RECYCLING OF ALUMINIUM BY EXTRUSION PROCESS WITH ANNOVA OR TAUGHI DESIGN APPROACH”

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***ABSTRACT:** In this paper we discuss about aluminium how to recycle after work if remaining available. So their some technique is determined during work by which improved quality and reduced wasteage og aluminium material by EXTRUSION, ANNOVA and TAUGHI design approach. The Hot backward extrusion method has been successfully utilized as a final processing route to generate fine-grained product. In future manufacturing industry alloy of aluminium (Al-Zn-Mg-Cu) can be reprocessing by the hot backward extrusion method. For most aluminium foundries, reusing aluminium chips as raw material for the melting stocks is perhaps the best option as waste management policy in what concerns to economic and technical aspects. In house aluminium swarf recycling by hot backward extrusion method presents some significant benefits over other recycling solutions, namely: Reduction on buying costs of raw material, Elimination of swarf transport costs, Simplified waste management system, High cost /benefit ratio.*

***Keywords:** Extrusion, ANNOVA, Taughi Methods.*

1. INTRODUCTION

Aluminium is everywhere. We see it in the packaging, soft drink cans, food plates, foil, siding, gutters, automotive part and more. What most people don’ t realize is that aluminium is practically the perfect recyclable material. Out of the most common recyclable materials that clutter up our landfills; glass, paper, metals, cardboard, plastics, aluminium is the only material that’ s endlessly recyclable, 100% recyclable, and that pays for itself. Air pollution is associated with synthetic materials and other harmful impurities that diffuse and become part of the air. These materials are mostly industrial wastes, vehicle exhaust fumes, action logging and so the issue of solid particles and gases that escape into the air. There are many adverse effects that would befall mankind if control measures are not taken immediately to address the contamination. Even for recycling culture among the country's government intensify campaign 3R (Reuse, Reduce, Recycle) to provide bins garbage variety of colours so that litter easily separated by categories such as plastic, glass and paper.

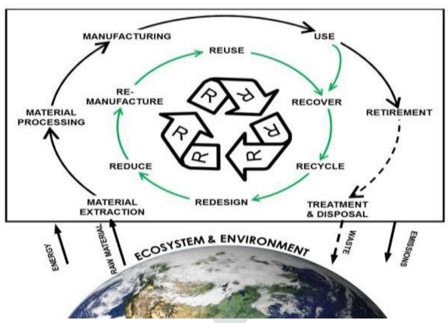

Fig. 1.1 :- closed-loop system of Recycling of Aluminium

Metals have always been the most recycled material in the world. The recycling of waste metallic material and use of scrap is important for economic production of steelworks Matjaz Torkar. In fact, the making of steel requires recycled steel in the production of the raw material. Recycling metals saves energy and helps prevent the depletion of natural resources. An entire industry has grown up around recycling metal. This is because everything that contains metal is intrinsically valuable. In subsequent decades, the transportation and construction sectors have always been the principal benefactors of aluminium extrusion products. Even in present times, the bulk of extrusion usage is in manufacturing doors and windows, followed by passenger vehicles. The short history of aluminium extrusion, in comparison to other metals, has seen extensive development and growth, revolutionizing the way we live. As new purposes are discovered in space exploration and here at home, aluminium extrusion will continue to be an important part of the future.

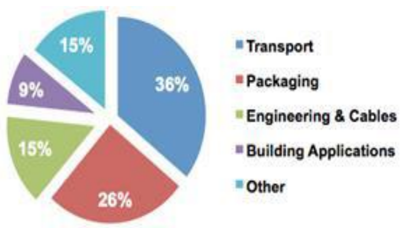

Fig.1.2-. Global Old Scrap Recycled by Market (IAI report 2012)

Figure2 above shown, based on data from the International Aluminium Institute, the current global aluminium old scrap market primarily consists of scrap from automotive and packaging. These factors will make recycling more competitive, and over time the relative importance of secondary aluminium production to society will grow.

1.1 Recycling Aluminium

Aluminum recycling is one of the process by which scrap aluminum can be reused in products after its initial production. The process involves simply re-melting the metal, which is far less expensive and energy intensive than creating new aluminum through the electrolysis of aluminium oxide (Al_2O_3), which must first be mined from bauxite ore and then refined. The processes used for recycling aluminium scrap follows very different from that used to produce primary metal, but in many ways the same general sequence. The industrial scale production and use of aluminum metal are barely a century old, yet in the time, the industry has grown until it is second only to the iron and steel industry among metal producers (figure 3). The influence of automotive aluminum use of recycling pattern is significant, since most recycled aluminum is used in this sector. According to study by Jirang Cui, et at show with the climate change of concern, usage of aluminum in automotive application with the concept of light weight is predicted to be increased steadily. And that researcher also show by using recycled aluminum in place of primary aluminum metal results in significant energy and greenhouse gas emissions was saved.

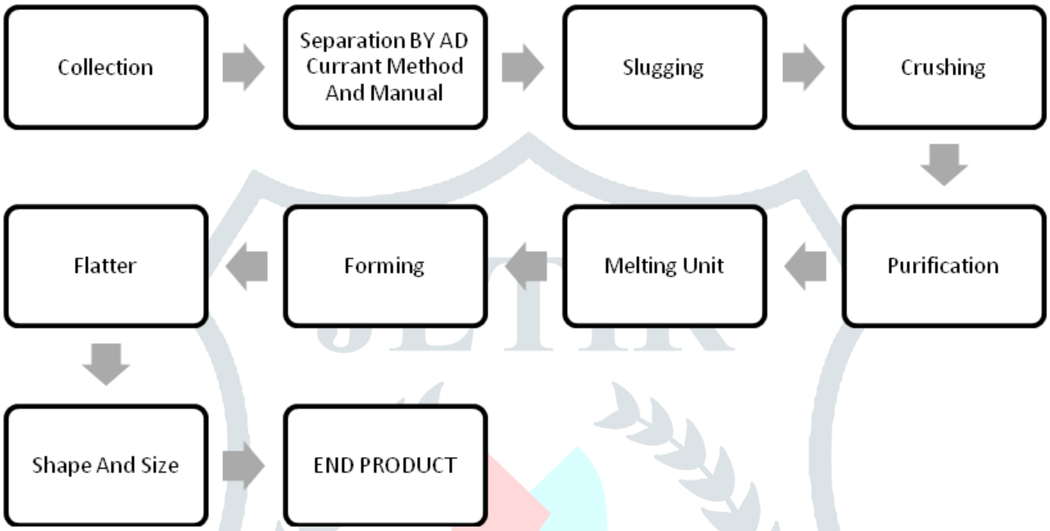

Fig. 1.3 - Conventional aluminium recycling process (FPO, Belgium)

The current predominance of cast alloys makes this easier, since cast alloys have a higher tolerance for impurities and can absorb a wider variety of scrap. Metal are important, reusable resources. Although metals, in contrast to resources such as lumber, are not renewable and therefore exist in finite supply. Sustainability energy savings are associated with producing aluminum from recycled aluminum scrap instead of original aluminum. A new technique of aluminum recycling published by Samuel , presented the work of the direct conversion technique introduced characterized by low energy consumption, large metal savings and very low air pollution emission as compared with conventional methods. Recycled aluminum uses 5% of the energy that would be needed to create a comparable amount from raw materials. The benefit with respect to emissions of carbon dioxide depends on the type of energy used.

1.2 Hot backward extrusion:-

Extrusion is defined as the process of shaping material, such as aluminum, by forcing it to flow through a shaped opening in a die. Aluminum extrusion is a technique used to transform aluminum alloy into objects with a definitive cross-sectional profile for a wide range of uses, as illustrated in Fig. 4. The extrusion process makes the most of aluminium's unique combination of physical characteristics. Its malleability allows it to be easily machined and cast, and yet aluminum is one third the density and stiffness of steel so the resulting products offer strength and stability, particularly when alloyed with other metals. Extrusion is done by squeezing the metal in a closed cavity through a tool, known as an die using either a mechanical or hydraulic press. Extrusion performance can be affected by three major factors, mainly, the number of billets used scrap, the die life and the extrusion speed. Extrusion produces compressive and shear forces in the stock. No tensile is produced, which makes high deformation possible without tearing the metal. The cavity in which the raw material is contained is lined with a wear resistant material. This can withstand the high radial loads that are created when the material is pushed the die. According to Tekkaya , that due to the occurring strains, pressure and temperature at high quality longitudinal seam weld within the profile was assumed during conventional extrusion. Backward extrusion is also known as indirect extrusion. In the backward extrusion process the flow of metal and the direction of the ram both are in opposite direction. The ram creates a mirror image in the material as required. The aluminum extrusion process starts with the die being loaded into the press. The die has openings that will create the profile when the aluminum is pushed through. That dies was preheated to prevent the aluminum from sticking in these openings. Next, the wrought alloy is brought to the press in the form of a billet. The billet as a solid so lent oracle length of a lawyer there can be up to seventy two inches long abilities and placed in a heating furnace and he did to 900°F. This temperature allows the billet to become soft yet still maintain its shape in a solid form. Note that the aluminum has not changed color. Even as a basis for heating furnace at 900 degrees. The heat has made billet it is now loaded into the press. As pressure is first applied the billet is crushed against the dye. Them as the pressure increases the soft but still solid aluminum has no place else to go and begins to squeeze out through the opening of the die to emerge on the other side as a fully formed profile. The extrusion has cooled after emerging from the dye either naturally or through the use of air or water quenchers. This is a critical step to ensure sufficient metallurgical properties after aging. The extrusion is then transferred to a cooling table. A stretcher is used after the profile has been cool to straighten the extrusion incorrect any twisting that may have occurred after the extrusion. A finish cuts off is used to cut the profile to the specified commercial life. Extrusions are then placed on rafts as they are prepared for the aging process. Extrusion alloys reach their optimal strength through the process of aging. Sometimes known as age hardening natural dating occurs at room temperature. Artificial aging takes place through controlled heating in an aging often. The aging of and further strengthens or hardens the profile through controlled thermal treatments that affect the metallurgical structure of the alloys. Yielding maximum strength hardness has elasticity for the profile. Once the extrusion process is complete the die is removed from the press and cleaned of any residual aluminum. After cleaning the die is inspected and prepared for the next time it will be used to extrude this profile.

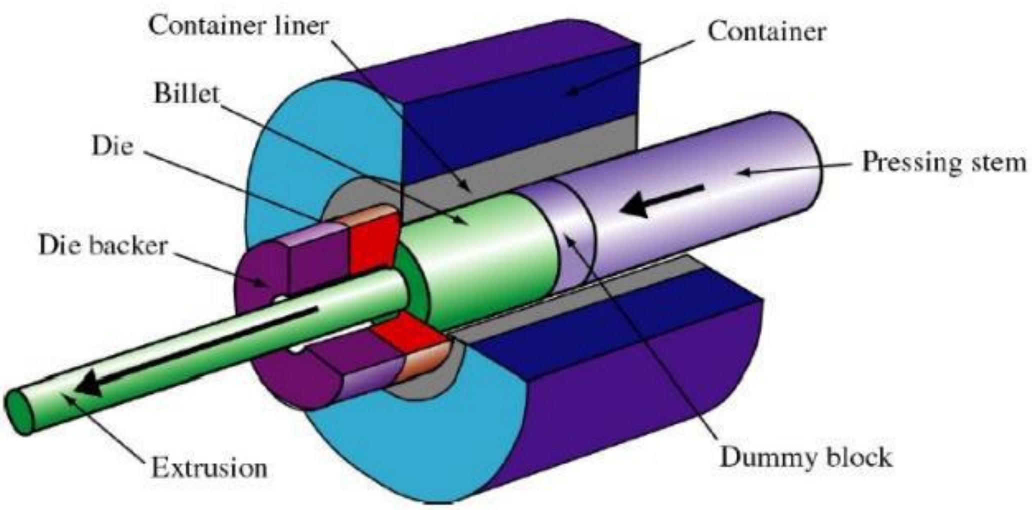

Fig.1.4. Illustration of extrusion process by Kalpakjian,S.

In an extrusion press, pressure is applied to the billet by the ram where the dummy block is attached to the end of the ram stem. The most important factor in the extrusion process is temperature. Temperature is most critical because it gives aluminum desired characteristics such as hardness and finish. The alloyed press bars that are cut into smaller pieces are heated in an induction furnace to around 450°C to 500°C. Right after the completion of pressing operation, air or water is used to cool the profile. Just after cooling, the profile is straightened and all the internal stresses are released by the process of stretching, which is done on a pulling machine. The resultant profile is then cut into the desired lengths. Finally, the process of ageing provides the material the required strength. The ageing process can be done naturally at normal temperature or artificially at an elevated temperature in the range of 170°C to185°C. To reduce possible deviations, an accurate control of the material flow and its influencing parameters such as temperature field or die geometry is necessary.

1.3 Advantage of hot backward extrusion:-

- A 25 to 30% reduction of friction, which allows for extruding larger billets, increasing speed, and an increased ability to extrude smaller cross-sections
- There is less of a tendency for extrusions to crack because there is no heat formed from friction The container liner will last longer due to less wear
- The billet is used more uniformly so extrusion defects and coarse grained peripherals zones are less likely.
- Impurities and defects on the surface of the billet affect the surface of the extrusion. These defects ruin the piece if it needs to be anodized or the aesthetics are important. In order to get around this the billets may be wire brushed, machined or chemically cleaned before being used.
- This process isn't as versatile as direct extrusions because the cross-sectional area is limited by the maximum size of the stem

1.4 Limitations:-

Aluminium swarf is a low density product (0.25 kg/dm3) and is usually covered by a thin film of aluminium oxide and machining fluid. Melting such a product without suitable previous preparation would lead to several problems of different nature:

- Economic aspects: very low metal recovery rate and high energy consumption.
- Environmental aspects: high smoke and gases generation.
- Quality aspects: low quality of the final product (non-metallic inclusions, gas porosities, poor mechanical properties)

2. LITEREATURE REVIEW

2.1 Introduction to aluminum recycling

Aluminum is becoming popular in all kinds of fields and is suitable for use in a wide variety of products for the consumer and capital goods markets. The largest markets are transportation, packaging, construction, electrical, consumer durables, machinery and equipment. Among them, transportation sector, which is one of the largest single markets for aluminum worldwide, includes the manufacture of automotive, buses, trailers, ships, railroad and subway cars, as well as aerospace applications and mobile homes. Aluminum and its alloys have outstanding corrosion resistance with good strength and low density as mentioned. For these advantages, aluminum saves more energy when used in mobile applications, and consequently gives a significant reduction in the greenhouse gas emissions over lifetime. Besides, its lightweight and recyclability have provided the impetus for the increased use of aluminum to help meet new and more stringent corporate average fuel efficiency standards. However, the production of primary aluminum is an energy costly process, involving bauxite mining, purification of alumina by a Bayer process, and a molten salt electrolyte based on cryolite. With the climate change being of concern, the secondary aluminum stream is becoming an even more important component of aluminum production and is attractive because of its economic and environmental benefits. Increasing demand for aluminum-based products and further globalization of the aluminum industry have contributed significantly to the higher consumption of aluminum scrap for re-production of aluminum alloys. At the same time, tons of 5 wastes are created during daily aluminum production. Those wastes, including slag, chips and scraps, covered with coolant are difficult to be recycled. With more and more attention drawn to the recycling industry, advanced techniques need to be developed to improve recycling process. There are several advantages to society when aluminum is produced by recycling rather than by primary products from bauxite ores. Firstly, it is believed that the remelting of recycled aluminum saves almost 95% of the energy required manufacturing pure aluminum from bauxite ore. Secondly, European estimates suggest that the mass of solid waste generated per ton of recycled aluminum is 95% lower than that for primary metal. Thirdly, primary aluminum productions generate both hazardous and non-hazardous emissions. Currently, a large amount of the aluminum going into products is coming from recycled products. In the work of Shinzato et al , in addition to the recovery of metallic aluminum, salt flux and magnesium chloride, the process generates a waste, known as non-metallic (NMP), which is usually disposed in landfills. And fine grains (less than 150 um) of the NMP can also be used as raw material in cellular concrete. The aluminum content in this fraction reacts with water during the production of the concrete while releasing hydrogen. This reaction promotes the formation of pores that reduce concrete density without affecting its strength.

2.2. History:-

A common practice since the early 1900s and extensively capitalized during World War II, aluminium recycling is not new. It was, however, a low-profile activity until the late 1960s, when the exploding popularity of aluminium beverage cans finally placed recycling into the public consciousness. Model promoting aluminium recycling at douglas Aircraft Company in 1942. Sources for recycled aluminium include aircraft, automobiles, bicycles, boats, computers, cookware, gutters, siding, wire, and many other products that need a strong lightweight material, or a material with high thermal conductivity. As recycling does not transmute the element, aluminium can be recycled indefinitely and still be used to produce any product for which new aluminium could have been used. People often think of aluminium as a cheap and plentiful metal, but 130 years ago aluminum was considered rare and expensive. According to the book " Chemical Principles," refining aluminum from bauxite was so costly in the 19th century that the Washington Monument was given an aluminum tip to symbolize its value. In 1886, chemist Mr. Charles Martin Hall invented a cheaper way to refine aluminum from bauxite. The method he discovered is still in use today. Despite its convenience, however, the Hall process uses a considerable amount of energy.

2.3. Researcher's Study:-

In A. Erman Tekkaya et al 2014 have done their work which shows the Recycling of aluminum chips by hot extrusion with subsequent in the direct conversion of AA6060 aluminum alloy machining chips into finished products by hot extrusion with subsequent cold extrusion is investigated. For hot extrusion, two different types of extrusion dies, a conventional flat-face die and an experimental die, are used. The experimental die combines the process of equal channel angular pressing with the process of hot extrusion in a single die, which increases the strain and pressure affecting the chips during extrusion, both critical factors for achieving sound chip bonding. Subsequently, the chip-based extrudates are machined to fabricate chip-based preforms for the cold extrusion experiments. In order to investigate different processing routes, forward rod extrusion and backward can extrusion trials were conducted. In A. Ryoichi Chibaa, et al 2011 have done their research on Solid-state recycling of aluminium alloy swarf through cold profile extrusion and cold rolling which shows the the possibility of solid-state recycling of aluminium alloy machining swarf using cold extrusion and a subsequent cold rolling process is investigated. And he was found that the strength and density of material recycled through extrusion and an additional rolling process were superior to material recycled using extrusion only. Moreover, it was observed that the ductility of the recycled materials was inferior to that of the original aluminium alloy.

In J.Z. Gronostajski et al Discuses in their research on Direct recycling of aluminium chips into extruded products method of direct convertion of aluminium and its alloys chips into final products. The chips were comminuted in cutting device, and for the future processing the granulated chips larger than 5 mm in length were eliminated. Such prepared chips were pre-pressed with the pressure of 210 MPa and hot extruded for final products. High density and good properties of products can be obtained at high extrusion temperature 1 extrusion rates which give the time for diffusional transport of matter. In Raviraj Shetty, et al in their research on Experimental and Analytical Study on Chip Formation Mechanism in Machining of Dracs study experimental work and finite element analysis to investigate the mechanism of chip formation during machining of DRACs. Focus on understanding the influence of different cutting parameters on mechanism of machining. Chips generated experimentally and by finite element modeling during orthogonal machining of DRACs were used for this purpose In J.Z. Gronostajsk in their research describes the experience obtained with the chips of Al and its alloy with addition of small amount of tungsten powder directly converted into the final product by hot extrusion process. The mechanical and physical properties of Al and AlCu4 based composites are presented. The effect of tungsten contents and heat treatment on the properties is described. Direct conversion method do not harmfully affect an environment and produced material can be used as a final product or can be further processed by another plastic working methods like forging or rolling. Over the last two decades, aluminum recycling has grown rapidly in terms of both size and importance to the U.S. economy. Between 1950 and 1974, recycled aluminum constituted only about 5% of the total domestic aluminum market. Since then, both the fraction of recycled materials and the total domestic aluminum market have grown substantially. In January 1997, for example, total aluminum shipments to domestic markets were 1,591 million lbs., an increase of 12.5% over January 1996 levels. Of this total, 639 million lbs., or about 40%, was recovered from new and old metallic scrap. In most applications, recycled aluminum materials perform as well as primary material, and provide significant savings in both production costs and energy usage. At present, most aluminum-bearing scrap is recycled through a smelting process. Although the details of the smelting process differ between various installations, most involve melting the scrap in the presence of chloride-based slag, generally using either a reverberatory or rotary furnace. This slag is typically a eutectic or near-eutectic mixture of sodium and potassium chlorides containing low levels of fluorides (cryolite) or other additives. It serves two primary functions. First, since the material is molten and fairly

3. PROBLEM STATEMENT

3.1 Problem Definition

Aluminum chips is a low density product (0.25 kg/dm3) which makes them inconvenient for handling and transportation, and their surface area is relatively large to the volume, and their surfaces are usually covered with oxides, oil emulsion and machining fluid, which is not good for recycling by re-melting approach. Also, aluminum and aluminum-alloy chips are fouled chiefly with the coolants and lubricants used in machining, usually with oil emulsion. Directing melting such a product without suitable previous preparation would lead to several problems of different nature:

- Economic aspects: very low metal recovery rate and high energy consumption;
- Environmental aspects: high smoke and gases generation;

- Quality aspects: low quality of the final product (non-metallic inclusions, gas porosities, poor mechanical properties)

3.2. Objectives

The objective of this proposed idea is to develop an effective recycling process for aluminum machining chips with good metal quality and yield strength. To optimize the recycling process via the Design of Experiments;

1. To perform a literature review on the applications and potentials of various recycling processes for aluminum chips, which should include not only the conventional method, direct melting, currently used in the industry but also the emerging technologies such as the direct conversion method, solid state transformation;
2. To determine the recovery rate based on the measurement of the recovered metal and the input chips weight;
3. To evaluate mechanical properties of the recycled alloy including ultimate tensile strength (UTS), yield strength (YS), Elongation (Ef), and porosity content and corrosion resistance for quality assessment

4. METHODOLOGY

In this proposed idea , recycling process of aluminum alloy A380 was conducted via Design of Experiment. Taguchi orthogonal array were designed based on flux types, chips/flux ratio, holding times and holding temperatures as four factors while for each factor, three corresponding levels were selected. Recovery rate, tensile strength, elongation at fracture and yield strength was selected as four individual responses to evaluate the effectiveness of the recycling process and the quality of the recycled alloy. Also, S/N ratios for multiple characteristics and analysis of variance (ANOVA) were utilized to analyze experimental data for optimization with weighing factors of corresponding responses. For the four individual responses, the rank of effectiveness of factors (factors selected in Taguchi orthogonal array) and the optimum combinations were concluded. For the multi-response with weighing factors, the combination using Al-clean 101 as the refining flux, 10:5 as the chips/flux ratio, 60 mins as the holding time and 760℃ as the holding temperature achieved the recycling process effective considering both the recovery rate and tensile properties as objective functions. Examination of microstructure by scanning electron microscopy confirmed the consistency between the recycled alloy and the die-cast counterpart.

4.1 Aluminum alloys Chip and industry Waste

Aluminum alloys as a light weight material have been increasingly used in the automotive industry for the past two decades. Among the aluminum usage in each vehicle, almost 35% of automotive aluminum components were manufactured by conventional high pressure die-casting (C-HPDC) processes When C-HPDC components are manufactured, considerable amount of aluminum waste in the forms of scrap, dross, and machining chips are produced as by products. The casting scrap is easily returned to melting; where by most of the metal is recovered and re-utilized in production processes. The study by Gronostajski and Matuszak showed that, in the process of melting aluminum and aluminum alloy chips, on average, 72% aluminum would be recycled after casting. The recovery of aluminum from dross can be achieved at a recovery rate of around 80% by mixing dross and chips with certain types of fluxes. During the recycling of machining chips and melt dross, however, large amount of metal is lost as a result of oxidation, and the costs of labor and energy as well as the expenditure on environmental protection increase the general cost of the process. The chips as a by-product not only bring huge waste, but also could produce pollution to the environment. Also, due to high market demand for cost saving on die castings, the recovery of Al chips becomes critical for die casters

4.2 Design of Experiment

For this proposed idea, the Taguchi method for design of experiment (DOE) was used for the optimization of the recycling process for machining chips of high pressure die cast aluminum alloy A380. Since the preliminary results indicates that the recovery rate was primarily determined by several key process parameters such as flux type, chips/flux ratio, holding time and holding temperature during melting, the present design of experiment took into account the influencing extent of each individual process parameter. This consideration led to the selection of those four influencing factors with three different levels. The results of the factor response analysis were used to derive the optimal level combinations. The contribution of each factor was determined by an analysis of variance. The chips collected directly from CNC machines were recycled with refining flux. The recovery rate of the recycled metal was determined based on weight measurements. To ensure the quality of the recycled aluminum, the mechanical properties and microstructure of the recovered aluminum alloy was analyzed.

4.3 Experimental Procedures

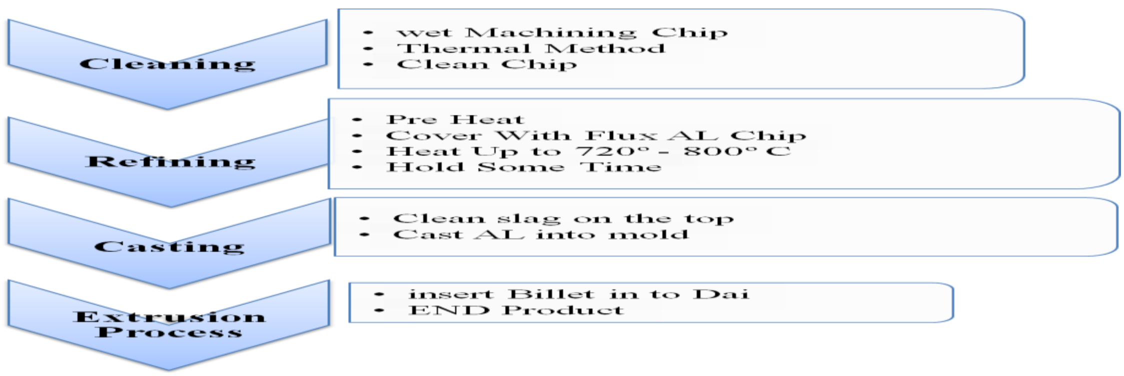

Fig. 4.1 Flow chart of recycling process of Al through hotbackward Extrusion

4.3.1. Materials

Machining chips of high pressure die-cast aluminum alloy shown in Fig.4.2 were the raw material to be recycled. The chips were wet and covered with coolants when collected from the CNC machines. shows one of the recycled aluminum plate.

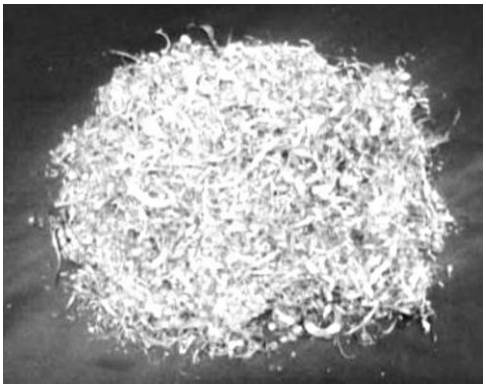

Fig. 4.2 Aluminum Chip

4.3.2. Cleaning

For safety and health considerations, wet machining chips were cleaned before refining process. Thermal method was employed in this study. Wet machining chips were loaded into a crucible and then, the crucible was heated up to the temperature of 400℃ for 45mins to 60mins in a furnace. With this kind of cleaning method, emulsions and coolant were easily burnt out. Then place those cleaned aluminium chips in a fume hood. a clay graphite crucible and a crucible holder used during cleaning and refining process.

4.3.3. Refining

A Sample of Some amount cleaned and dried chips were loaded into a clay-graphite crucible inside an electric resistance furnace. The chips inside the crucible was heated to 500℃ for 20 minutes of preheating to remove any entrapped moisture, and then refining flux was added into the crucible to cover the chips. Three different kinds of fluxes made by Basic Resources Inc. were selected for the purpose of comparison. They were Al-clean 10, Al-clean 11 and Al-clean 13. Two of them, Alclean 10 and Al-clean 13 were fluoride-containing flux, and Al-clean 11 was fluoride-free flux. The chips/flux ratio was selected based on DOE. The crucible with chips and flux was held at 500℃ for 20 minutes. After chips and flux were preheated, the temperature of the furnace was increased to a desired temperature for holding a fixed period of time given by the DOE.

4.3.4 Melting and casting

The slag floating on top of liquid aluminum was scooped out after the holding process. After removing the slag, the recovered liquid aluminum alloy was poured into an ingot mold and cast as a plate. The solidified aluminum plates were quenched in water for analysis.

4.3.5. Recovery rate

Chips were weighed after cleaning and prior to refining experiments, while the recovered aluminum alloy in the form of the cast plate was weighed after refining experiments. The recovery rate of the chips was determined based on the following expression:

$$\text{Recovery rate (\%)} = \frac{\text{Weight of recory AL}}{\text{Chips Weight}} \times 100$$

here the weight of the cleaned and dried aluminum chips was 250 grams for each test of all the nine designed recycling experiments.

4.3.6. Tensile testing

The mechanical properties of the recycled aluminum were evaluated by tensile testing, which was performed at room temperature on a universal testing machine Tensile Test. 4 chosen flat tensile specimens (25 mm in gage length, 6 mm in width, and 3 mm in thickness) were machined from each recycled aluminum plate. The tensile properties, including ultimate tensile strength (UTS), yield strength (YS), and elongation to failure (Ef) were recorded during the tests. Fig.4.3 show the dimensions of a tensile specimen and the tensile test machine, respectively.

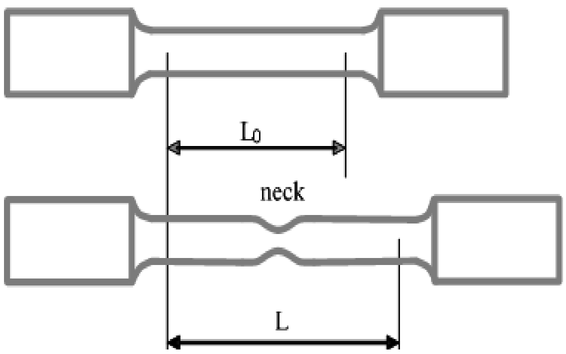

Fig. 4.3 Recycle Aluminium Specimen for Tensile test

4.3.7 Microstructure Analysis

Specimens for micro structural analyses were cut from the interior of the Components and prepared following the standard metallographic procedures. After proper polishing and etching, micro structural changes were examined on the surface of metallographic specimens obtained from as-cast samples using scanning electron microscopy (SEM) .

Samples for metallographic observation were prepared by the following preparation procedure:

- Samples were cut into rectangular shape;
- Mounted with DIALLYL PHTHALATE (Mounting powder);
- Ground with CARBIMET abrasive papers.
- Polished with emery paper ;
- Fine polishes using 1 µm gamma alumina powder; and
- Etched with 1% NaOH solution. Performed by submerging the sample into the etchant for about 40 seconds for SEM, rinsing with water and finally cleaned with ethanol specimen surface with running water and ethanol.
- Specimens for SEM investigation were coated with either gold or carbon before being inserted into the microscope.

4.4. Taguchi design of experiment

4.4.1. Design of orthogonal array

Concluded from the experimental procedures, Table 4-1 gave the parameters selected for specific experimental parameters. Here four factors (flux type, chips/flux ratio, holding temperature and holding time during melting) with three levels were selected. The factors and levels were used to design an orthogonal array L9 (34) for experimentation. the experiment plan for this study, and these 9 experiments were conducted twice for consistency. Since each experiment was repeated once for verification, in total, the eighteen (18) tests were conducted base on the DOE given in Table 1 with four factors and three levels.

Number of Level's	Number of Parameters (P)																										
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
2	L4	L4	L8	L8	L8	L8	L12	L12	L12	L12	L16	L16	L16	L16	L32	L32	L32	L32	L32	L32	L32	L32	L32	L32	L32	L32	L32
3	L9	L9	L9	L18	L18	L18	L18	L27	L27	L27	L27	L27	L36	L36	L36	L36	L36	L36	L36	L36	L36						
4	L'16	L'16	L'16	L'16	L'32	L'32	L'32	L'32	L'32																		
5	L25	L25	L25	L25	L25	L50	L50	L50	L50	L50	L50																

Table4.1

Design Factor And Parameters 4				
Factor				
Level	A Flux Type	B Chip Flux Ratio	C Holding Time	D Holding Temp.
1	10			
2	11			
3	13			

4.4.2 Analysis of variance (ANOVA)

The analysis of variance (ANOVA) on the experimental results was performed to evaluate the source of variation during the recycling process. Following the analysis, it was relatively easy to identify the effect order of factors on recovery rate and mechanical properties of the recycled alloys as well as the contribution of factors to corresponding characteristics.

5. EXPECTED OUT COMES

Aluminum recycling is the process by which scrap aluminum can be reused in products after its initial production. The process involves simply re-melting the metal, which is far less expensive and energy intensive than creating new Aluminum from its Bauxite Ore. Proposed work included 2 different stages First one is recycle the auminum chip and alloy by hot backward extrusion and after complication this work optimize the recycling process of aluminum alloy with the help of Taguchi method for the design of experiment. The recovery rate and porosity content were selected as two original responses. Two combinations of weighting factors were selected in this study for the multiresponse S/N ratio calculate to evaluate the effectiveness and efficiency of the recycling process and the quality of the recycled plates for different requirements.

- Multi-response of S/N ratios
- Optimal recycling factors
- Factor contributions
- Tensile strength of recycle Aluminum Alloy
- Recovery rate of Al

6. CONCLUSION

As per the literature survey the previous methodology cold extrusion adopted were not much effective so, it is found that by using a Hot backward extrusion method for reprocess aluminium chip efficient and effectiveness of such system can be improved. As Reducing Waste & Mining Impacts Reducing Greenhouse Gas Emissions Saving Energy & Achieving Carbon Credit non-convection methodology can be adopted for achieving the objective of this proposed idea In The second stage of the Work Taguchi method will be used for the design of experiment for optimizing the recycling process for the machining chips of high pressure die cast aluminium alloy. Four factors, three levels for each factor were designed based on Taguchi method. To achieve the maximum recovery rate and tensile properties, the signal-to-noise ratio of HB characteristics will be employed to calculate the S/N ratio of recovery rate, yield strength, elongation and tensile strength. The optimum combinations were worked out based on the S/N ratio of each factor.

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