

Book of Abstracts from 9th International Scientific Conference on Advances in Mechanical Engineering



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Welcome Message

On behalf of the ISCAME Scientific and Organizing Committee I am pleased to welcome you to Debrecen for the 9th International Scientific Conference on Advances in Mechanical Engineering organized by the Department of Mechanical Engineering, Faculty of Engineering of the University of Debrecen.

The main goal of ISCAME is to yearly bring together engineers working on research, development and practical application in the field of mechanical engineering. Furthermore, the purpose of this Conference is to provide opportunities for scientists and engineers to meet and to discuss current research, new concepts and ideas and establish possibilities for future collaborations in all aspects of mechanical engineering.

I am pleased to inform you that 202 experts from higher education have registered for this year's conference from altogether 12 countries. In the framework of ISCAME 110 presentations were given and 49 posters were exhibited.

This year, the theme of the plenary lectures was artificial intelligence (AI) and material testing. Accordingly, the head of the Material and Process Analysis Laboratory of the BMW Group Plant Debrecen gave lecture about their activities and the representatives of Mathworks introduced the AI solutions of Matlab. Furthermore, the researcher of the host Department of Mechanical Engineering presented the application of artificial intelligence and the related material testing in the context of a case study. Accompanying programs of ISCAME was a Matlab Workshop and the Exhibition of Creative Mechanical Engineers.

We invite you to be an active participant in this Conference and to contribute to any topic of your scientific interest. We hope that the 9th International Scientific Conference on Advances in Mechanical Engineering will have an important impact on the research in all topics included in its program.

It is also an honour for us to have a privilege to give a report about the 9th Mechanical Engineering Industrial Exhibition and Job Fair. The Department of Mechanical Engineering of the University of Debrecen hosted – parallel to ISCAME – the event, called “Mechanical Engineering Industrial Exhibition and Job Fair” where 27 companies were exhibited. This professional program benefited the visitors who wanted to get up-to-date knowledge with the latest technology.

We want to express our appreciation to all members of the committees involved in the preparation of this Conference and to all the staff who were managing the different aspects of the Conference and to all the contributing authors and participants who created the real Conference. We hope that all of you feel awarded for your participation and contribution.

Website of the Department of Mechanical Engineering, Faculty of Engineering, University of Debrecen:

www.mecheng.unideb.hu

Website of ISCAME:

<https://konferencia.unideb.hu/en/iscame-home-page>

Yours Sincerely,

Tamás Mankovits
Chair of ISCAME, Head of Department
Department of Mechanical Engineering
Faculty of Engineering, University of Debrecen

Chair of ISCAME 2023

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The Influence of Different Grain Refining Fluxes and Master Alloy Addition on the Melt Quality of an Aluminum Casting Alloy

Levente Bogoly^{1,a*}, Tamás Mende^{2,b}, György Fegyverneki^{3,c}, Gábor Gyarmati^{4,d}

^{1,4}University of Miskolc, Institute of Chemical Metallurgy and Foundry Engineering,
H-3515 Miskolc, Hungary

²University of Miskolc, Institute of Physical Metallurgy, Metalforming and Nanotechnology,
H-3515 Miskolc, Hungary

³Nemak Győr Alumíniumöntöde Kft., H-9027 Győr Ipari park, Hungary

^abogoly.levente@gmail.com, ^btamas.mende@uni-miskolc.hu, ^cgyorgy.fegyverneki@nemak.com,
^dgabor.gyarmati@uni-miskolc.hu

Keywords: Grain Refining, Melt Treatment, Flux, Master Alloy, Aluminum Casting Alloy, Rotary Degassing, Melt Cleaning

Abstract. Rotary degassing coupled with the addition of different fluxes is the most common melt treatment method in aluminum foundries, due to its high efficiency in inclusion removal and the possibility of grain refining. In this study, the effect of different fluxes and master alloy addition was investigated on the melt and casting quality in different stages of the melt preparation.

Four experiments were conducted, which are labeled as “A”, “B”, “C” and “D”. In all cases, EN AC-45500 alloy (the standard composition in weight percentage is 7 % Si, 0.5 % Cu, 0.4 % Mg, 0.12 % Ti) was melted in a shaft-type melting furnace and then approximately 1000 kg was poured into a resistance-heated holding crucible furnace. In case “A” we applied a melt cleaning flux, whereas in case “D” we used the same flux combined with the addition of Al-5%Ti-1%B grain refining master alloy. In cases “B” and “C”, cleaning and grain refining fluxes from different suppliers were used.

Each experiment consisted of 5 melt treatment cycles with 9 minutes long treatment time, the N₂ purging gas flow rate was 20 ± 2 l/min and the pressure was 5 ± 1 bar. The rotational speed of the impeller was 490 rpm during the vortex formation and 380 rpm in the degassing phase. 800 ± 30 g of the granulated fluxes was added in all cases. The melt cleanliness and grain refinement were investigated in different stages of the melt preparation; after pouring into the crucible, right after and 15 minutes after the melt treatment, and finally before the next pouring into the holding furnace (approximately 200 kg residual melt at the bottom of the crucible).

During the experiments, the evolution of the inclusion content was investigated by the fracture surfaces of K-mold samples. The mechanical properties (elongation, yield strength, ultimate tensile strength) were measured by tensile test of samples machined from the castings, and the quality index was also calculated. The oxide inclusions found on the fracture surfaces of the K-mold samples and the tensile samples were also investigated by scanning electron microscopy (SEM) and energy dispersive spectroscopy (EDS).

The degree of grain refinement and the nucleation temperature were investigated by thermal analysis in different stages of the melt preparation. The exact grain size was measured by image analysis of the polished and Barker-etched thermal analysis samples. The susceptibility to pore formation was compared by Density Index samples, X-ray analysis, and metallographic investigation of polished surfaces from the castings.

The chemical composition of the melt was measured by optical emission spectroscopy (OES) in different stages of the melt preparation, while the phase composition of the applied fluxes was analyzed by X-ray diffraction (XRD).

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