coated copper bath for 20 minutes on hold
Current (A)	3,98	3,98	3,98	3,98	3,98
Voltage (V)	0,0035891	-0,000009	-0,000009	-0,000009	-0,000009
Resistance (μohm)	90,017	-	-	-	-

Table 6.2: Graphical Representation of data of experiment for aluminium alloys coated copper



In the second part of the experiment it was carried out by description torque measurement.

1000 series of 2,5 mm thick attached to the terminal screws tightened wire resistance measurements were made at different torque.

First, compressed with both terminals 1 torque rotating screws, and then one end fixed while the other end of the compression measurements have been made by varying amounts.

VR2 terminal screws are tightened with the Bosch brand electric screwdriver.

Table 6.3: Data of torque experiment for the one screw

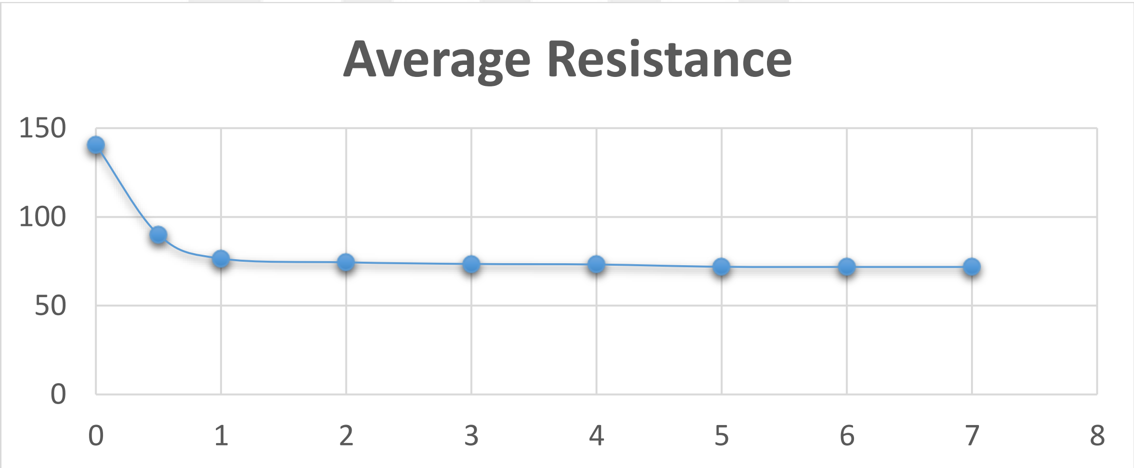
	Manually (loose)	Manually (tight)	Electric Screwdriver (Torque 1 Nm – Both screws)	Electric Screwdriver (Torque 2 Nm – 1 screw)	Electric Screwdriver (Torque 3 Nm – 1 screw)	Electric Screwdriver (Torque 4 Nm – 1 screw)
Current (A)	3,98	3,98	3,98	3,98	3,98	3,98
Voltage (V)	0,0035891	0,0035891	0,0035891	0,0035891	-0,0035891	0,0035891
Resistance (μohm)	140,6	90,01	76,5	74,4	73,5	73,2

End also tightening the terminal screws held constant measurements were taken at different torque.

Table 6.4: Data of torque experiment for the other screw

	Electric Screwdriver (Torque 2 Nm)	Electric Screwdriver (Torque 3 Nm)	Electric Screwdriver (Torque 4 Nm)
Current (A)	3,98	3,98	3,98
Voltage (V)	0,0035891	0,0035891	0,0035891
Resistance (μohm)	71,9	71,8	71,8

Table 6.5: Graphical Representation of datas of experiment for torque experiment



Graphic shows thar resistance decreased by 51 percent.

7. EXPERIMENTAL MATERIALS AND METHODS

After the 1000 series aluminum alloy have been subjected to some cleaning process in the assay test are coated with copper. In addition, aluminum wire was passed through tubes made of copper. This copper alloy wire coated with compressed power source and an electric current which is passed through the aluminum wire terminals copper tube is fitted. The result of this test result was followed by thermal cameras. These results were observed through fetch machine.

Experimental Materials: The prototype consists of terminals and wire holder, electrical supply, data acquisition machine, 1000 series Al alloy wire, copper clad 1000 Al alloy wire, brass terminals

Arcing due to conductivity and copper clad aluminum alloy wire using these materials in the assay are intended to prohibit not give rise to sparking and fire disaster due to low.

In the second part of the experiment it was carried out by description torque measurement. 1000 series of 2,5 mm thick attached to the terminal screws tightened wire resistance measurements were made at different torque. First, compressed with both terminals 1 torque rotating screws, and then one end fixed while the other end of the compression measurements have been made by varying amounts.

Test method: The aluminum alloy wire resistance measurement by measuring current and voltage.

8. DISCUSSION

1000 series aluminum alloys made with wire in the first experiment, 5 minutes, 10 minutes, 15 minutes and 20 minutes by passing a constant current through the resistance changes Button on the copper coated wire was measured. Copper plated wire showed extreme resistance and have been found to conduct an electrical current.

Copper coated for 5 minutes and finest with a copper thickness of aluminum alloy can not hold the copper coating on the wire and was observed to peel off and the consequent electrical current cyanide copper plating process to be used for power transmission, aluminum alloy concluded that should not be used on the wires has been reached.

The resistance of the wire made in different torque tightening of the clamp screw is fastened keeping the wire in the second experiment was measured. Tighten the screws are tightened more than the resistance torque is reduced and as a result it was observed that an electric current is better.

9. RESULTS

In this thesis, depending on the amount of material or counter bored electrical terminal with spark and cause a fire in the electrical wire and installation time alternative methods have been tried.

This is why aluminum alloys electricity transmission by examining the well-studied aluminum alloys and other alloys according to the 1000 series of electrical transmission was observed to be better.

Alternatively 1000 series aluminum alloy material is preselected, and via copper wires coated with the aim of increasing the electric current surface. Different thickness aimed transmitting good copper surface coated with aluminum alloy wire width is increased and the reduction of copper wire resistance is a good conductor of electric current.

The experiments are observed to show extreme resistance of the copper clad aluminum alloy. The minimum time held on the copper plating bath (5 min) is stripped in a simple manner the coating on the aluminum alloy, it is determined not to hold onto the wire.

Aluminum alloy snag on the wire up (etching) to conduct copper plating after the procedure is not appropriate, prevented the passage of this process aluminum wire with copper in the air space and aluminum air contact causes the electric current to be on the surface of the oxide layer.

As a result of these experiments, it was determined that the aluminum alloy was not suitable for copper plating by etching.

Torque test was performed on the same aluminum wire in the second experiment. Terminal screws for securing the two ends of the wire are made of wires of different resistance measurement of tightening torque. As a result of tightening of the screws with more torque and compression resistance of the wire it was observed to fall.

To reduce the resistance of the wire with terminals of spraying over the results of this experiment and it was found that a good conductor of electric current.

The wire used for electricity meters in the experiment, found in the attached terminals at the ends of the screws will be tightened to reduce the wire resistance and thereby reaching more power to be transmitted along with a good result would be an increase of energy.

Tightening of the wire holding more terminals, in time to prevent arcing of the wire can be prevented and the consequences that can occur with the arc spark and cause a fire due to wire screws loosened over time has been reached.

10. CONCLUSIONS

General properties of the aluminium during the first part of this study were investigated. Often encountered in electrical transmission function due to a conductive material is an aluminium material.

Other section consists of aluminium alloy and classified. The second section was created in order to learn more about aluminium alloys used in the experiment.

It was also in the copper and conductivity study. Copper and copper plating is studied by detailed information on aluminium alloys. The material used in the experiment has found itself a place in literature.

In areas where Turkey has been giving importance in the last term for these materials. There is a wide range of applications of aluminium and copper. Both low cost and enables them to be selected to be both conductors. Thus it was terminated in this way in the literature.

In the experimental part 1000 series alloy coated with copper and copper it has also performed some measurements forming a tube. This is done by measuring the electrical resistance is not the desired result in raising disaster. Compressed and heat resistance copper alloy tube clamps with copper plating was measured. The results are compatible with the intended measure. Better conduction of electricity is provided by the better mounting of the wire and the terminals. Periodic control of counters is useful. These controls can be made during electricity usage measurements. Technical precautions of mounting the connected parts of electric counters can be controlled periodicaly as safety rules.

REFERENCES

Books

AKAR, N., & MUTLU, İ., 2010. AA2024 "*Alüminyum Alaşımının Tiksotropik Yapısı Üzerine Sıma Yöntemindeki Deformasyon Oranının Etkisi*" Journal Of The Faculty Of Engineering & Architecture Of Gazi University, *25*(4).

Askeland, D. R., 1990. "*The science and engineering of metarials"* 2. Edition, İstanbul, Chapman&Hall s.423.

ASM International, 1990. ASM Metals Handbook, "*Properties and Selection Non ferrous Alloys and Special Purpose Materials"*, Introduction to Aluminium and Aluminium Alloys, 2, 17-18, Belgium.

Başer, T. A. 2012. "*Alüminyum Alaşımları ve Otomotiv Endüstrisinde Kullanımı*" Mühendis ve Makina, cilt 53, sayı 635, s. 51-58.

Conserva Mario, Donzelli Giancarlo, Trippodo Rodolfo, 1992. "*Aluminium and Its Applications*", Edimet, Brescia.

Deschams, A., Dumont, D., Brechet, Y., Siğli, C. ve Dubost, B. 2001. "*Process modeling of age-hardening aluminum alloys : from microstructure evolution to mechanical and fracture properties*", ASM International, Materials Park, OH, 298-305

Hatch Jhon E., 1984. "*Aluminum: Properties and Physical Metallurgy, American Society For Metals*", Metal Park Ohio.

Karabay Sedat, Taşçı Yusuf, Yılmaz Muharrem (2005). "*Isıya Dayanıklı Al-Zr Alaşımlı İletkenlerin Teknik Karakteristikleri Ve Geleneksel İletkenlerle Karşılaştırılması*" Mühendis ve Makina - Cilt: 46 Sayı: 540

Robert E. Sanders, Jr., February 2001. "*Technology Innovation in Aluminum Products*", JOM, 21-25.

SurTec Deutschland GmbH, July 2008. Surtec Techical Letter, Anodisation, *Anodic Oxidation of Aluminium,*

Singh R. V., 2000. Aluminium – Rolling (Process, Principles & Application), The Minerals, Metals & Materials Society, Pennsylvania.

Other Publications

Alan Gürkan, 2013. "*Alüminyum Alaşımlarının Karışım Asal Gaz Ortamında Tıg Yöntemiyle Kaynaklanması, Mekanik Ve Mikroyapı Özelliklerinin İncelenmesi*" Marmara Üniversitesi Fen Bilimleri Enstitüsü, İstanbul.

Çavuş Zeki, 2010. "*Susuzlaştırılmış Boraksın Alüminyum Bakır Alaşımının Mikro Yapı Ve Mekanik Özelliklerine Etkisi*" İstanbul Teknik Üniversitesi Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, İstanbul.

Demiral Fatih, 2015. "*İkiz Merdane Sürekli Döküm Yöntemiyle Üretilen AA 1050 Alüminyum Alaşımına Anodik Oksidasyon (Eloksal) İşleminin Uygulanabilme Kabiliyetinin İncelenmesi*" Gebze Teknik Üniversitesi Fen Bilimleri Enstitüsü, Gebze.

Doğan Bilgehan, 2011. "*AISI 1350 Çeliğinden İmal Edilmiş Buraj Makinesi Kazmalarının Yerine, AISI 1040 ve AISI 4140 Çeliklerinin Kullanabilirliğinin Araştırılması*" Cumhuriyet Üniversitesi Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, Sivas.

Doğan Ergin, 2006. "*1050 ve 8006 Alüminyum Alaşımlarının Deformasyon ve Yeniden Kristalleşme Davranışı*" İstanbul Teknik Üniversitesi Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, İstanbul.

Durmuş, S., Akgün, S. ve Şahin, S., 2009. "*Çökelme Sertleştirilmesi uygulanmış AA 7012 Alüminyum Alaşımlarında Sertliğin Mikro yapı ile değişiminin incelenmesi*" 5. Uluslararası İleri Teknolojiler Sempozyumu (IATS'09),Karabük

Eker Ayegül, 2008. “*Bakır ve Bakır Alaşımları*” Yıldız Teknik Üniversitesi, İstanbul.

Erkal Sibel, 2011. “*AA2024 Alüminyum Alaşımlarında Yaşlandırma Isıl İşlemlerinin Mekanik Özelliklere Ve İşlenebilirliğe Etkisi*” Gazi Üniversitesi Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, Ankara.

European aluminium association and the university of liverpool partnership program, (n.d). http:// aluminium.matter.org.uk.

Geçkinli, L. F. (2002). “*Aluminyum ve alaşımlarının ısıl işlemi”* 2.ısıl işlem sempozyumu, İstanbul, TÜRKİYE, Şubat 07 – 08

Gümüş İlhan, 2004. "*Elektrik Enerjisi İletiminde Alüminyum*" Elektrik Mühendisleri Odası Dergisi.

Harput, S., & Onuk, A. G., 2008. “*Bakır Lamalarda Bağlantı Yüzeylerinin Elektriksel Temas Direnci Üzerindeki Olumsuz Etkileri Ve Bunların Azaltılmasına Yönelik Çözüm Yollarının Araştırılması*”.

<http://www.alcoa.com/gcfp/catalog/pdf/alcoa_alloy_2024.pdf>.

<http://www.alcoa.com/gcfp/catalog/pdf/alcoa_alloy_7075.pdf>.

<http://www.butunsinavlar.com/havai-enerji-hat-iletkenleri.html>

<http://www.elektrikport.com>

<http://www.fairdene.com/chimera/materials%20specs/alloy%206082.pdf>.

<http://www.kmyocorrosionlab.duzce.edu.tr/Dokumanlar/e3ea391d-3ab8-485b-b346-be285b57c274_Al%20ve%20Ala%C5%9F%C4%B1mlar%C4%B1%20Korozyon.pdf>.

<http://nautilus.fis.uc.pt/st2.5/scenes-e/elem/e01310.html>.

<http://www.oerlikon.com.tr>

<http://teknolojikarastirmalar.com>

Karabay Sedat, Yılmaz Muharrem, 1996. "*Alüminyum iletken imalat sanayiinde AlB2 ve AlB12 ön-alaşımlarının %99.5-%99.7Al ve AlMg0.7Si alaşımları üzerindeki iletkenlik tesirlerinin araştırılması*" Kocaeli Üniversitesi Mekatronik Mühendisliği.

Kılıç Nurel, 2003. "*Bol ve Kullanışlı Bir Madde: Alüminyum*" A&G Bülten Araştırma Ve Meslekleri Geliştirme Müdürlüğü.

Kumru Nurcan, 2007. "*ETİAL-141, 145 ve 160 Tipi Döküm Alüminyum İle Plaka Tipi Alüminyum Malzemeler İçin Yorulma Makinası Tasarımı Ve Eğilmeli Yorulma Davranışlarının İncelenmesi*" Celal Bayar Üniversitesi Fen Bilimleri Enstitüsü, Doktora Tezi, Manisa.

Oğuz Burhan, 1990. "*Demir Dışı Metallerin Kaynağı*" OERLIKON Yayını.

Odabaş Can, 2007. "*Alüminyum ve Alaşımlarının Kaynağı*" ASKAYNAK Kaynak Tekniği ve Ticaret A.Ş.

Övündür Merih, 2014. "*Alüminyum Alaşımlarına Uygulanan Mikroark Oksidasyon Ve Anodik Oksidasyon İşlemlerinin Karşılaştırılması*" İstanbul Teknik Üniversitesi Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, İstanbul.

Özdemir Bilal, 2014. "*Kablolardaki İletken Tipleri*" Türk Prysmian Kablo ve Sistemleri A.Ş.

Şafak Ali, 2011. "*Uçak Endüstrisinde Kullanılan Alüminyum Alaşımlarının Elektrik Direnç Nokta Kaynak Yöntemi İle Birleştirilmesi Ve Mekanik Özelliklerinin*

İncelenmesi” Sakarya Üniversitesi Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, Sakarya.

TKB, 2006. “*Alüminyum Sektörü Hakkında Bir Değerlendirme*” Türkiye Kalkınma Bankası Ekonomik Ve Sosyal Araştırmalar Müdürlüğü, Ankara.

Yazan A. Akar A. Özmerih L., 2011 “*Bakır ve Bakır Ürünleri Kullanım Alanları*” Maden Yük. Müh. M. T. A. Enstitüsü, Teknoloji Şubesi, ANKARA.

Zeren Muzaffer, 2012. “*Demir Dışı Düşük Sıcaklık Metal ve Alaşımları*”