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Research Article

Aluminum Alloy with High Magnesium: Investigation of Melt Quality Refinement Methods and Resulting Properties

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Abstract

The industrial practice places a lot of emphasis on the development of lightweight, high-performance materials. When it comes to meet the requirement of volume production and to represent part complexities, Aluminum alloy production and casting are of great interest for their mechanical and lightweight properties. Alloy preparation step and obtain high quality melt for casting is crucial to obtaining the required mechanical and physical properties. Main challenge has been cleaning of the metal melt in order to obtain clean internal structure and resulting properties. Therefore, the most difficult task has been the production and melt treatment step of these alloys. In the present work, high magnesium content aluminum alloys have been fabricated by gravity sand casting method. As melt quality is the most important feature of a successful casting, melt cleanliness has been investigated by reduced pressure test and bifilm count has been measured as the increase in bifilm number has shown a significant decrease in mechanical performance. The performance of the alloys has been assessed by tensile tests. The proper scheme to achieve the highest melt quality has been identified by comparing different melt treatment methods. Moreover, traditional methods such as increased melt holding time and alloying of different elements have not shown an improvement in RPT assessments. On the other hand, rotary degasser method has been observed as ineffective for cleaning of the metal melt because of the turbulence created within the high Mg content. The optimum composition with the highest performance has been proposed.

Keywords

Casting, Aluminum, Mechanical Properties, Melt Quality, Reduced Pressure Test.

1. Introduction

Casting alloys have been widely used in industry since they are easy to manufacture at desired shapes. Different methods exist for the casting of different products [1]. Bifilm index studies and microstructural changes must be evaluated at the same time for aluminium alloys in order to assess the final properties of the alloy, since solely the microstructural investigation is not sufficient to obtain the required properties for aluminium alloys. Lack of joint evaluation of casting quality and microstructural evolution yielded variability of mechanical properties, which hinder extended usage of aluminium alloys in an application where mechanical performance and fatigue life is important [2-10].

During casting, it was shown by Campbell [11-12] that impurities and nonlinear flow of liquid create bifilms which are the defects causing failure of the components in service. The structure of the bifilms is multi-layered, closed, or semi-closed porosities that behave like a crack initiator in the part-in-service condition. In order to evaluate final properties, bifilm index measurements and pore formation must be studied and assessed for a given alloy system [13]. As the alloys tend to form bifilms and pores during solidification, there are also methods to improve melt cleanliness by several methods such as tablet addition to melt, purging gas through melt, degassing, shear methods, and runner design improvement [14-19]. Ultrasonic degassing methods have been investigated by Puga et al. [20–22], who proposed that three minutes of degassing is sufficient and optimal for cleaning the melt to increase mechanical properties. However, it is important to note that not all alloys and charges have the same quantity of bifilms or defects. Therefore, the duration of any degassing operation should not be limited to any period. It

depends on the cleanliness level which could be controlled by bifilm index and then the casting decision can be made.

There has been debates that bifilms have been formed from external medium by the interaction of metal melt and ambient air. This approach has neglecting that intermetallic and bifilms which has been in the master or base alloys could be the main reason of the porosities and defects. In case of the different alloying elements, inherent bifilms must be removed to obtain a clean metal melt.

Some studies have also investigated the effectiveness of hold time of the melt at stable conditions as well as solidification rate impact on bifilm and porosity formation. The main purpose was to assess the effect of dissolved hydrogen within the melt and its effect on gas formation tendency. It has been shown that as the hold time increases, the pore formation increases [23]. Alloying elements are another important aspect in bifilm assessment. In literature, it has been shown for A356 alloys, Sr alloying yielded a lower bifilm index by leading to the formation of smaller and perfectly scattered bifilms [24]. Raiszadeh et al. [25] described this effect as a fusion of folded oxide bifilms and acts as a healing mechanism proposed by Campbell [1]. Effect of alloying elements on bifilm formation has been discussed by Gul et al [26] indicating that different alloying elements yielded different bifilm contents and incorporated variation in bifilm evolution.

The effectiveness of these methods is questionable and some of those methods have been discussed in the present work. In order to evaluate the melt cleanliness level, Dispinar [27–29] showed that molten aluminium melt quality must be identified which is most commonly possible and effective by Reduced pressure test (RPT). The evaluation of the metal solidification under vacuum gives a numerical count of pores linked to bifilm formation. The corresponding number is bifilm index giving an acceptable porosity range indication.

The Bifilm Index (BI) is a quantitative measure introduced to evaluate the amount of oxide film defects present in liquid metal. Calculation is based on reduced pressure test (RPT) results. Cross section of RPT specimens are analysed and size of the pores and quantities defines the BI according to equations 1.1 where h is the pore length of each pore observed in RPT sample cross section in mm and n is the number of pores.

$$BI = \sum_{i=1}^{n} h_i \qquad (1.1)$$

As the porosity and bifilm content can be measured, the quality index concept must be used to define the sufficient quality of the melt prior to casting. For this purpose, various quality index studies have been done by Caceres et al. [30–33]. Erzi et al. [34] proposed a new Supplier Quality Index approach to quantify and assess alloy melt quality using fluidity value, yield strength, tensile strength, elongation, and bifilm index value.

Melt quality and specimen quality have been assessed via Reduced pressure test (RPT)-solidification under vacuum. Bifilm counts have been done for RPT evaluations. Correlation with mechanical tests has been built.

Prior melt cleanliness work using RPT and the bifilm index (BI) has focused mainly on Al–Si–Mg casting by the following methods: pouring/runner design, and degassing methods, rotary degassing and shearing to enhance melt quality. Separate studies has outlined the hold time effects and oxide entrainment. Underexplored areas include high-Mg aluminium (>5 wt.% Mg) and Mg-rich Al–Mg–Cu melts where Mg's strong oxygen/hydrogen affinity governs bifilm formation and degassing efficiency.

Present study provides a comparison of the various melt treatment methods and their effect on melt quality of high containing Mg Al Alloys with side-by-side comparisons of treatment routes.

2. Experimental Methods

In the present study, three-steps of experimental procedure has been adopted. First, casting trials and design of experiments have been selected to manipulate the metal melt and affecting factors. Secondly, melt quality assessment procedures have been used to evaluate the effectiveness of the different methods and finally, mechanical testing procedures have been applied, and the results have been linked with melt quality assessment.

2.1. Casting Studies

AlMg5, A206, AlMg20 master alloys have been used as base in casting studies with main composition of Al-Mg and Al-Mg-Cu. Strontium, Boron and Titanium, Zirconium, Tin have been added in the form of master alloys to base alloy to evaluate the properties. The first set of Alloys have been numbered as Alloy A.n (n= 1-9) having alloying elements of Strontium, Boron and Titanium, Zirconium, Bismuth, Tin, Copper. Alternative of Alloy Ay has been selected with main alloying element of copper. Compositions are given in table 1.

Table 1. Main Constituents by wt.% for Alloy A.n and Ay

Alloy	Mg max	Cu		Sr max	Ti max	B max	Zr max	Sn max
A.n	5	*		400ppm	0,4	0,4	0,4	0,4
Ay	7	2		200ppm	0,4	0,4	0,4	*

Induction furnaces have been used for casting experiments. The melting temperature is set to 780°C; during alloying it was lowered to 765°C. The castings were done at 750°C. Mammut A50 and A5 type crucibles have been used. 10 minutes of holding time have been selected. Sand mould castings have been done without any preheating.

Permanent steel moulds have been used in the experiments. In Figure 1, cupcake specimen geometry was given which was used for melt quality assessment experiments via RPT tests.

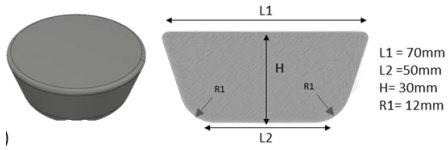


Figure 1. The geometry RPT Specimen

A5 crucibles have been used to identify the effect of different hold times for the same liquid level within the crucible at the same furnace condition with various holding times of 15, 30, and 45 minutes as shown in Figure 2.

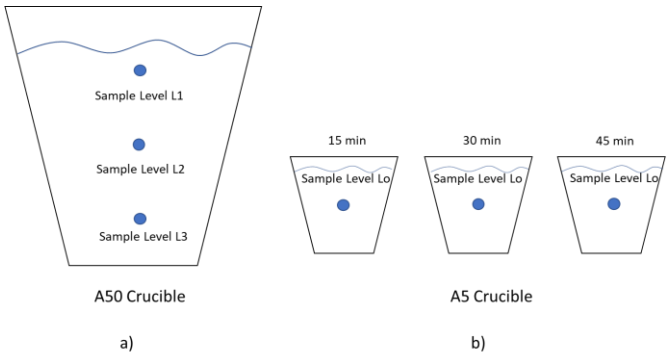


Figure 2. Effect of melt level and hold time effect: a) A50 Crucibles have been used to collect melt samples at different levels of the melt, b) A5 Crucibles have been used for holding time effect at the same level

A50 crucible has been used to assess the bifilm quantity and metal cleanliness on a large volume of metal melt. In this experimental setup, after a constant hold time of 30 minutes, consecutive castings have been done in order to sample alloy at different levels within the crucible.

Degassing method's effectiveness on the melt quality within a large volume of melt has been investigated. Rotary degassing and lance degassing methods have been applied to clean the metal melt using nitrogen gas. Rotary degassing parameters have been chosen as N_2 gas flow of 2 L/ min, rotation speed of 300 rpm for 10 minutes. Static lance degassing by immersion has been applied with N_2 gas flow of 2 L/ min into the molten metal for 10 min. Both degassers were immersed to the same metal level in the crucible.

2.2. Characterization Studies

In order to evaluate the bifilm level and melt cleanliness, reduced pressure tests were carried out at 100 mbar. Cross-section analysis of RPT specimens has been evaluated for different experiments of melt quality assessment. Image analysis was used to measure the pore size.

The mechanical property characterization has been done via tensile tests according to ASTM E8 standards. Specimen dimensions are as follows: head diameter, 8 mm; gauge diameter, 6 mm; gauge length, 30 ± 2 mm; R5 gauge radius. Tensile tests have been performed in stroke speed condition in Zwick tensile test machine at 1mm/ min head displacement. Hardness tests on the Brinell scale (2,5mm/1839N) have been done. The alloy's quality index has been calculated and evaluated according to Erzi et al [34].

3. Results and Discussion

3.1 Melt Quality and Bifilm Index Evolution

At the first stage of the casting studies, no degassing was carried out with an aim to evaluate the effect of bifilms on the properties.

In the second stage, the following methods of melt treatments have been respectively used: using selective alloying elements, molten metal level assessment, hold time increase, application of external vibration of the crucible, rotary degassing and lance degassing.

3.1.1 Alloying Element Effect

Effects of alloying elements into the Alloy A.n alloys on bifilm index change have been shown in Figure 3. Alloying elements drastically change bifilm index. However, none of the alloying elements could provide melt quality increase therefore a degassing method must be applied. All additions have increased the oxide content. All these values appeared to be in the ‘bad quality’ classification which was defined by Dispinar [29].

Increasing the melt cleanliness by Bi and Sn addition was applied if Bi could create a stable oxide layer on the top of the melt metal and Sn to protect Mg content within the melt thus preventing oxidation of the metal. On this context, Alloy A.8 has been cast but the method yielded ineffective results due to compositional deviations. Alloy A9 has been cast and results has been presented in rotary degassing section.

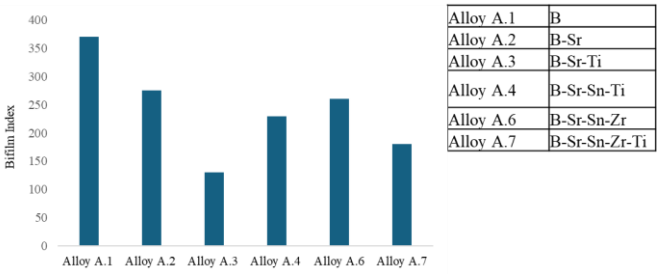


Figure 3. Bifilm index of Al-Mg Alloys by alloying[26]

3.1.2 Melt Level and Hold Time Effect

Figure 4 shows the effect of metal melt level on bifilm formations on Alloy A.7. Although the surface of the melt has been skimmed off, the bifilms are ascending within the metal

melt towards the top of the crucible. The decrease in bifilm content can be seen from the cross-sections.

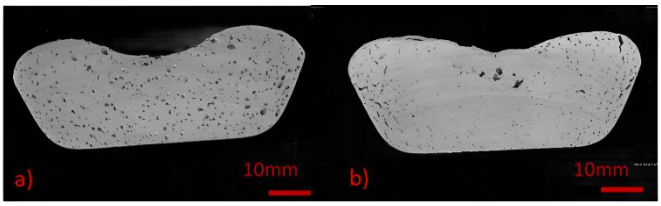


Figure 4. Alloy A7 bifilm index change at (a) Level 1 and (b) Level 3 (according to Figure 2a)

Bifilm formation and RPT cross-sections of 15- and 45-minutes holding time of different but identical composition crucibles have been shown in Figure 5. As the holding time had increased, the pore size has not changed significantly however the number of pores increased slightly. This is mainly attributed to neutral buoyancy and interaction of the bifilms-aluminum matrix during the process.

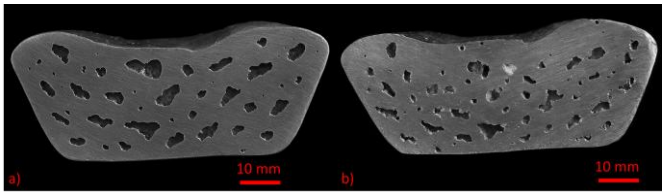
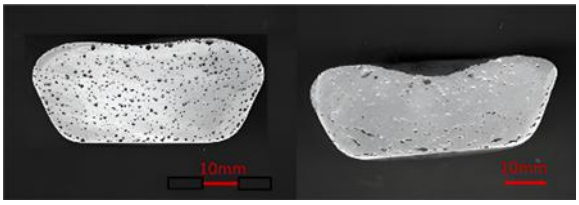


Figure 5. Alloy A7 bifilm change at holding times of (a) 15minutes and (b) 45 minutes.

3.1.3 Rotary and Lance Degassing Methods

As for Figure 6, the effect of rotary degasser has been shown for Alloy A9 whose composition contains B-Ti-Sr-Zr with %5 Mg. The rotary degasser provides improvement in bifilm index. Nevertheless, alloy melt quality is far from the good quality level.



(a) b)

Figure 6. Effect of Rotary Degasser (a) Before Degassing (b) After Degassing

On the last approach, lance degassing was carried out in the melt with ceramic diffusor. The assumption is the airflow outward lance tip should push the oxides to the surface This situation was schematically shown as a balloon/feather analogy by Yorulmaz [35].

During the casting stage, 5 minutes of degassing was applied after the alloying was done for Alloy AY1. Afterward, 5 minutes of holding time, reduced pressure test sample collected. Figure 7 shows the effect of melt quality impact of lance degasser. Static immersed lance degassing process has proven its effectiveness as per literature [35-36].

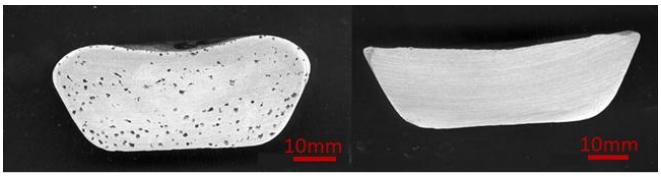


Figure 7. Effect of Lance Degasser Alloy AY1 a) before degassing, b) after degassing

3.1.3 Buoyancy Modification by External Excitation

In order to overcome the neutral buoyancy problem, the A5 crucible has been vibrated externally during hold time regime but it has no positive effect on the metal quality. Therefore, the results are not presented in detail.

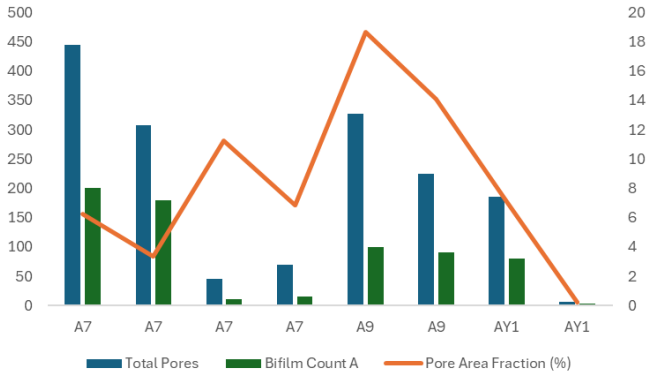


Figure 8. Pore Quantity and Bifilm Calculation Results

Figure 8 provides pore quantities, area fraction and bifilm counts of the specimen cross sections that were presented in figure 4-7.

3.4 Hardness Results of Al-Mg Alloys

Table 3 summarizes hardness profiles of Set A and Set B to assess bifilm effects of hardness. Hardness evolution in Set A in Figure 9, gives the variation of hardness at the same metal melt level, with 30 minutes and 15 minutes hold time respectively according to figure3b of Alloy A7.

Set B gives the effect of hold time within the crucible as per figure 3a at level2 and level3 of Alloy A7. As Bifilm level increases hardness decreased.

As per Set A results, it is clearly obvious that increasing the hold time does not increase the melt quality, furthermore, this decreases the mechanical properties. On the other hand, as per Set B, the fact that the crucible has a different section of metal melt each having different melt qualities affects the properties as well.

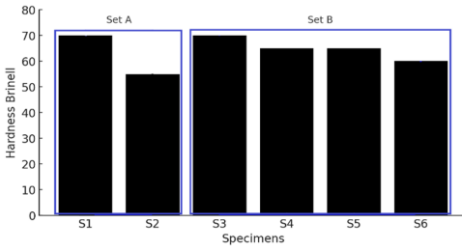


Figure 9. Effect of Hold Time and Melt Level to the Hardness of Alloy A7

3.5 Tensile Test Results of Degassed Specimens

In the final step, degassed specimens A.9 and AY have been tested, and results has been presented in Table 5.

Table 4. Mechanical Properties of as-cast Al-Mg alloy specimens. (Sand Mould Casting)

Degassing Type	Alloy	Tensile Strength MPa	% Elongation	Bifilm Index
Lance	AY	157	1	x<50
Lance	AY	168	0.65	x<50
Rotary	A.9	133	0.55	x~100
Rotary	A.9	127	0.47	x>100

As degassing overcame the non-degassing methods, tensile test results have been given for degassed specimens on Al-Mg and Al-Mg-Cu Alloy of Y series.

4. Discussion

Although alloying proposes an improvement in properties, the present study has shown that metal melt quality is negatively influenced by each additional alloying therefore proper melt treatment is mandatory.

Selective alloying of elements has not shown any improvement if degassing has not applied. This has been attributed to the intermetallic formation with neutral buoyancy. Moreover, the affinity of magnesium to create oxides and affinity to hydrogen could not be prevented by any alloying elements.

As proposed by Gyarmati [6] the use of flux during degassing operations was more efficient in cleaning the melt than the sole use of rotary degasser . In the present study, flux addition has not been discussed and the effect on high magnesium alloys have not been investigated.

Hold time or crucible external vibration has been found ineffective because as per figure 5 and figure 8 bifilm index has not been improved with above mentioned methods. BI results were 45 and 69 in hold time experiments and similar trends has been encountered in crucible external vibration.

Inducing vibration onto the crucible has been found ineffective because the methodology has failed to exert any internal excitation to the bifilms and to separate them from the melt.

Different melt levels in large crucible have shown variable bifilm indexes due to stable melt movement in the crucible. Therefore, bifilms and other melt defects varied along different horizontal volume sections of the melt. Similar findings were reported by Ghanaatian [38].

Rotary degasser (RD) has been found ineffective which has been attributed to large inert gas bubbles and insufficient shear force applied by the rotor blades in high magnesium containing Al alloys.

Lance degassing has proven the most effective method to clean the metal melt of high Mg-Aluminium alloys. This has been attributed to static lance with multiple small gas bubbles which have swept defects toward to the surface of the metal melt.

5. Conclusion

Effect of alloying elements on the mechanical property improvement of any alloy must be coupled with proper melt quality cleanliness in order to achieve high mechanical properties.

The effect of Bi and Sn in metal melt quality has been found to have no effect. Therefore, alloying of Bi and Sn are not viable options for metal quality enhancement.

Flux application should be investigated in future studies. Rotary degassing parameters should be optimized (depth, rotation speed) in future studies

Authors' Contributions

Conceptualization: Kamil Armağan Gül, Methodology: Eyüp Sabri Kayalı, Investigation: Kamil Armağan Gül, Validation: Kamil Armağan Gül, Resources: Eyüp Sabri Kayalı, Data curation: Kamil Armağan Gül, Eyüp Sabri Kayalı, Writing—original draft preparation: Kamil Armağan Gül, Writing—review and editing: Kamil Armağan Gül, Eyüp Sabri Kayalı, Supervision: Eyüp Sabri Kayalı

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

1. J. Campbell, Complete casting handbook: metal casting processes, metallurgy, techniques and design. Butterworth-Heinemann, 2015.
2. M. Tiryakioğlu, J. Campbell, and N. D. Alexopoulos, "On the ductility of cast Al-7 pct Si-Mg alloys," Metall. Mater. Trans. A, vol. 40, no. 4, p. 1000, 2009.
3. A. Ardekhani and R. Raiszadeh, "Removal of double oxide film defects by ceramic foam filters," J. Mater. Eng. Perform., vol. 21, no. 7, pp. 1352–1362, 2012.
4. J. Mi, R. A. Harding, and J. Campbell, "Effects of the entrained surface film on the reliability of castings," Metall. Mater. Trans. A, vol. 35, no. 9, pp. 2893–2902, 2004.
5. G. Gyarmati, G. Fegyverneki, T. Mende, and M. Tokár, "Characterization of the double oxide film content of liquid aluminum alloys by computed tomography," Mater. Charact., vol. 157, p. 109925, 2019.
6. G. Gyarmati, G. Fegyverneki, M. Tokár, and T. Mende, "The Effects of Rotary Degassing Treatments on the Melt Quality of an Al–Si Casting Alloy," Int. J. Met., pp. 1–11, 2020.
7. G. Lasko, M. Apel, A. Carré, U. Weber, and S. Schmauder, "Effect of Microstructure and Hydrogen Pores on the Mechanical Behavior of an Al7% Si0. 3% Mg Alloy Studied by a Combined Phase-Field and Micromechanical Approach," Adv. Eng. Mater., vol. 14, no. 4, pp. 236–247, 2012.
8. H. Song et al., "Three-dimensional reconstruction of bifilm defects," Scr. Mater., vol. 191, pp. 179–184, 2021.
9. M. Mostafaei, M. Ghobadi, G. Eisaabadi, M. Uludağ, and M. Tiryakioğlu, "Evaluation of the effects of rotary degassing process variables on the quality of A357 aluminum alloy castings," Metall. Mater. Trans. B, vol. 47, no. 6, pp. 3469–3475, 2016.
10. C. Do Lee, "Variability in the impact properties of A356 aluminum alloy on microporosity variation," Mater. Sci. Eng. A, vol. 565, pp. 187–195, 2013.
11. J. Campbell, "Entrainment defects," Mater. Sci. Technol., vol. 22, no. 2, pp. 127–145, 2006.
12. J. Campbell, "Stop pouring, start casting," Int. J. Met., vol. 6, no. 3, pp. 7–18, 2012.
13. D. Dispinar and J. Campbell, "Reduced pressure test (RPT) for bifilm assessment," in Shape Casting: 5th International Symposium 2014, 2014, pp. 243–251.
14. G. E. Bozchaloei, N. Varahram, P. Davami, and S. K. Kim, "Effect of oxide bifilms on the mechanical properties of cast Al–7Si–0.3 Mg alloy and the roll of runner height after filter on their formation," Mater. Sci. Eng. A, vol. 548, pp. 99–105, 2012.
15. M. Uludağ, R. Çetin, D. Dispinar, and M. Tiryakioğlu, "Characterization of the Effect of Melt Treatments on Melt Quality in Al-7wt %Si-Mg Alloys," Metals (Basel)., 2017.
16. D. Eskin, N. Alba-Baena, T. Pabel, and M. da Silva, "Ultrasonic degassing of aluminium alloys: basic studies and practical implementation," Mater. Sci. Technol., vol. 31, no. 1, pp. 79–84, 2015.
17. Z. Y. Fan, Y. B. Zuo, and B. Jiang, "A new technology for treating liquid metals with intensive melt shearing," in Materials Science Forum, 2011, vol. 690, pp. 141–144.
18. Y. B. Zuo, B. Jiang, Y. J. Zhang, and Z. Fan, "Degassing LM25 aluminium alloy by novel degassing technology with intensive melt shearing," Int. J. Cast Met. Res., vol. 26, no. 1, pp. 16–21, 2013.
19. T. Yamamoto, K. Kato, S. V Komarov, Y. Ueno, M. Hayashi, and Y. Ishiwata, "Investigation of melt stirring in aluminum melting furnace through Water model," J. Mater. Process. Technol., vol. 259, pp. 409–415, 2018.
20. H. Puga, J. Barbosa, T. Azevedo, S. Ribeiro, and J. L. Alves, "Low pressure sand casting of ultrasonically degassed AlSi7Mg0. 3 alloy: modelling and experimental validation of mould filling," Mater. Des., vol. 94, pp. 384–391, 2016.
21. H. Puga, J. Barbosa, J. C. Teixeira, and M. Prokic, "A new approach to ultrasonic degassing to improve the mechanical properties of aluminum alloys," J. Mater. Eng. Perform., vol. 23, no. 10, pp. 3736–3744, 2014.
22. H. Puga, J. Barbosa, E. Seabra, S. Ribeiro, and M. Prokic, "The influence of processing parameters on the ultrasonic degassing of molten AlSi9Cu3 aluminium alloy," Mater. Lett., vol. 63, no. 9–10, pp. 806–808, 2009.
23. M. Uludağ, L. Gemi, R. Çetin, and D. Dispinar, "The effect of holding time and solidification rate on porosity of A356," Am. J. Eng. Res., vol. 5, no. 12, pp. 271–275, 2016.
24. B. Atakav, Ö. Gürsoy, E. Erzi, K. Tur, and D. Dispinar, "Sr addition and its effect on the melt cleanliness of A356," Mater. Res. Express, vol. 7, no. 2, p. 26549, 2020.
25. R. Raiszadeh and W. D. Griffiths, "The effect of holding liquid aluminum alloys on oxide film content," Metall. Mater. Trans. B, vol. 42, no. 1, pp. 133–143, 2011.
26. Gul, A., Gürsoy, Ö., Erzi, E., Dispinar, D., Kayali, E. (2019). Aluminum Alloy with High Mg Content: Casting Studies for Microstructural Evolution, Phase Formation and Thermophysical Properties with Different Alloying Elements. In: Tiryakioğlu, M., Griffiths, W., Jolly, M. (eds) Shape Casting. The Minerals, Metals & Materials Series. Springer, Cham. https://doi.org/10.1007/978-3-030-06034-3_33
27. D. Dispinar and J. Campbell, "Critical assessment of reduced pressure test. Part 1: Porosity phenomena," Int. J. Cast Met. Res., vol. 17, no. 5, pp. 280–286, 2004.
28. D. Dispinar and J. Campbell, "Critical assessment of reduced pressure test. Part 2: Quantification," Int. J. Cast Met. Res., vol. 17, no. 5, pp. 287–294, 2004.
29. D. Dispinar and J. Campbell, "Use of bifilm index as an assessment of liquid metal quality," Int. J. Cast Met. Res., vol. 19, no. 1, pp. 5–17, 2006.
30. C. H. Cáceres, "A phenomenological approach to the Quality Index of Al-Si-Mg casting alloys," Int. J. Cast Met. Res., vol. 12, no. 6, pp. 367–375, 2000.
31. C. H. Cáceres, "A rationale for the quality index of Al-Si-Mg casting alloys," Int. J. Cast Met. Res., vol. 12, no. 6, pp. 385–391, 2000.
32. C. H. Cáceres, "Microstructure design and heat treatment selection for casting alloys using the quality index," J. Mater. Eng. Perform., vol. 9, no. 2, pp. 215–221, 2000.
33. C. H. Cáceres and J. Barresi, "Selection of temper and Mg content to optimise the quality index of Al-7Si-Mg casting

alloys," Int. J. Cast Met. Res., vol. 12, no. 6, pp. 377–384, 2000.
34. E. Erzi, Ö. Gürsoy, Ç. Yüksel, M. Colak, and D. Dispinar, "Determination of Acceptable Quality Limit for Casting of A356 Aluminium Alloy: Supplier's Quality Index (SQI)," Metals (Basel)., vol. 9, no. 9, p. 957, 2019.
35. A. Yorulmaz, E. Erzi, O. Gursoy, and D. Dispinar, "End product rejection rate and its correlation with melt treatment in direct-chill casted hot rolling slabs," Int. J. Cast Met. Res., vol. 32, no. 3, pp. 164–170, 2019.
36. Gul, A., Dispinar, D. & Aslan, O. Effect of Ti–V and Nb addition on the properties of AlMg7Cu1.2 Alloy. *Inter Metalcast* (2025). https://doi.org/10.1007/s40962-024-01545-9
37. Gul, K.A., Dispinar, D., Kayali, E.S. *et al*. Assessment of Tensile Properties of Cast High Mg containing Al-Mg-Cu Aluminum Alloy with Correlation of Computed Tomography Scans and Optical Crack Surface Analysis. *Inter Metalcast* **17**, 2622–2637 (2023). https://doi.org/10.1007/s40962-023-01038-1
38. Ghanaatian, MH., Raiszadeh, R. "Effect of Different Methods for Removing Bifilm Defects from A356 Aluminum Alloy". Metall Mater Trans B (2022).