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EXTRUSION BEHAVIOR OF WROUGHT AND AS-CAST AL-5.5%ZN-2,5%MG ALLOY AT DIFFERENT TEMPERATURES AND REDUCTIONS USING SQUARE DIE ANGLE.

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ABSTRACT: - Laboratory scale extrusion experiments were carried out on AA7075 billets. Two groups of wrought and homogenized as-cast (Φ 25 X 60) mm cylindrical billets were used. Each billet was cut longitudinally into halves, the two mating surfaces were polished and scribing an orthogonal network of furrows (0.1 mm wide and 0.3 mm deep) onto one of the faces. The network formed was as a square grid of 1 mm spacing. The two halves were put together and partially extruded, removed from the die, separated along the same plane and the grid distortions were observed.

16 experiments were carried out on each group of wrought and as-cast billets. Each group 3 6 was extruded at four different pre-heating temperatures (350, 400, 420, and 450) ^{o}C. Four values (60, 70, 78, 95.6) % of percentage reduction in cross sectional area were used at each temperature. The ram speed was 4.6 mm/sec. A mixture of graphite powder and grease was 40 used as a lubricant.

The usual type consisting of a single maximum in the transverse grid lines located at the extrusion axis was occurred in all the experiments of both groups.

Microstructure tests were done on the other half after it has been extruded for all the billets of the two groups. Five positions were taken for the microstructure. The magnitude of the maximum load needed for the experiments was reported for both wrought and as-cast billets.

Keywords: AA7075, Extrusion, Billet, Metal Flow, Aluminum alloy, Reductions.

INTRODUCTION

The term “extrusion” in the strict sense applies to processes wherein the movement of the ram reduces the volume of a chamber within which metal is confined and forces it, by reason of its incompressibility, to escape through an opening of dies.

The shape of the opening of the extrusion die determines the shape of the product. Thus, a wider variety of shapes can be produced. Both hot and room - temperature extrusions are quite common (1). Dies with angles of 90 degrees (square dies or shear dies) can also be used in extrusion of nonferrous metals, especially aluminum. The dies should generally be polished to avoid surface roughness on the section resulting from adhesion (2). The usual method of studying the flow in plastically deforming metals, particularly in metal working processes, is to either scribe, print, emboss, etch or photograph a geometric pattern on the surface where the flow is to be studied and recorded the distortion under-gone by the pattern as the metal deforms, under suitable conditions velocities, strain rates and strains can be computed from changes in the pattern. This method is called (Visioplasticity Method) (3). For aluminum alloys, they are frequently worked without a lubricant, or with only a very little in the die.

Graphite and molybdenum disulphide when used will impart a dark skin to these metals, which they are non-metallic inclusions and blisters, which cannot be got rid off [1, 2, 4, 5]. The pressure to deform the billet is increased when lubrication is not used, using high extrusion ratios, high ram speeds, low billet temperatures, and when the shape factor value is too high.

LITERATURE SURVEY

Due to its very high strength, the AA 7075 is mainly used for highly stressed structural parts, such like in commercial aircraft, aerospace, defense equipment, aircraft fittings, and recently in sport tools [6]. This alloy could be extruded at a ram speeds like (15-20) mm/sec [1], (1020) mm/sec [4], and (16-33) mm/sec for direct extrusion and 50 mm/sec for indirect extrusion [6].

The best billet temperature is 420 ºC [1], (410-460) ºC [4], and (300-460) ºC [6]. Deep bearings (die land) could be used with the 7xxx, and even choked bearings are sometimes used to help minimize the depth of peripheral recrystallization [6]. It can be possible to produce good surface finishes from rough billets as a result of wall friction and dead zone in the die-chamber corner by the means of flat dies [7].

Homogenization practices for the high strength Al-Zn-Mg-Cu have been the subject of much development to ensure maximum reduction in microsegregation and elimination of low melting point phases, or phases that can adversely influence material characteristics such as fracture toughness. The homogenization heat treatment for the AA 7075 was to heat the billet between (8—16) hrs at (470—480) ºC. The soak time was typical for billets that have a diameter between (175—225) mm [6]. The billets that are made of materials subject to segregation are often heated to just below the solidus temperature (homogenization) after casting. The aim is to reduce stresses set up during casting, which later could lead to cracking during sawing. Increasing holding time improves extrudability just as an increase in temperature does. However the heat treatment that would lead to optimum extrudability cannot usually be performed since it leads to a substantially coarse microstructure and inadequate strength in the extruded product [4].

For high strength aluminum alloys, which contain appreciable amounts of hard compounds in eutectic colonies or as groups of coarse particles rather unevenly distributed through the matrix of the alloy. Many of these are brittle and do not deform much during extrusion but are broken down into smaller fragments.

The reduction required to do this and to distribute these hard compounds uniformly in order to obtain the highest benefit from working, is high and seems to increase roughly with the amount of the hard phases and with the evenness of their occurrence in the first place. For duralumin (2xxx series) the reduction in cross-sectional area (to convert the as-cast alloy to the wrought state) should preferably be not less than 85 % [1]. The deformation is greater in the outer zones of a bar than it is at the center, which may result in differences between the properties at these places. The variation is greatest when the extrusion ratio (reduction) is low, for then the center receives only light deformation. In smaller sections, involving heavier reductions, both central and outer regions are sufficiently, even though not equally, worked to bring them into a fully wrought condition and the properties become more uniform [1]. The maximum degree of reduction in percent area that could be obtained in extruding the AA 7075 is 96.6 % [4], or 97.75% [1].

Light metals are often hot extruded without lubrication, especially where an extrusion of high-quality surface finish is required. With aluminum and aluminum alloys, when lubricant is required, (10 -15) % colloidal graphite is mixed with light or heavy mineral oil. Liquid and wax-type lubricants are generally put onto the contact surfaces, normally the tool surfaces, by brushing or spraying. Brushing may cause uneven film thickness, which can easily lead to variations in material flow [4].

EXPERIMENTAL WORK

Material

16 Wrought Billets (two halves) with the dimensions of (Φ25 x 80) mm were produced by machining from AA7075 shafts of (Φ70x1800) mm delivered from State Company of Mechanical Industries-Babylon-Iraq. The temper of the alloy was T6 (solution heat treated and artificial aged). The chemical composition is given in table 1.

Another 16 billets were prepared by sand casting to get the same composition as that of the wrought alloy. 1500 grams of Al (high voltage cables) + Cu (commercially pure) + Zn (commercially pure) was melted and poured in a sand mould which has 3 cavities of Φ35x320 mm dimensions.N2 was used as degasing agent. Pouring temperature was 750 ^{0}C.The castings were cleaned and then machined to get the required specimens for the extrusion process. The chemical composition of the as cast billets is shown in table-2.

The Mesh

A mesh of orthogonal grids was done on the face of one half of the two combined halves; the shaper machine was used to do the scribbling on them using a feed of 1 mm/stage. A spacing of 1 mm was used between each line; the line is a furrow of (0.3 mm deep and 0.1 mm wide), when the longitudinal lines was done, the vise was rotated 90 ^{0} and another set of lines was done, which are the transverse lines, until the mesh is completed.

Extrusion Die

A die made of hot work tool steel (type 56CrMoV7) was designed and manufactured to perform the extrusion experiments at different temperatures and reduction ratios. The die was heat treated (hardened) by heating to 850 ^{o}C, soaking for 60 min. and then oil quenched. The hardness after hardening and tempering at 300C was HRC60.

Extrusion Experiments

32 experiments were done on the rig (which is shown in figure 1) at four different temperatures (450, 420, 400, 350) ^{o}C, and two groups of (wrought and as-cast) billets were extruded, using a 300T vertical hydraulic press.

The steps of doing the experiments for the small rig is mentioned in these points:

1) Preheating the rig with two torches, each one is in an opposite direction and they both blow fire at the rig at each other half, so the heat can be distributed uniformly. They are fixed at a distance of 15 cm from the rig and the preheating operation is done for about (15 - 20) minute, the die and the liner are inside the rig and are closed tight.
2) After removing the torches away from the rig, the bolts are to be checked if they are not tight, the six finger heaters and the peripheral heater are put in their places.
3) The thermocouple is put in its place and the temperature controller system is switched on, at that time the temperature is about (460 - 500) ^{o}C, after about (5 -10) minutes the temperature will reach 450 ^{o}C, which is our first temperature experiment, the heaters will be working at that temperature, the experiment is done after waiting 30 minute on that temperature, to guaranty uniform distribution among the whole rig.
4) Before 5 minute of inserting the billet in the hole, the liner and the die are lubricated with a mixture of (powder graphite and grease), and at this high temperature, the grease will vaporize, so only the graphite powder will be sticking (adhering) on the wall and the die.
5) The two halves are lubricated well and then inserted together to the end of the hole (one half having the square grid), until it touches the die. The dummy block is lubricated too and inserted after the billet. At that time the temperature will decrease 30 ^{o}C, since the billet and the dummy block absorbs the heat of the liner, die, and the area around them, but after 5 minutes it will return to its normal level.
6) A waiting period of (20 - 23) minutes is done, so the heat will be distributed to the whole billet uniformly, the punch is inserted (only its beginning) and the upper block of the press is lowered, until it touches the punch.
7) Extrusion is carried out (partially) using a ram speed of 4.6 mm/sec until the product's length is about (10 - 15) cm, which depends on the reduction of percent area, as when the

reduction is higher, the product gets out long with a simple punch movement. The maximum load is measured directly from the load gauge (tons), which is attached with the hydraulic press.

8) After extrusion is complete, the temperature controller system is shut down, the ram, thermocouple and the finger heaters are removed, the bolts are removed, and the liner is left up (the billet and the die are attached together), with a light blow on the billet, the billet is free from the liner.
9) The product is quenched in water to be cooled. And the hot die is put again in the rig.
10) The hot liner is inserted again in the rig, and bolts are closed tight, the finger heaters are inserted to their positions, and the temperature controller system is switched ON again.
11) The thermocouple is inserted in its position again, after all these movements, the temperature is lower than its normal level about (100-150) ^{o}C, so not to waste the time in heating, the next lower temperature is chosen to be done, which is 420 ^{o}C, therefore; a waiting period of (35 - 45) minute is required.
12) When the temperature reaches 420 ^{o}C, there is another waiting period, which is about 15 minute, to get uniform distribution of the heat.
13) The same thing is done for this temperature, and when this experiment is completed, the next temperature will be 400 oC, and then 350 ^{o}C.

Microstructure Investigations

Five locations were chosen to be examined on all 32 specimens directly after extrusion without heat-treating them to T6, so all the investigations were done on the temper F. These five positions are schematically shown in Fig.2

RESULTS AND DISCUSSION

Results of the Metal Flow

The temperatures (350, 400, 420 and 450) ^{o}C were chosen to establish an agreement with the previous investigation parameters mentioned in these references [6, 7, 8, 9, 10, 11 and 12]. The reductions (60, 70, 78, 95.6) % were chosen due to the fact that almost all the experimental investigations are done using reductions higher than 60 %, since extruding billets below r = 60 % will not be practical to study. Figures (3, 4, 5, 6) shows a sample of the metal flow of the AA7075 for both wrought and as-cast billets extruded at 420 ^{o}C.

After having a close look over all the billets, the following observations may be obtained:

1) The surfaces of the wrought billets were clean and were not darken when they were extruded using the powder graphite, since it did not penetrate the surface of the billet, but it penetrated the surface of the as-cast billets, so the as-cast billets that were partially extruded were dark and unclean, because the graphite has the ability to penetrate into the as-cast matrix [1].
2) In both wrought and as-cast billets, it is appeared that the flow type was the same for all the experiments, which is the single maximum type (the strain is maximum at the center and minimum at the edges).
3) It is clear that the Visioplasticity method cannot work properly using high reductions as r = 95.6 %, since the flow lines are highly distorted.
4) In figure 6, the extruded part is separated from the billet because it was very hard to remove the extruded part from the billet, so it has been cut by the saw from the die face to make the removal operation more easy.
5) The separation process of the dead metal zone from the billet is easier and appears in the earlier stages in lower reductions experiments , because the distance (the inclined line from the corner of the die edge until the inside surface of the liner) that is needed to complete the separation process is less in lower reductions. The addition of the lubrication helps this process to a certain extent.
6) Unequal angles of dead metal zones in the same billet is caused by the non-uniform flow of the metal, which is related to the non-uniform lubricant distribution, non-uniform heat

distribution. Off-center (misalignment) between the center of the die orifice and the center of the liner is another factor and can be considered as one of the most important point .New techniques in extrusion plants use tracking laser interferometer to correct the misalignment) (13).

7) The skull (back flash) for all wrought experiments was more ductile and flexible than those of the as-cast billets.
8) The flow lines at the first part of the product was not severely distorted compared to the rest for both wrought and as-cast billets, because it is a free end that could come out first from the die with little deformation on it, but after this area it is obvious that the deformation is increased uniformly until it is equal all over the product (reaches a steady state). The uniform deformation area (steady state) starts to take place after a distance of (1.25-1.5) of the product's diameter from the beginning of the product (for round products, according to this work). Therefore; it is obvious that in all the theoretical calculations and even in the production plants, the first area of the product is neglected. It is obvious that the reduction and the temperature of extrusion do not affect the length of this incompletely deformed area.
9) It is obvious that the temperature has a small effect on the transverse flow lines. The transverse lines are slightly curved with increasing the temperature, since increasing the temperature will make the metal easy to deform, which will help the metal in the center to move relatively faster than the edges in hotter billets for both wrought and as-cast billets. There wasn't any effect observed of the temperature on longitudinal flow lines.

Results of Microstructure Tests

The 32 billets that have been extruded at different reductions and temperatures, were tested under the microscope, since each billet have two halves, so the other clean half that don't have the original mesh is tested with a magnification of 250 X. Figure 7 shows the structure of both wrought and as-cast billets at five different locations mentioned in figure 2 extruded at 420 ºC which is the best extrusion temperature found and r = 95.6 %. Figure 8 shows the structure for both wrought and as-cast of the same five locations extruded at 400 ºC and r = 70 %.

After studying the pictures of the structures, these few points could be mentioned: -

1) In all wrought billets at the first location, there structures were free from casting defects, because these defects were eliminated by using very high reductions at their production so that they could be converted from their original as-cast state to the recent wrought state. The casting defects were very clear in the structure of the first location in as-cast billets.
2) The dark despersoids in the structure of the wrought billets were MgZn2, but in the as-cast billets, casting defects such as voids of porosity, blowholes and inclusions were clear.
3) One of the most important factors to help the voids to close was the amount of percentage reduction in area. It could be seen that the voids were closed due to the high temperature and pressure during the flow of the metal which is increased by increasing the amount of the reduction, so the voids were insured to be elongated and welded [1,4, 5 and 14].
4) In all the as-cast billets structure, it is obvious that the billet after extrusion is better (according to casting defects) than the unextruded area of the billet (1).
5) In all billets, the structure of the area near the surface is better (according to casting defects) than the area in the center, because the deformation is higher near the surface than the center (1, 2, 4, 5, 14 and 15).
6) The voids are elongated with the direction of the flow as it could be seen in zones 4&5.
7) The best structure (according to voids) for the as-cast was at T = 420 ºC, and r = 95.6 %, see figure 7. The voids are almost completely closed, so it could be said that it is almost converted to the wrought state.

8) To insure a complete closure of the voids in the as-cast billets, a reduction higher than 95.6 % should be used, even with this. The voids didn't disappear completely using the other extrusion temperatures.
9) The voids in the as-cast billets are more elongated and closed at zone 3 more than zone 2, because the deformation near the surface was higher than the center (1, 2, 4, 5, 14 and 15).
10) In the recent investigations artificial voids are being created in the billet (holes made by a drill at different diameters and locations to study and view the elongation, welding, and closure of those holes, using different reductions and temperatures. This project managed to view this closure process on real casting defects. In figure 8 it could be seen that the as-cast billets have large casting defects from other as-cast billets, and the process of void closure and elongation is very clear in this figure.
11) The edge of the groove that separates the dead metal zone with the billet is smooth and sharp for both sides of the wrought billet, but with the as-cast billet, the edge is rough at the billet side and smooth at the dead metal zone's side, because the metal moves during the flow at the side of the billet, so the graphite have a bigger chance to enter the as-cast matrix than the dead metal zone, and even the billet starts to get dislocated from the dead metal zone by the help of the lubrication, and this kind of dislocation is rough in as-cast billets compared to the wrought billet, because the fracture in wrought billets is almost ductile fracture which it is brittle fracture in as-cast billets due to its cast structure.
12) It is obvious that the flow stress decreases monotonically towards a steady state regime with a varying softening rate. The stress level decreases with temperature increasing and strain rate decreasing because lower strain rate and higher temperature provide longer time for energy accumulation and higher mobilities at boundary which result in the inoculation and growth of dynamically recrystallized grains and dislocation annihilation [16].

Maximum Load Results

The maximum load for each experiment was measured from reading its magnitude from the gauge attached on the press. Figure 12 shows the relationship between the load and reduction in percent area at different temperatures for both wrought and as-cast billets.

It could be seen that the wrought billets loads are always higher than in the as-cast billets. Because the flow stress of the wrought billets are higher. In colder billets, the load is higher too because the yield stress increase with decreasing temperature (1, 2, 4, 5, 10, 11, 14 &15). The load of the reduction 95.6 % was relatively high among the other reductions.

OTHER Investigations

Funnel (Piping Defect).

Three experiments were carried out completely, two of them were with wrought billets and the third was with as-cast, these experiments were conducted for two reasons: -

1) To calculate the extrusion speed (ram speed), according to this formula (speed is equal to the distance divided by the time), and by dividing the displacement of the ram that had moved during extrusion, which is equal to the length of the billet over the time that was taken to complete the extrusion experiment. It starts from the moment when the punch touches the billet until the pressure starts rising rapidly (by seeing it on the gauge), which is an indication that the punch reached the end (die face).The displacement was 60 mm, and the time was 13 seconds, after dividing 60/13 the result is 4.6 mm/sec which is the speed of the ram.
2) To observe the extrusion defect (funnel) by using different reductions and what is the difference with both wrought and as-cast billets (See the figures 13, 14, & 15).

In figure 13 the funnel was not clear and didn't appear, so it could be concluded that r = 60 % is not enough to cause the funnel in wrought billets.

In figures 14 and 15 the funnel appeared and was very clear since the reduction was higher in these two experiments. It can be said that funnel in wrought alloy is not sharp but it is looks like a long uniform pipe with wide end at the bottom, while in the as- cast condition it is sharp, short, cone shape funnel is produced.

When using a high reduction of 95.6 % for both wrought and as- cast billets at the same billet temperature, the funnel for both billets were very clear and long compared to the lower reductions. The wrought funnel was longer and more uniform while it was short and nonuniform in the case of the as-cast funnel (See figure 16).

Subcutaneous Defect

This defect happens when square dies and lubrication just like powder graphite are used. See Figure 17, which shows the dead metal zones that were separated during the extrusion process of some experiments at different temperatures and reductions.

When lubrication is used especially if it is of powder form, and during the flow of the metal, the lubrication will separate the dead metal zone from the billet and the result is that the graphite penetrates into the product surface after the separation is complete, it is seen that; the product is clean at the beginning and then it will become dark especially in as-cast billets, because the graphite can penetrate into the as-cast matrix more than the wrought during the flow of metal at high temperatures.

The discards that were a result of some experiments of this project extruded at reductions of (60 and 70) %. See figure 17, which shows the discards as a half ring since the billets were of two halves.

The dead metal zone takes a shape like a triangle, and even it could be seen that the inside surface of the discards are rough due to the inside friction of the metal.

CONCLUSIONS

1) Wrought and as-cast AA 7075 billets have a single maximum flow type at all reductions and temperatures when it is extruded at V = 4.6 mm/sec.
2) The optimum extrusion temperature range of as-cast billets for high reductions is (350-420) ºC, and for wrought billets, the optimum temperature is (350-400) ºC.
3) The reduction 95.6 % is not enough to convert the as-cast billet to the wrought state for the AA 7075.
4) Visioplasticity method doesn't work at high reductions as r = 95.6 %, since the flow lines of the mesh is highly distorted.
5) The formation of the dead metal zone in high reductions needs relatively long distance of the billet to move more than that in lower reductions.
6) The best way to close the voids which are formed at the as-cast AA7075 structure is by using higher reductions at T = 420 ºC.
7) The structure near the surface is always better (less voids) than the center in as-cast extruded billets, especially at higher reductions.
8) For wrought billets, both edges of the dead metal zone are smooth, but the edge is smooth from the side of the dead metal zone and rough from the side of the billet in the case of as-cast billets.
9) Lubrication helps the separation process between the dead metal zone and the billet, and the graphite penetrates rapidly in the as-cast matrix at higher temperatures during the flow of metal.
10) The wrought funnel is longer and more uniform than the as-cast.

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Table 1-Chemical composition of the wrought AA7075 in wt %

	Si % Max.	Fe % Max.	Cu %	Mn % Max.	Mg %	Cr %	Zn %	Ti % Max.	Other elements		Al %
									Each % Max.	Total % Max.	
AA 7075 Standard [ASTM]	0.4	0.5	1.2 2	0.3	2.1 2.9	0.18 0.28	5.1 6.1	0.2	0.05	0.15	Rem.
AA 7075 Used	0.06	0.18	1.4	0.19	2.5	0.19	5.5	0.01	Pb = 0.004 V = 0.007 Ni = 0.009		Rem.

Table 2-The chemical composition of the as-cast AA7075 in wt %.

Element / Alloy	Si %	Fe %	Cu %	Mn %	Mg %	Cr %	Zn %	Ti %	Other elements	Al %
As-cast AA7075	0.07	0.18	1.94	0.19	2.44	0.17	5.12	0.01	Pb = 0.003 V = 0.004 Ni = 0.002	Rem.

Figure 1-The extrusion rig with different dies

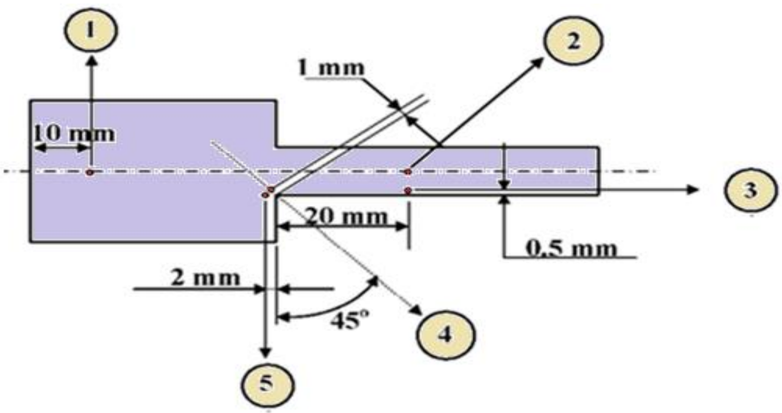


Figure 2 -The locations of the microstructure tests that have been done on the samples.

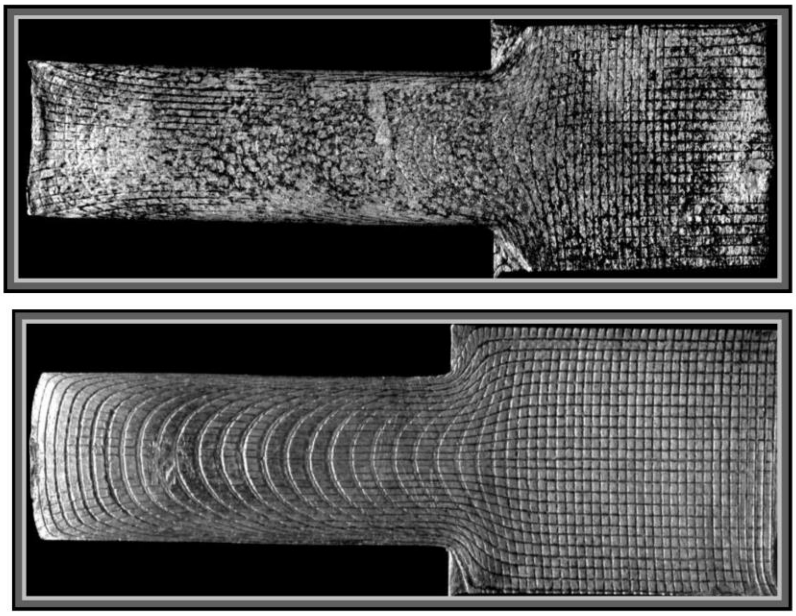


Fig.3 Incomplete extruded parts, both at T = 420 °C, r = 60 %, V = 4.6 mm/sec.

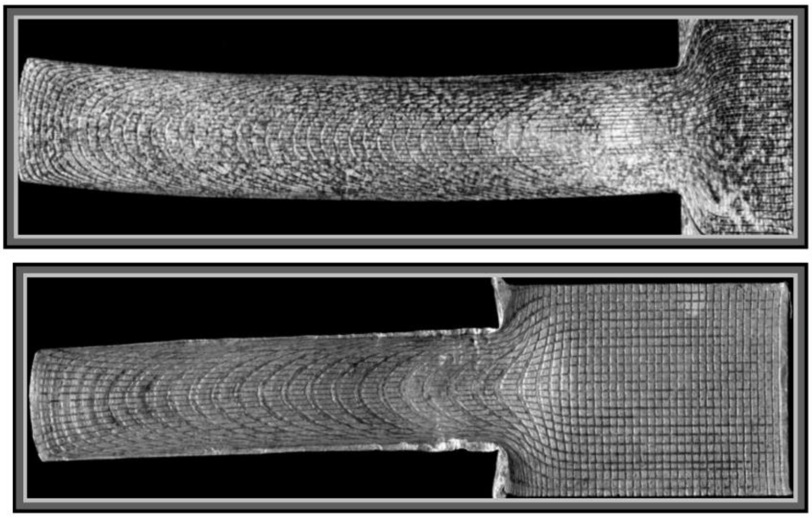


Fig.4 Incomplete extruded parts, both at T = 420 °C, r = 70 %, V = 4.6 mm/sec.

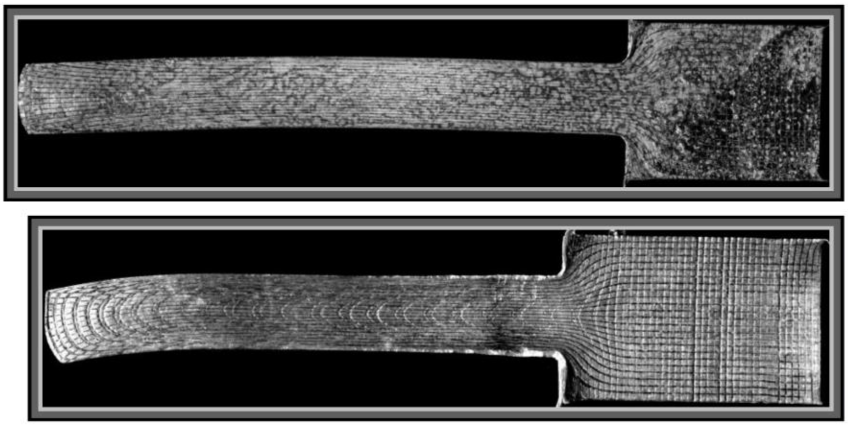
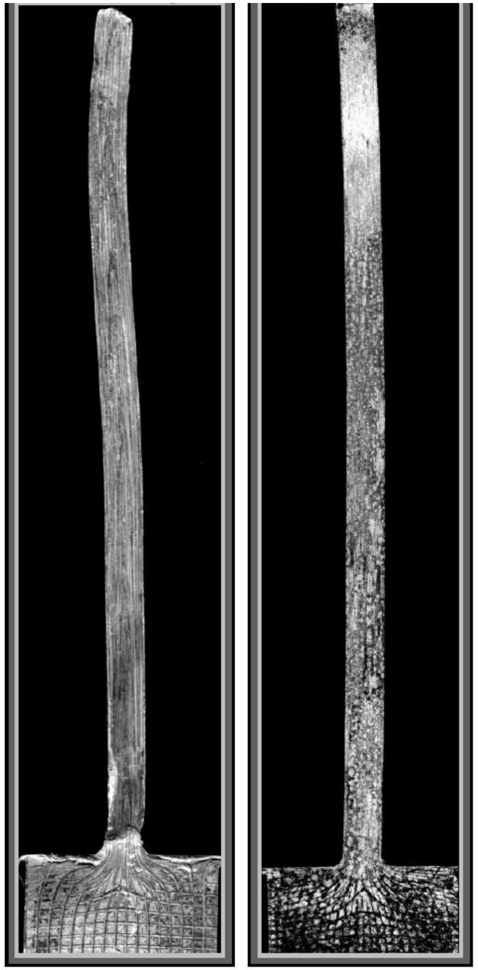
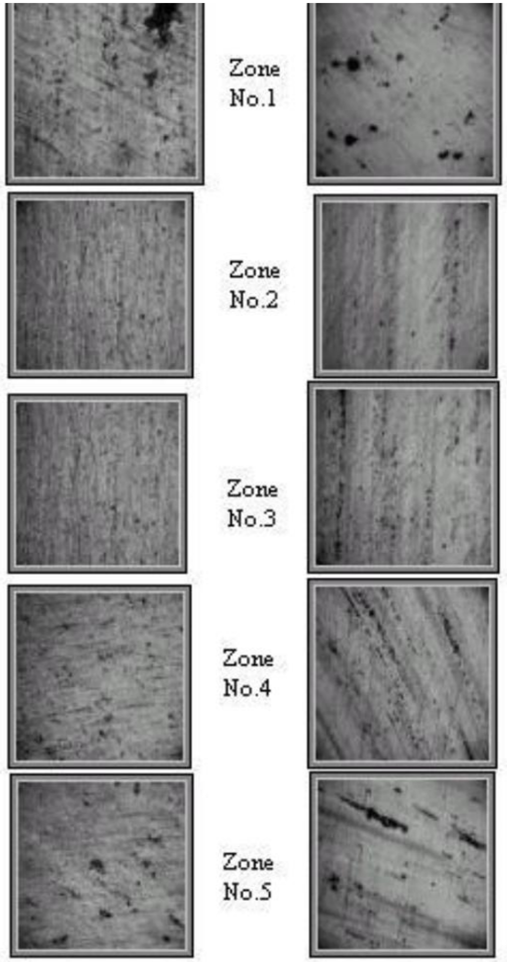


Fig.5 Incomplete extruded parts, both at T = 420 °C, r = 78 %, V = 4.6 mm/sec.



Wrought billet As-cast billet

Fig. 6 Incomplete extruded parts, both at T = 420 °C, r = 95.6 %, V = 4.6 mm/sec. (the photo shows only one-third of the billet) because the rest of the billet is the same.



Wrought billet As-cast billet

Fig. 7 The structure of the five locations for both wrought and as-cast billets extruded at T = 420 °C, r = 95.6 %, V = 4.6 mm/sec., Keller's reagent. 250X.

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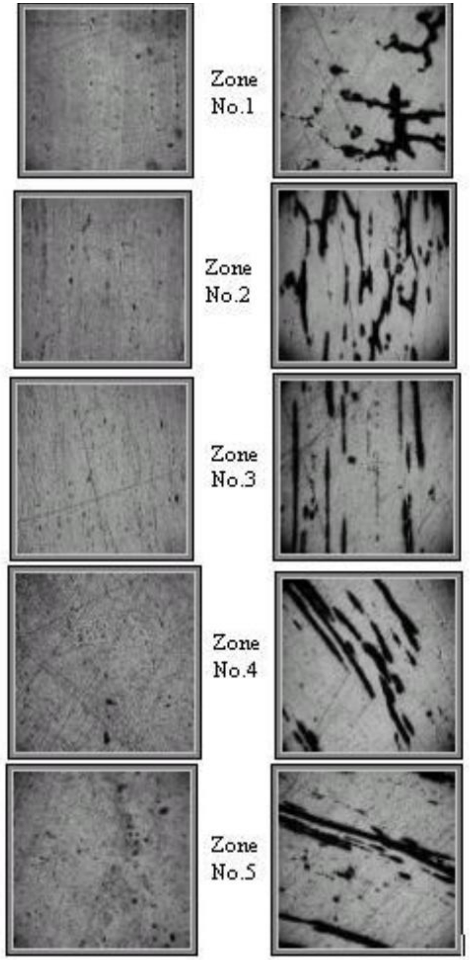
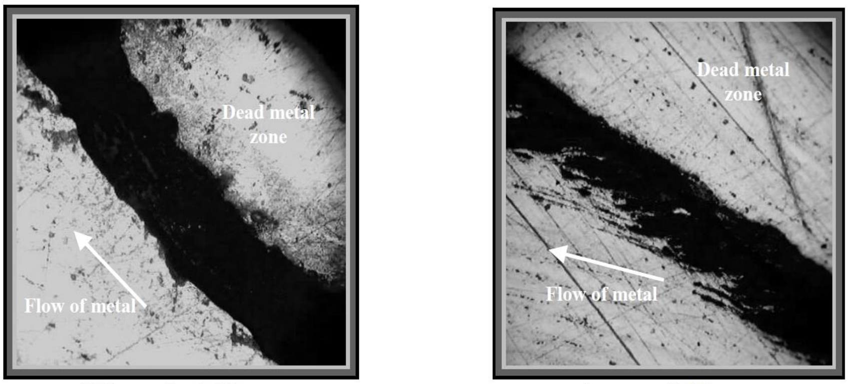


Wrought billet As-cast billet

Fig. 8 The structure of the five locations for both wrought and as-cast billets extruded at T = 400 °C, r = 70 %, V = 4.6 mm/sec., Keller's reagent.250X.

Wrought billet As-cast billet

Fig. 9-The structure of the area that splits the dead metal zone with the original billet for both the wrought and as-cast billets extruded at T = 420 °C, r = 60 %, V = 4.6 mm/sec., Keller's reagent.250X.



Wrought billet As-cast billet

Fig. 10-The structure of the area that splits the dead metal zone with the original billet for both the wrought and as-cast billets extruded at T = 450 °C, r = 70, V = 4.6 mm/sec., Keller's reagent.250X.

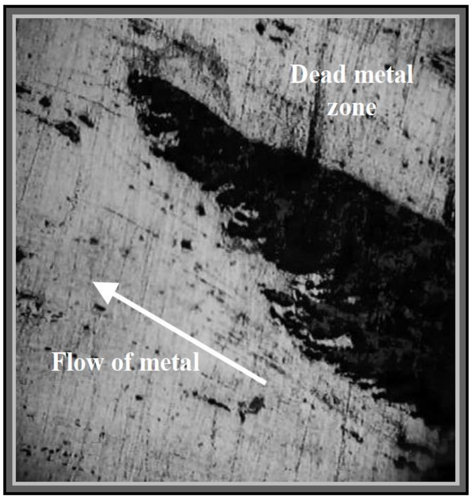


Fig. 11-The structure of the area that splits the dead metal zone with the original billet for the as-cast billet extruded at T = 420 °C, r = 78, V = 4.6 mm/sec., Keller's reagent.250X.

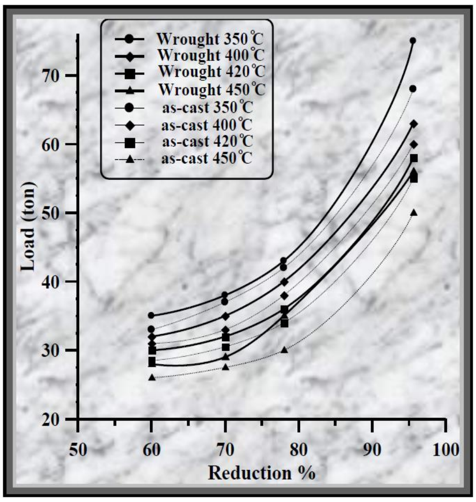


Fig. 12-The relationship between the load (ton) and Percentage reduction in cross sectional area at different temperatures for both wrought and as-cast billets.

15

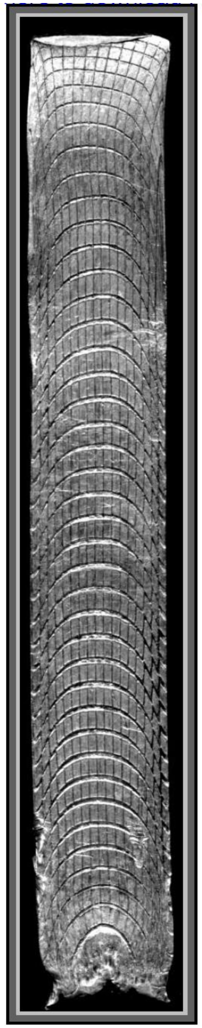


Fig. 13-The wrought billet extruded to the end using the extrusion conditions T = 350 ºC, r = 60 %, V = 4.6 mm/sec.

Fig. 14-The wrought billet extruded to the end using the extrusion conditions T = 400 ºC, r = 78 %, V = 4.6 mm/sec.

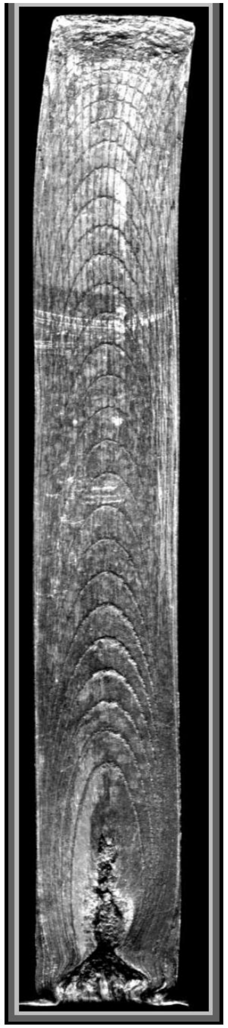


Fig.15-The as-cast billet extruded to the end using the extrusion conditions T = 420 ºC, r = 78 %, V = 4.6 mm/sec.

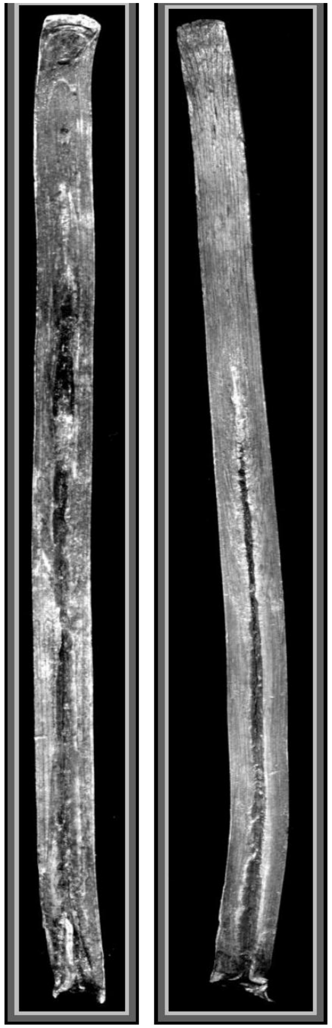


Fig.16-The wrought and as-cast billets extruded both to the end using the extrusion conditions T = 420 ºC, r = 95.6 %, V = 4.6 mm/sec.

16

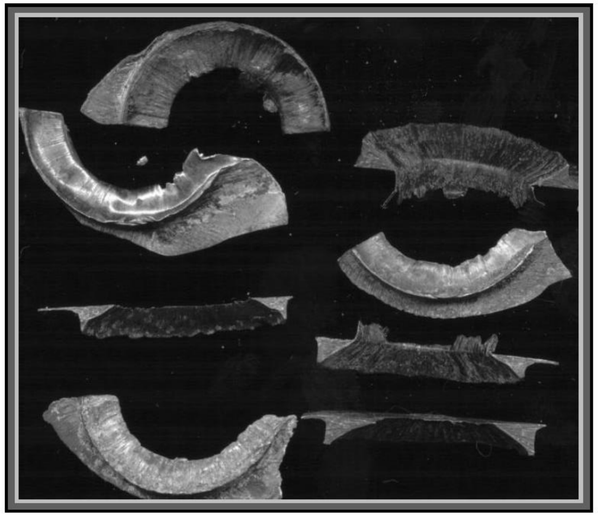


Fig.17-Shows the dead metal zones that were separated during the extrusion process of some experiments of the small rig at different temperatures and reductions.

الخلاصة

تم في هذا البحث اجراء تجارب بثق على مستوى مختبري لنماذج من سبيكة الالمنيوم نوع AA7075 و كانت النماذج عبارة عن عينات من السبيكة بحالتها الطروقة و نماذج أخرى من نفس السبيكة بعد عملية السباكة و اجراء معاملة حرارية عليها(معادلة).كانت النماذج المعدة لغرض البثق اسطوانية الشكل بابعاد(قطر25ملم و طول 60 ملم).تم قطع كل نموذج طوليا الى نصفين و تنعيم السطحين المقطوعين و صقلهما ثم عمل شبكة اخاديد صغيرة بسمك 0.1 ملم و عمق 0.3 ملم على احد النصفين وعلى شكل مربعات طول ضلعها 1 ملم .تم بثق العينة جزئيا بعد وضع النصفين على بعضهما و رفع العينة لدراسة التشوه الحاصل في الشبكة بعد البثق.تم اجراء 16 تجربة بثق على كل مجموعة من العينات الطروقة و المسبوكة مسبقة التسخين عند درجات حرارة(350,400,420,450°م) وكانت نسب التخفيض المئوية في مساحة المقطع هي (60,70,78,95%) عند كل درجة حرارة . سرعة البثق 4.6 م/ثا وباستخدام نوعين من المزيتات هما الكرافيت و الشحم (الزيت الصلب) لوحظ ان التشوه الطبيعي يحدث بقيمة عليا واحدة وعلى طول محور البثق ولمجموعتي التجارب . تم فحص التركيب المجهري للنصف الثاني للعينة وفي خمس مناطق كما تم تسجيل الحمل الأقصى المطلوب في كل حالة بثق للمطروقات والمسبوكات.